Architecting C4I Systems

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Defence Science & Technology Agency


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Multi-faceted and multi-dimensional security challenges

<table>
<thead>
<tr>
<th>State-on-State Conflict</th>
<th>Pirate Attacks</th>
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<tbody>
<tr>
<td>Terrorism</td>
<td>Cellphone Bomb Detonator</td>
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Network-Centric Warfare Concept

Link up knowledge-enabled forces to create greater synergies and firepower.
How to build a coherent C4I System-of-Systems?
Designing a C4I System-of-Systems

Systems Architecting
Systems Architecting

System View

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<tr>
<th>JTA Service Area</th>
<th>Service</th>
<th>JTA Standard and Source Document</th>
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<tr>
<td>Information-Processing Standards</td>
<td>Higher Order Languages</td>
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<td>Software Life-Cycle Process</td>
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<td>Geospatial Data Interchange</td>
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<td>Motion Imagery Data Interchange - Video</td>
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<td>Distributed-Object Computing</td>
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<td>Information Transfer Standards</td>
<td>Data Flow Network</td>
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<td>Command and Control Information (C2) Network</td>
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<td>Physical Layer</td>
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<td>Network Interface</td>
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<td>Layer Management</td>
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<td>FSE Transfer Standards</td>
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<td>Remote Terminal Standards</td>
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<td>Network Time Synchronization Standards</td>
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<td>Web Services Standards</td>
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<td>Connectionless Data Transfer</td>
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<td>Transport Services Standards</td>
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<td>Information Modeling, Metadata, and Information Exchange Standards</td>
<td>Activity Modeling</td>
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<td>Human Computer Interface</td>
<td>Data Modeling</td>
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<td>Information Security / Information Infrastructure Standards</td>
<td>Object-Oriented Modeling</td>
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<td>Mandates</td>
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<td>Password Security</td>
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Operational View

Technical View
Systems Architecting

- People
- Processes
- Enablers (IT systems, Machines)
Systems Architecting – Both a Science & an Art

People

Processes

Enablers
(IT systems, Machines)
C4I Systems Architecting Framework

Systems Architecting Process
- Frame-the-Issue Guidance Package
  - Stakeholder Analysis
  - Systems Thinking
  - Systems Decomposition

Architectural Description & Analysis Package
- Architectural views
- Design Principles
- Reusable Components

Programme Management Package
- Org Process Model
- Org QMS
- Process Guide

Governance
- Decision-Making Forums
- Certification Process
- Governance Framework

Knowledge Book of Architecting
- C4I Systems Architecting Guidebook
- C2 System Development Guidebook
- BPMS Competency Guidebook

Competency Development Guidebook
- C4I Competency Guidebook
- C2IT Competency Guidebook
- Business Analysis
- Systems Thinking

Consultation Environment
- BPMS Competency Portal
- C4I Competency Portal

Body of Knowledge
Systems Architecting Process

A Six-step Systems Architecting Process

Iterative
Systems Architecting Process ...

Recursive

Enterprise Level
Capability Level
System Level
Product Level
Understanding the Capability Gap

1. Frame the Issue
2. Develop SoS Alternatives
3. Evaluate SoS Alternatives
4. Finalise SoS Architecture
5. Realise SoS
6. Certify SoS

Frame-the-Issue Guidance Package
- Stakeholder Analysis
- Systems Thinking
- Systems Decomposition

Capability Gap List

Stakeholder engagement

Problem Analysis
Devising the SoS Solution

1. Frame the Issue
2. Develop SoS Alternatives
3. Evaluate SoS Alternatives
4. Finalise SoS Architecture
5. Realise SoS
6. Certify SoS

Solution Space Exploration
Modelling and Simulation

Finalised SoS architecture
Analysis of possible solutions
Examples of SoS Architectural Views

Operational View

Technical View

System View
Devising the SoS Solution …

**Speeding up the Development of Operational Capabilities**

- Common Repository
- Service Oriented Architecture (SOA)
- Business Process Management Systems (BPMS)
Common Repository

Process for Maintenance of Common Repository
Devising the SoS Solution ...

Service Oriented Architecture (SOA)

- **Data Base Layer**
  - Manpower Info
  - Research Info
  - Logistics Info
  - Situation Info

- **Business Logic Layer**
  - UDDI Service (Yellow pages)
  - Weather Services
  - Terrain Services
  - Planning Services
  - Logistics Services
  - Situation Services

- **Presentation Layer**
  - Planner
  - Planner
  - Intel Officer
  - Ops Controller
  - Logs Operator
  - Ops Controller

**Intel Officer**

**Ops Controller**
GARTNER’s 10 components of BPMS
Source: GARTNER BPMS Summit 2008

Business Process Management System

Commercial BPMS: BEA Aqualogic
Developing and Certifying the SoS Solution

1. Frame the Issue
2. Develop SoS Alternatives
3. Evaluate SoS Alternatives
4. Finalise SoS Architecture
5. Realise SoS
6. Certify SoS

Solution Development
Solution Acquisition
Systems Integration
Programme Management Package
Governance
Field Test and Ops Validation
Annual Learning Plan for each individual
- systems design
- systems thinking
- business analysis
Books of Knowledge

C4I Systems Architecting Guidebook

C4I Development Guidebook

Enterprise Architecture Reference
C4I Competency Development...

• Consultation Environment
The Values of the Systems Architecting Framework

2-3 years

1. Frame the Issue
2. Develop SoS Alternatives
3. Evaluate SoS Alternatives
4. Finalise SoS Architecture
5. Realise SoS
6. Certify SoS

3-6 months
The search for alternatives to harness state-of-the-art technologies for rapid development and fielding of new operational capabilities is a never ending business for C4I systems architects…