NASA AMMOS
Architecture Updates

Brian Giovannoni
Jeff Estefan
Jet Propulsion Laboratory, California Institute of Technology
Message

• Transition Plan
  – Task Plans with Rec / Dels
  – Integrated schedule
• Plan for how the architecture will be instantiated
• 6 Year impl plan showing how tasks deliver key capabilities of the architecture
• SE schedule to address work to go
• Identified business opportunities
Agenda

• AMMOS architecture progress to date
  – Context & Progress
  – Firming up architectural elements
    • System services
  – Major architecture decisions
• AMMOS architecture highlights
• Take away
Take Away

- Commonly managed application platforms independent of applications
  - Reduces cost to deploy and maintain
- Common and scalable compute platform
  - Reduces H/W cost and improves system flexibility
  - Reduces risk (test as you fly fly as you test )
- Standardizing on Common Information Exchange / Definitive source of shared information
  - Reduces system integration cost and complexity by standardizing on a canonical information model and associated shared services
  - Improves data and product accountability
- Adopting industry technology standards and support the development of CCSDS information standards
- Operations modernization allows missions to standardize planning execution & reconciliation operational processes
AMMOS ARCHITECTURE – PROGRESS TO DATE
AsIs – Complete  
ToBe – In draft / under review  
Transition Plan – In development
Progress: Architecture Deliverables

MOS 2.0 AD – In review
Information & Data AD – Planned
Application Architecture Description – In review
Technology Architecture Description – In review

Based on enterprise architecture approach (TOGAF)
Purpose & Scope of Deliverables (1/5)

• Purpose:
  – Describe overview of overall architectural approach, architecture deliverables, and strategic context

• Scope:
  – Top level document with links to other architecture description modules that collectively provide complete system architecture description of AMMOS Target State (“TO-BE”) architecture
Purpose & Scope of Deliverables (2/5)

• **Purpose:**
  - Describe system level overview of MOS 2.0 mission services and associated products

• **Scope:**
  - High level description of MOS 2.0 closed-loop control concept, mission services and their characteristics, product deliverables (e.g., interfaces, agreements, processes, training, and V&V), process layer security
Purpose & Scope of Deliverables (3/5)

• **Purpose:**
  – Describe information and data models to be used in OpsRev and S/W modernization efforts

• **Scope:**
  – All aspects of information and data modeling (from ontology level to data schema to data layer security) centered on concept of Timeline, where Timeline is primary information object to be used in AMMOS-based Mission Ops of the future

Timeline is being introduced as a potential CCSDS standard.
• Purpose:
  – Describe architectural patterns for use in architecting individual AMMOS functional software applications as well as their integration across functional areas

• Scope:
  – Recommended application architecture tiers and layering, application integration strategy, common S/W services & characteristics, packaging & deployment, application layer security
Purpose & Scope of Deliverables (5/5)

• Purpose:
  – Describe prescriptive set of technical standards (Tech Stds Profile) and Common Scalable Compute Platform (AMMOS Platform Description)

• Scope:
  – List of approved set of technical standards and supported technologies to be prescriptive for OpsRev and S/W & H/W modernization tasks, technology forecast, runtime compute platform for hosting AMMOS tools and services
AMMOS
Architecture Layering
System Services

- Our target state system architecture will standardize on Timelines as the common information model
- Our target state system architecture we need a Common Information Exchange -> This will be composed of:
  - Timeline Management Service (TMS)
  - Relationship Management Service (RMS) – formally known as Information Management Service (IMS)
  - File Management Service (FMS)
- Our target state system architecture we need a common Business Process Management (BPM)/Workflow Service
- Our target state system architecture we need an Enterprise System Management system

BPM – Industry Standard
Service based approach – Common industry approach to reuse
ESM – COTS & GOTS product adoption
• **AAD #1:** Adopt a *Resource Oriented* architectural style as the primary architectural style for AMMOS modernization applications across AMMOS functional areas.  
  **Rationale:** Provides the most *flexible, adaptable, reliable, scalable, and multi-language/multi-platform-based* capability over other architectural styles such as *Distributed Object Oriented Computing* and *Service Oriented Architecture*.

• **AAD #2:** The Common Information Exchange (CIE) represents the primary strategy for application integration for managing shared data between AMMOS functional applications and represents a “logical” entity. This implies that common software services that comprise the CIE are a set of discrete, modular software services each with a set of exposed interfaces for use by information producing and consuming applications.  
  **Rationale:** Provides the most *flexible* and *adaptable* solution for integrating functional applications across AMMOS functional areas and providing time-varying MOS information in the form of Timeline representations, non-time-varying MOS information, and relationships among MOS information objects. Discrete services are exposed and managed as separate subsystems over a single ‘service-based’ interface to an opaque set of services, which is less manageable.

