

# Software Technology Conference

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## Joint Technical Architecture (JTA): Standards for Interoperability

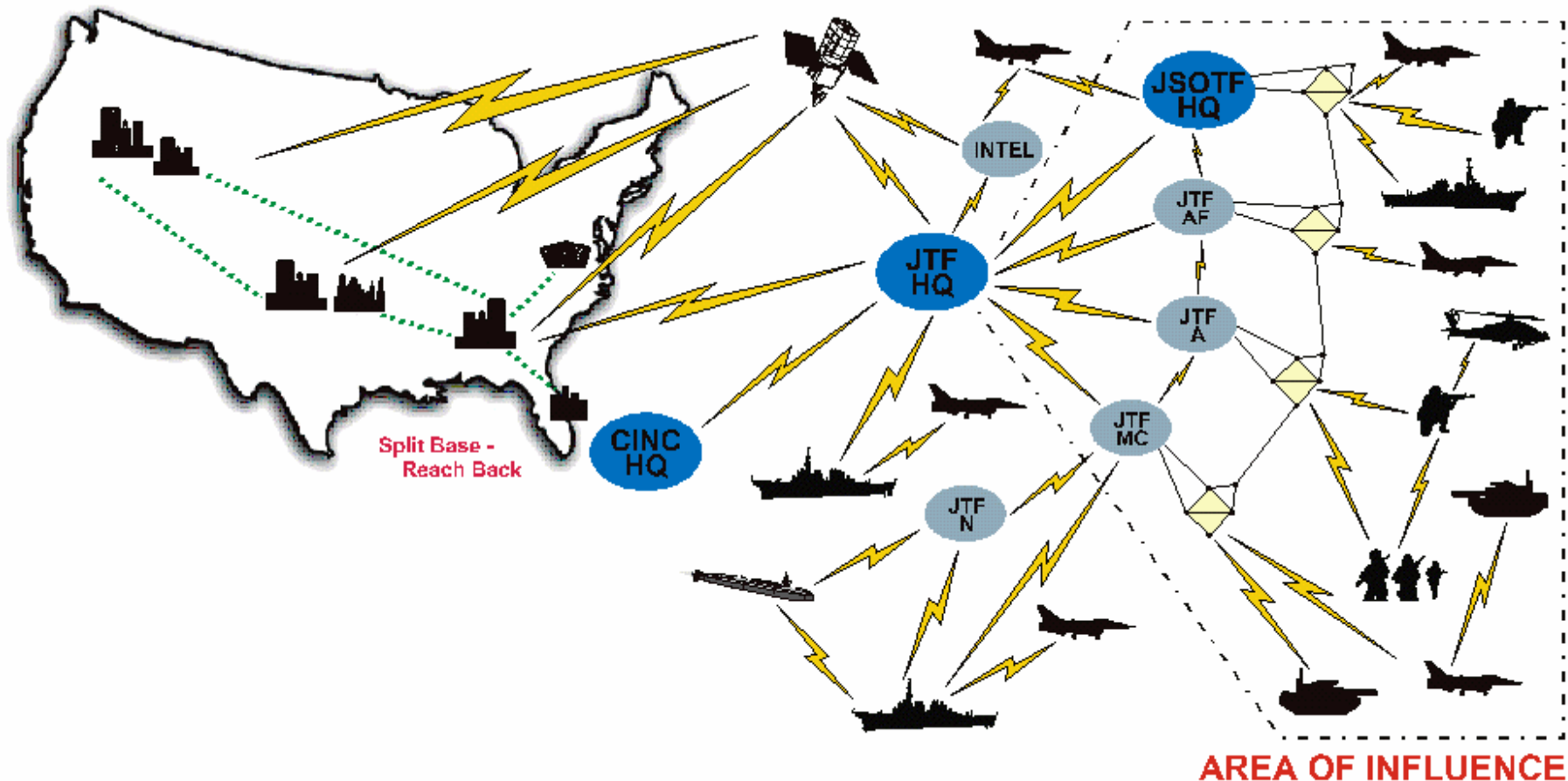
Judy Kerner  
The Aerospace Corporation  
1 May 2002

# Outline

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- ➔ • **Motivation for Open Systems**
  - **Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Architectures**
  - **JTA Explained**
  - **Implementing JTA**
  - **Summary and Resources**

