Representing System Architectures using the C4ISR* Architecture Framework

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* C4ISR = Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
Why develop Architecture Models?

“The purpose of modeling is to relentlessly expose the inevitable consequences of your assumptions”

– Anonymous
The Context of Architecture

Architecture is characterized by views, which are reflected in models. Concerns have viewpoints, and stakeholders have views. Stakeholders have concerns.
Architectural Insights

Architectures

Stakeholders
Provide Insights
Concerns

Viewpoints
Drive Modeling Features
Views

Models
The C4ISR Architecture Framework provides a “standard” set of views

- 3 Major Views
- 26 Smaller Views
The 3 Views in the C4ISR Framework

Operational View

Systems View

Technical View
Five Steps

- Alternative approaches and tools can be used to generate the C4ISR architecture views (Step #2)
- Alternative approaches and tools can be used to develop the executable model (Step #3)
- Measures of Performance (MOPs) and Effectiveness (MOEs) are needed to evaluate and compare architectures
Architecture Methodology

From Alex Levis,
Course Notes at GMU

ETG Reconnaissance Systems Division
14 March, 2002

Insights
Summary

● **Modeling is Important**
  - But must be aligned with key **stakeholder concerns**
  - And must be “portrayed” using the **proper views**

● **Architecture Views are Important**
  - The right views give the **right “insights”** into the situation
  - Architecture frameworks try to **standardize** on a common set of views and viewpoints

● **Static vs. Dynamic Models**
  - **Static** models give **limited insight**
  - **Dynamic** models give **more insight**, but are more difficult to develop and use
Backup Slides

- Why model?
- Operational, systems, and technical views
- Integration of architecture views
- 6-step guidance on development and use of architectures
- Purpose of an architecture
- The C4ISR architecture framework (as the silver bullet)
- DOD strategic direction regarding the C4ISR architecture framework
- IEEE 1471 data model
Why Model?

• Models describe, specify and communicate
• Models can be modified and manipulated
• Models provide analytical insight for decision making
  ■ Performance, cost and utility can be modeled
  ■ Models of alternate architectures can be compared
• Models inform various architecture views
Operational, Systems & Technical Views

Operational View

- Identifies Warfighter Relationships and Information Needs
- Processing and Inter-Node Exchange Requirements
- Systems, Associations to Nodes, Activities, Needlines and Requirements

Systems View

- Relates Capabilities and Characteristics to Operational Requirements

Technical View

- Prescribes Standards and Conventions
- Technical Criteria Governing Interoperable Implementation/Procurement of the Selected System Capabilities
Integration of Architecture Views

HIGH-LEVEL OPERATIONAL CONCEPT DESCRIPTION (OV-1)
VALUE ADDED: SUMMARY LEVEL REPRESENTATION OF ORGANIZATIONS/ROLES, MISSION, AND CONTEXT FOR THE ARCHITECTURE

OPERATIONAL NODE CONNECTIVITY DESCRIPTION (OV-2)
VALUE ADDED: STATEMENT OF OPERATIONAL NODES, ACTIVITIES AND CRITICAL INFORMATION NEEDS (NEEDLINES & SUMMARY INFORMATION EXCHANGED)

OPERATIONAL INFORMATION EXCHANGE MATRIX (OV-3)
VALUE ADDED: PERFORMANCE REQUIREMENTS FOR OPERATIONAL INFORMATION EXCHANGES

ACTIVITY MODEL (OV-5)
VALUE ADDED: BUSINESS/MISSION PROCESS & RELATIONSHIPS AMONG ACTIVITIES AND OPERATIONAL INFORMATION EXCHANGED

TECHNICAL ARCHITECTURE PROFILE (TV-1)
VALUE ADDED: COMPLETE LIST OF RELEVANT STANDARDS WITH OPTIONS & PARAMETERS

SYSTEMS INTERFACE DESCRIPTION (SV-1)
VALUE ADDED: STATEMENT OF SYSTEMS NODES, SYSTEMS, SYSTEM ELEMENTS, & SYSTEM COMPONENTS; LINKS & COMPONENT INTERFACES; AND SYSTEM INFORMATION EXCHANGES

NOTE: THE DIRECTION OF ARROWS IS NOT MEANT TO INDICATE THE ORDER OF BUILDING PRODUCTS
Architecture Guidance

1. Determine the intended use of the architecture

2. Determine scope of architecture
3. Determine characteristics to be captured
4. Determine views and products to be built
5. Build the requisite products
6. Use architecture for intended purpose

Defense Organizations
Industry

From Alex Levis, Course Notes at GMU
The purpose of C4ISR architectures is to improve capabilities by enabling the quick synthesis of “go-to-war” requirements with sound investments leading to the rapid employment of improved operational capabilities, and enabling the efficient engineering of warrior systems.”

- C4ISR Architecture Framework, Version 2.0
The Silver Bullet

- To deal with the real challenges of change we must look for Problem Invariants
  - The Architecture is the right invariant
  - A series of studies recommended that DOD undertake the development of architectures as the basis for acquisition
    - USAF Scientific Advisory Board study of summer ’93
    - Army Science Board study, early ’94
    - Defense Science Board study, 94-95

- The C4ISR Architecture Framework (version 2.0) was issued in December 97; a DOD directive was signed in February 98.
  - Memorandum dated 21 March 2000 broadens scope of C4ISR AF to DOD AF
  - The DOD Architecture Framework, version 2.1, is under review; expected release in the near future
DOD Strategic Direction

“We see the C4ISR Architecture Framework as a critical element of the strategic direction in the Department, and accordingly direct that all on-going and planned C4ISR or related architectures be developed in accordance with Version 2.0. Existing C4ISR architectures will be redescribed in accordance with the Framework during appropriate revision cycles.”

- USD (A&T), ASD (C3I), Joint Staff Director for C4 Systems
23 February 1998 Memorandum,
Subject: Strategic Direction for a DoD Architecture Framework
Schema from the IEEE 1471 standard on architecture descriptions

1..* System

1..* Stakeholder

1..* Architectural Description

described by

1

provides

Rationale

1..* View

selects

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organizes by

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participates in

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