ReST – Adoption of common industry architectural style
• **AAD #3**: Adopt Shared Database with REST as a Connector as the primary integration style for integrating functional applications across AMMOS functional areas.

**Rationale**: Provides the most **flexible**, **adaptable**, **reliable**, **scalable**, and **multi-language/multi-platform** and standards-based option for integrating functional applications across AMMOS functional areas. Enterprise messaging does not offer such favorable properties largely because the industry has not converged on a unified programming model and wire-level protocol that supports a multi-language/multi-platform environment with adequate flexibility and adaptability and that can scale to the level of the Web.
AMMOS ARCHITECTURE
HIGHLIGHTS
AMMOS Application Modernization

**Application**

- Application Platform
- Security
- Data Management

**Modernization Activities**

- Application refactoring to simplify deployment
- Application and or Software Frameworks (e.g. Standalone or JavaEE)

**Common Information Exchange**

- Common Scalable Compute Platform
- Common Security
- Common software and infrastructure services

- Commonly managed application platforms independent of applications
- Common loosely-coupled information integration / Definitive source of shared information

**Heterogeneous and difficult to manage**

- Redundant installation / varied versions
- Redundant installation
- Tightly coupled interfaces

**Common Information Exchange**

- NASA AMMOS Software (e.g. MPCS, SEQ)

**Compute platform**

- Industry standard hypervisor
- Industry standard security approach

---

Copyright 2012 California Institute of Technology. Government sponsorship acknowledged.
Operations Modernization

Common information exchange simplifies integration.

Enables operations modernization.

Copyright 2012 California Institute of Technology. Government sponsorship acknowledged.
Application Modernization In Context Of Architectural Elements

Common Information Exchange

- **Common Scalable Compute Platform**
  - **Common Security Service** (Central Management of Policy)

- **Application Platform**
  - **Modernized Planning Applications** (e.g. SEQR)
  - **S/C Analysis Application** (e.g. ISCA)
  - **Modernized Telemetry System** (e.g. AMPCS)

- **External System Application** (e.g. @ JSC/MSFC/GSFC)
  - **Standard Interchange Protocol(s) & Data Format(s)** (e.g., CCSDS MAL, CCSDS XTCE, “Pico-Core”)

- **Adoption of COTs / GOTS components and infrastructure**

- **Common Scalable Compute Platform**
  - **Timeline Management Service** (Definitive Source Of Time-Ordered Operations Data)
  - **Relationship Management Service** (Definitive Source Of Operations Data Relationships)
  - **File Management Service** (Definitive Source Of Non-Time Ordered Data)
Closing the U:
How Our Task Support

Receive Telemetry
Process Telemetry

Execute Mission Operations Plans

Transmit
Approve
Package

Plan Mission Operations

Develop Plan/Sequence

Analyze Mission Operations Plans
Analyze
Reconcile

Allows missions to standardize planning execution & reconciliation operational processes

Nov 27, 2012
Copyright 2012 California Institute of Technology. Government sponsorship acknowledged.
Closing the U:
How Our Task Support

Receive Telemetry
Process Telemetry
Execute Mission Operations Plans
Transmit
Approve
Package

Plan Mission Operations
Develop Plan/Sequence

Analyze Mission Operations Plans
Analyze
Reconcile

Modernized Telemetry System (AMPCS)
S/C Analysis Application (e.g. ISCA)

Common Scalable Compute Platform
Application Platform

CMD (AMPCS)

Modernized Planning Applications (SEQR)

Common Scalable Compute Platform
Application Platform

Common Information Exchange
Timeline Management Service (Definitive Source of Time-Ordered Operations Data)
Relationship Management Service (Definitive Source of Operations Data Relationships)

Nov 27, 2012
Copyright 2012 California Institute of Technology. Government sponsorship acknowledged.
Take Away

- Commonly managed application platforms independent of applications
  - Reduces cost to deploy and maintain
- Common and scalable compute platform
  - Reduces H/W cost and improves system flexibility
  - Reduces risk (test as you fly fly as you test)
- Standardizing on Common Information Exchange / Definitive source of shared information
  - Reduces system integration cost and complexity by standardizing on a canonical information model and associated shared services
  - Improves data and product accountability
- Adopting industry technology standards and support the development of CCSDS information standards
- Operations modernization allows missions to standardize planning execution & reconciliation operational processes