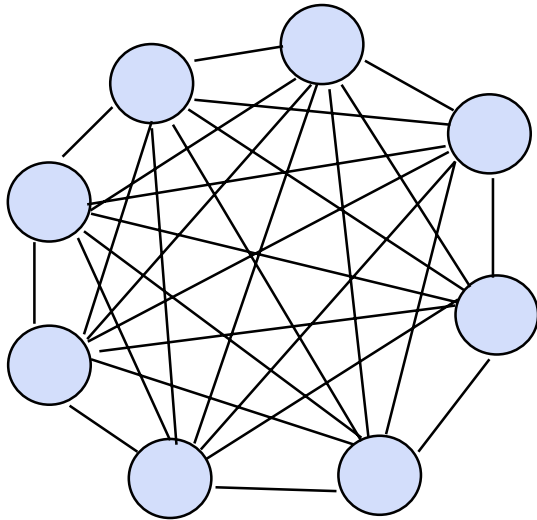
# DoD Warfighter Information Technology Environment



[From DoD JTA 4.0]

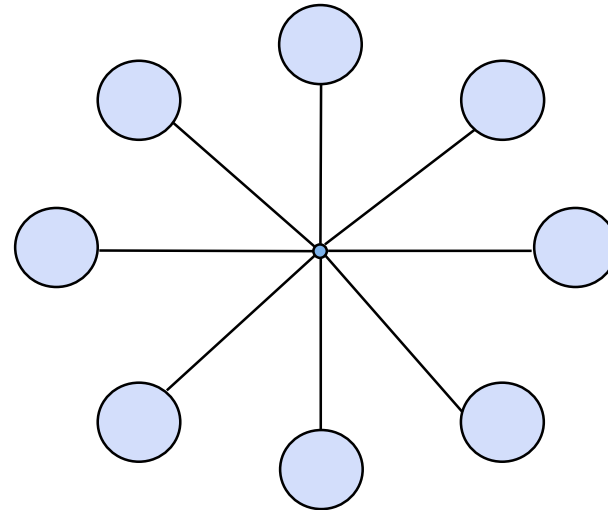
# Achieving Interoperability

## By Interface Ctl Docs (ICDs)



- Each interface separately defined
- Evolutionary path prohibitive
  - Never gets cheaper
  - Each new system needs all I/Fs
- Minimal chance that add'l system happens to be interoperable

## By common interface stds



- Std interface defined once, used by all
- Evolutionary path identified
  - Each system built to the same stds
  - Can evolve in sync if stds evolve
- Better chance that add'l system will be interoperable

**Impossible to anticipate all the systems that will have to interoperate**

# Open Systems Are Based on Common Interface Standards

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- **An open system is a system that implements sufficient open standards for interfaces, services, and supporting formats to enable properly engineered components**
  - ❖ To be utilized across a wide range of systems **with minimal changes**
  - ❖ To **interoperate** with other components **on local and remote systems**
  - ❖ To **interact with users** in a style that facilitates portability

[OSJTF Terms of Reference 1998]
- **Key characteristics: facilitates and enables**
  - ❖ Component **portability**
  - ❖ Component and system **interoperability**
  - ❖ **User** portability

