Professional Development Short Course On:

C4ISR Requirements, Principles, and Systems

Instructor:

William J. Gecke

ATI Course Schedule:  http://www.ATIcourses.com/schedule.htm
ATI's C4ISR Requirements: http://www.aticourses.com/c4isr_requirement_principles.htm
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Recent TCT Approach

- SIPRNET Chat Imagery
- Formed target tracks for waiting F-15
- Imagery A/C control
- MCE (GH) (Beale, CA)
- WAN
- CGS(U2) (Beale, CA)
- Intel Unit (NV); target coordinates; ID
- U2 Global Hawk
- F15 Holding orbit
- TADII
- CAOC
  - AOC Ops GH Liaison Officer
  - Chat
  - TCT Cell
  - HUMINT

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Synthetic Aperture Radar (SAR)

- Resolution for real aperture is \( \theta_B \approx \frac{\lambda}{D} \)
- At a distance \( R \) from the sensor, a region is illuminated of length \( L = R \theta_B \)
- The aperture may be synthesized for entire length, \( L \), yielding a synthetic beamwidth \( \theta_S \approx \frac{\lambda}{2L} \) i.e., as if \( D = 2L \)
- Ground resolution at \( R \) is then \( \delta_{CR} = R \theta_S = \frac{D}{2} \) (strip mode)

Smaller real antenna >> greater resolution; in spot mode, illuminate loner to reduce \( \delta_{CR} \)

- Usually processed with multiple looks at lesser resolution, looks are incoherently added to reduce speckle

Note: \( \frac{L}{R} = \frac{\lambda}{D} \)
<table>
<thead>
<tr>
<th></th>
<th>Link-11</th>
<th>Link-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addresses</td>
<td>3 Digit Octal</td>
<td>5 Digit Octal</td>
</tr>
<tr>
<td>Track #’s</td>
<td>4000+</td>
<td>524,000+</td>
</tr>
<tr>
<td>Track Q</td>
<td>0-7</td>
<td>0-15</td>
</tr>
<tr>
<td>Track ID</td>
<td>3 fields</td>
<td>5 fields</td>
</tr>
<tr>
<td>Position res.</td>
<td>500 yds</td>
<td>32 ft</td>
</tr>
<tr>
<td>Air Speed Res.</td>
<td>28 dmh</td>
<td>2 dmh</td>
</tr>
</tbody>
</table>

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Transformational Communications System (TCS) – Notional
USAF, Intelligence Community SATCOM Architecture for 2010-2020

$100 B

Protected
Milstar I,II: geosync., polar
Freeflyer Polar
AEHF
TSAT

Wideband
DSCS
WB Gapfiller
TC-WS (Adv. WB System)

Narrowband
UHF: FLTSAT COM
UFO
UHF Gapfiller

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MC2C

- Terrestrial BB: Fixed, Mobile Users, Packets (Tbps)
- ISR Edge Services: MP-CDL (100 Mbps)
  - Link-22
  - SINCgars
- Airborne Backbone: Persistent, High BW (Gbps)
- Tactical Edge Services (TADILs)
  - Link 16 (500 kbps)
  - WNW (2 Mbps)
- MC2A: E-3, EC-130E, E-8, RC-135, OC-135B, EC-130H, E-4B (GMTI, SAR, C2, All-INTs, Air Tracking, etc.)
### Products Overview (cont’d)

- **Seven essential products**
  - At least one per view
- **Nineteen support products**

