Breakout Session 10A
Architecture-Centric Evolution & Evaluation (ACE2) of Software-Intensive Systems

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ACE2 Session Goals

• Promote central role of software architecture during acquisition/development of software-intensive systems
  ❖ Improved responsiveness to changes in requirements and complexity
  ❖ Early identification of flaws
  ❖ Streamlined system implementation, testing, and maintenance

• Explore how to specify and evaluate software system architectures that support software system evolution
  ❖ Techniques for software architecture representation
  ❖ Tools for software architecture analysis
  ❖ Software system architecting practices, standards, and policies
ACE2 Session Discussion Baseline

1. Architecture as a Basis for Understandability
   - Provide views of software system with levels of granularity appropriate for each stakeholder (acquirer, overseer, developer, tester, and operator) to have insight into system functionality

2. Architecture as a Basis for Assessing Maintainability
   - Link requirements to system implementation so that stakeholders can assess degree of system change and cost/schedule impact from upgrading, changing, and integrating COTS products used in implementation

3. Architecture as a Basis for Assessing Extensibility
   - Link requirements to system implementation so that stakeholders can assess degree of system change and cost/schedule impact from new requirements on system size, complexity, environments, services, and interoperability

4. Architecture as a Basis for Assessing Executability
   - Support development of executable models so that stakeholders can assess impact of new requirements on system performance and reliability
ACE2 Session Agenda

• First Segment (13:00 – 15:00)
  - Lt. Col. Laura Pope, Air Force Space and Missile Systems Center
  - Dr. Joel Sercel, MILSATCOM Joint Program Office
  - Dr. Linda Northrop, Software Engineering Institute
  - Dr. Peter Hantos, The Aerospace Corporation
  - Discussion and formulation of findings

• Second Segment (15:15 – 17:00)
  - Capt. Bryan Berg, Air Force Space and Missile Systems Center
  - Peter Shames, Jet Propulsion Laboratory
  - Jim Boegman, Raytheon
  - Dr. Allen Nikora, Jet Propulsion Laboratory; Myron Hecht and Douglas Buettner, The Aerospace Corporation
  - Discussion and formulation of findings
Lt. Col. Laura Pope:
ACE2 Opening Statement

• Why does the Government care about migrating to an architecture-centric evolution and evaluation of software-intensive systems?
  ❖ Understandability
    – CONOPS not fully mature at the start of software design
  ❖ Extensibility/Executability
    – Changing interfaces, new requirements, changing CONOPS
  ❖ Maintainability
    – Architecture design does not adequately consider O&M costs

• Create & document architecture-centric views of software-intensive system up-front
  ❖ Fully coordinate them with all system stakeholders
  ❖ Keep them current.
Dr. Joel Sercel:
Architecture as a Tool for Managing Change

• Architecture is a set of constraints on designs
  ❖ Effective constraints define effective architecture
  ❖ C4ISR useful but not necessary nor sufficient

• Architecture necessary for managing change
  ❖ Defined early in the product development life cycle
  ❖ Maintained as collaborative product of software IPT
• The architecture must be descriptive and prescriptive

• Quality attribute requirements drive the software architecture
  - Examples: Understandability, Maintainability, Extensibility, Executability …
  - SEI has methodology/tools for defining quality attributes

• Architecture-centric activities drive software system life cycle
  - Explicit focus on quality attributes
  - Directly involve stakeholders
Dr. Peter Hantos:
Software Reviews Since Acquisition Reform – Architecture-Driven Considerations

• Architecture-driven considerations essential in carrying out reviews
  ❖ MIL-STD-1521B is inadequate as the basis for design reviews

• Object-oriented methodologies critical in planning reviews
  ❖ Configuration Item concept not supportive of development practices

• In-process reviews must track allocated Technical Performance Measurements
Capt. Bryan Berg: COBRA Architecture

- **COBRA=COTS-Based Real-Time Architecture**
  - Based on COTS to minimize cost and maximize functionality
  - COTS chosen for “best in class”
  - Architectural decisions based on system risk

- **Lessons Learned**
  - **Maintenance**: Upgrades limited because of hardware/software compatibility
  - **Extensibility**: Older products cannot be upgraded cost effectively
  - **Way Ahead**: Use standardized interfaces to avoid compatibility problems
Peter Shames:
Reference Architecture for Space Data Systems (RASDS)

- RASDS provides architectural view of end-to-end data systems

- Understandability
  - Provides insight into functionality and relationship among elements so that complexity may be managed

- Maintainability
  - Supports allocation of functionality, design trades, deployment trades, and analysis of impact of requirements changes

- Extensibility
  - Provides the means to describe and reason about system and component size, complexity, performance, and operating environments

- Executability
  - It is possible to model system behavior at a coarse level of granularity
Jim Boegman:
Raytheon (NPOESS) Perspective on Software Architecture

• **Spectrum from architecture to implementation**
  - Requirements describe the spectrum

• **Software architecture**
  - Understandability
    - Different views enable comprehension at appropriate level of detail
  - Maintainability/extensibility/executability
    - Architecture alone not enough to assess cost/schedule impacts
Dr. Allen Nikora, Myron Hecht, & Douglas Buettner: Software Reliability Measurement

- Reliability-centric process
  - Software reliability important to determine software release schedule
  - Reliability estimated from testing results

- Architecture not a good predictor of software reliability

- Reliability a good indicator of good architecture
ACE2 Session Summary

- **Central role of software architecture in understandability**
  - Define, create, document, and keep current architecture-centric views
  - Directly involve all stakeholders

- **Standards needed to support reviews**

- **Open question: How to specify architecture to address maintainability, extensibility & executability**
  - Develop up-front stakeholder agreement on views and requirements on illities
  - Define domain-specific reference architectures
  - Use architecture in conjunction with other tools/models (e.g., reliability models)

- **GSAW should continue supporting ACE2 discussion**
  - Gain insight why/how to develop descriptive and prescriptive architectures