<table>
<thead>
<tr>
<th>Applicable Architecture View</th>
<th>Product Reference</th>
<th>Architecture Product</th>
<th>Essential or Supporting</th>
<th>General Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Views (Context)</td>
<td>AV-1</td>
<td>Overview and Summary Information</td>
<td>Essential</td>
<td>Scope, purpose, intended users, environment depicted, analytical findings, if applicable (4.2.1.1)</td>
</tr>
<tr>
<td>All Views (Terms)</td>
<td>AV-2</td>
<td>Integrated Dictionary</td>
<td>Essential</td>
<td>Definitions of all terms used in all products (4.2.1.2)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-1</td>
<td>High-level Operational Concept Graphic</td>
<td>Essential</td>
<td>High-level graphical description of operational concept (high-level organizations, missions, geographic configuration, connectivity, etc.) (4.2.1.3)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-2</td>
<td>Operational Node Connectivity Description</td>
<td>Essential</td>
<td>Operational nodes, activities performed at each node, connectivities &amp; information flow between nodes (4.2.1.4)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-3</td>
<td>Operational Information Exchange Matrices</td>
<td>Essential</td>
<td>Information exchanged between nodes and the relevant attributes of that exchange such as media, quality, quantity, and the level of interoperability required. (4.2.1.5)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-4</td>
<td>Command Relationships Chart</td>
<td>Supporting</td>
<td>Command, control, coordination relationships among organizations (4.2.2.1)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-5</td>
<td>Activity Model</td>
<td>Supporting</td>
<td>Activities, relationships among activities, I/Os, constraints (e.g., policy, guidance), and mechanisms that perform those activities. In addition to showing mechanisms, overlays can show other pertinent information. (4.2.2.2)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-6a</td>
<td>Operational Rules Model</td>
<td>Supporting</td>
<td>One of the three products used to describe operational activity sequence and timing that identifies the business rules that constrain the operation (4.2.2.3.1)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-6b</td>
<td>Operational State Transition Description</td>
<td>Supporting</td>
<td>One of the three products used to describe operational activity sequence and timing that identifies responses of a business process to events (4.2.2.3.2)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-6c</td>
<td>Operational Event/Trace Description</td>
<td>Supporting</td>
<td>One of the three products used to describe operational activity sequence and timing that traces the actions in a scenario or critical sequence of events. (4.2.2.3.3)</td>
</tr>
<tr>
<td>Operational</td>
<td>OV-7</td>
<td>Logical Data Model</td>
<td>Supporting</td>
<td>Documentation of the data requirements and structural business process rules of the Operational View. (4.2.2.4)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-1</td>
<td>System Interface Description</td>
<td>Essential</td>
<td>Identification of systems and system components and their interfaces, within and between nodes (4.2.1.6)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-2</td>
<td>Systems Communications Description</td>
<td>Supporting</td>
<td>Physical nodes and their related communications laydowns (4.2.2.5)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-3</td>
<td>Systems2 Matrix</td>
<td>Supporting</td>
<td>Relationships among systems given a architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc. (4.2.2.6)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-4</td>
<td>Systems Functionality Description</td>
<td>Supporting</td>
<td>Functions performed by systems and the information flow among system functions (4.2.2.7)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-5</td>
<td>Operational Activity to System Function Traceability Matrix</td>
<td>Supporting</td>
<td>Mapping of system functions back to operational activities (4.2.2.8)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-6</td>
<td>System Information Exchange Matrix</td>
<td>Supporting</td>
<td>Detailing of information exchanges among system elements, applications and H/W allocated to system elements (4.2.2.9)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-7</td>
<td>System Performance Parameters Matrix</td>
<td>Supporting</td>
<td>Performance characteristics of each system(s) hardware and software elements, for the appropriate timeframe(s) (4.2.2.10)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-8</td>
<td>System Evolution Description</td>
<td>Supporting</td>
<td>Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation (4.2.2.11)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-9</td>
<td>System Technology Forecast</td>
<td>Supporting</td>
<td>Emerging technologies and software/hardware products that are expected to be available in a given set of timeframes, and that will affect future development of the architecture (4.2.2.12)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-10a</td>
<td>Systems Rules Model</td>
<td>Supporting</td>
<td>One of three products used to describe systems activity sequence and timing -- Constraints that are imposed on systems functionality due to some aspect of systems design or implementation (4.2.2.13.1)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-10b</td>
<td>Systems State Transition Description</td>
<td>Supporting</td>
<td>One of three products used to describe systems activity sequence and timing -- Responses of a system to events (4.2.2.13.2)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-10c</td>
<td>Systems Event/Trace Description</td>
<td>Supporting</td>
<td>One of three products used to describe systems activity sequence and timing -- System-specific refinements of critical sequences of events described in the operational view (4.2.2.13.3)</td>
</tr>
<tr>
<td>Systems</td>
<td>SV-11</td>
<td>Physical Data Model</td>
<td>Supporting</td>
<td>Physical implementation of the information of the Logical Data Model, e.g., message formats, file structures, physical schema (4.2.2.14)</td>
</tr>
<tr>
<td>Technical</td>
<td>TV-1</td>
<td>Technical Architecture Profile</td>
<td>Essential</td>
<td>Extraction of standards that apply to the given architecture (4.2.1.7)</td>
</tr>
<tr>
<td>Technical</td>
<td>TV-2</td>
<td>Standards Technology Forecast</td>
<td>Supporting</td>
<td>Description of emerging standards that are expected to apply to the given architecture, within an appropriate set of timeframes (4.2.2.15)</td>
</tr>
</tbody>
</table>
**IDEF1x**

- Data Models
- NIST #184
- Independent and dependent elements

Discriminator (vehicle type) – double line indicates a complete set
JTA Hierarchy
New Acquisition Policy

Prerequisite: Integrated Architecture

5000.2 identifies specific regulatory requirements including C4ISR certification
Information Support Plan ISP

• **Introduction**

• **Analysis**
  – Information needs discovery and analysis
  – Questions and references provided in 6212.01C

• **Issues**
  – Refer to Operational Concept Matrix
  – Identify Operational Issue and Resolution Path
NCOW RM

NCOW Reference Model Overview
Reference Model Content

Version 0.9
BETA 2.0
BETA 1.5
BETA 1.0

Integrated Dictionary
From NCOW workshop 2003
T. Hagle

Overview and Summary Information
AV-1

High-Level Operational Concept Graphic
OV-1

Activity Model and Node Tree
OV-5

Target Technical View
TV-2

First description of Net-Centricity at the enterprise level
Power to the Edge

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GIG - Who’s In?

- GIG includes nearly all interconnected, networked systems
- Non-GIG systems: stand-alone, embedded or self contained
- DOD and Intelligence Community Guidance for new and upgrades to legacy systems
DCGS Family of Systems

from DCGS CRD
Mission Assessment Process

Mission (JMA)

Operational process

Critical system path

Data collection – validate, verify

Measure Pk, Ps, latency, accuracy,…

Alternate system path

Information Exchange Requirements

More Specific Operational Concept

More General Operational Concept

System Architecture

Operational process

Critical system path

Alternate system path

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# Build IERs (6212)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UJTL EVENT INFORMATION CHARACTER</strong></td>
<td><strong>SENDING NODE</strong></td>
<td><strong>RECEIVING NODE</strong></td>
<td><strong>Format</strong></td>
<td><strong>Classification</strong></td>
<td><strong>TIMELINE</strong></td>
<td><strong>CRITICAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employ Firepower</strong></td>
<td>Targeting. Target ID, Target Location, Track Updates, L/B, L/L, Course, Speed, Altitude, Confidence</td>
<td>Operational/tactical C2 nodes and sensors</td>
<td>Operational/tactical C2 nodes and sensors</td>
<td>Secret/encrypted</td>
<td>Less than ZZ seconds</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(fictitious example)
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• Sonar & Acoustic Engineering

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