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# Mandates for Architecture

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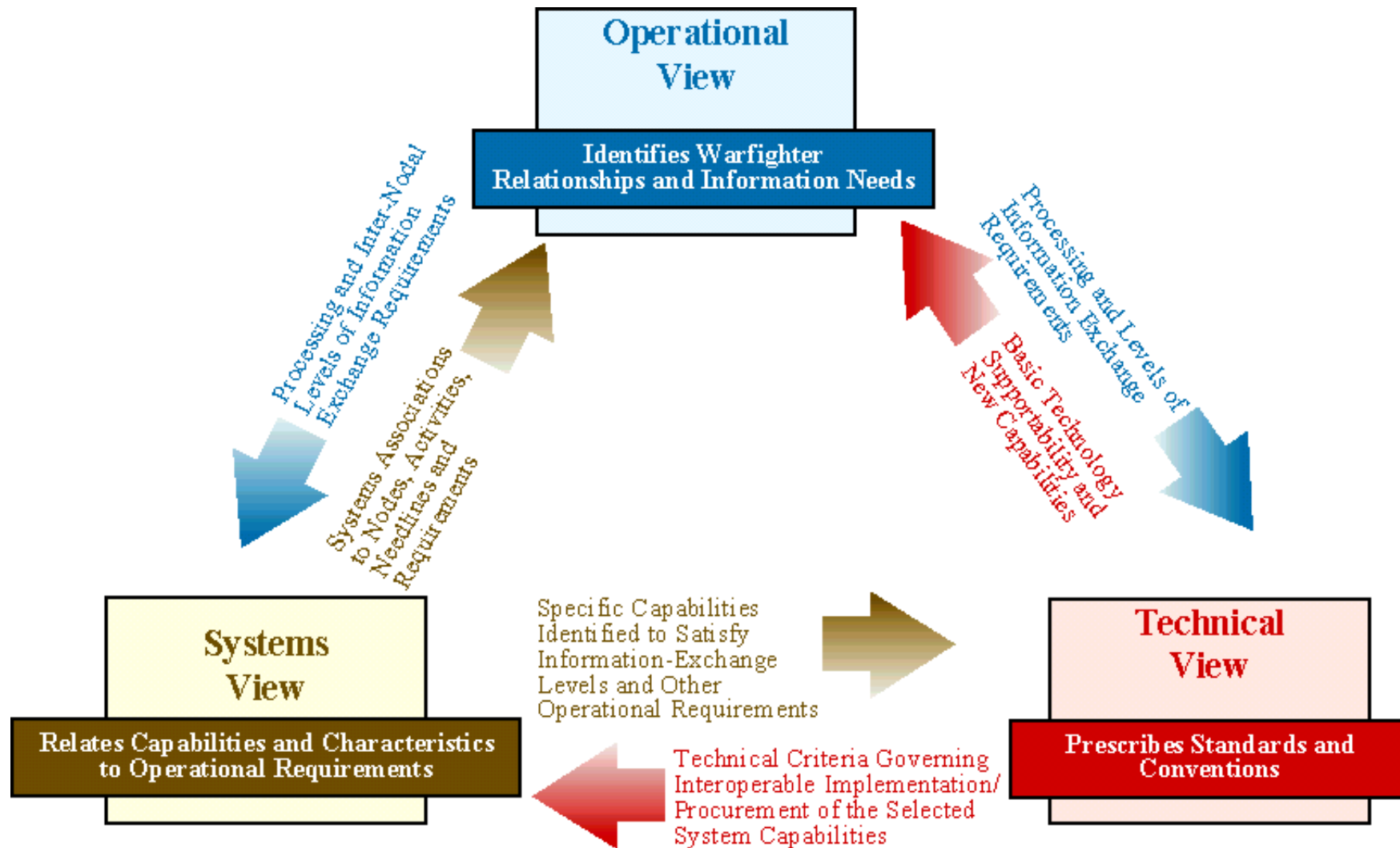
- **Information Technology Management Reform Act of 1996**
  - ❖ The Chief Information Officer of an ... agency shall be responsible for ... developing, maintaining, and facilitating the implementation of a sound and integrated information technology architecture
- **Memos signed by USD(A&T), ASD(C3I), Joint Staff (Director for C4 Systems)**
  - ❖ We ... direct that all on-going and planned C4ISR or related architectures be developed in accordance with [the C4ISR Architecture Framework] Version 2.0
    - ❖ 23 Feb 1998: Strategic Direction for a DoD Architecture Framework
  - ❖ The Framework was intended as a format for standardizing architecture development for all functional areas within the Department. Experiences ... demonstrate that the Framework concepts can be applied across DOD and in the Intelligence Community
    - ❖ 21 Mar 2000: Expands scope

# C4ISR/DoD Architecture Framework

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- **Framework defines formats for describing architecture products**
  - ❖ Supports Chief Information Officers' legal responsibility to develop and maintain integrated information technology architectures
- **C4ISR Architecture Framework Version 1.0 (7 June 1996)**
  - ❖ Defined operational architecture (OA), systems architecture (SA), technical architecture (TA), and standard products of each type
- **C4ISR Architecture Framework Version 2.0 (18 Dec 1997)**
  - ❖ Introduced concept of “architecture views” to describe architectures
  - ❖ Added “Supporting” architecture products in addition to “Essential”
- **Draft DoD Architecture Framework Version 2.1 (27 July 2000)**
  - ❖ Expands scope across DoD and to other communities
  - ❖ Renames “Essential” products to “Mandatory” products
  - ❖ Provides mappings to object-oriented diagrams

# Fundamental Linkages Among the Views



# Operational Architecture View (OV)

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- **Describes:**
  - ❖ Tasks and activities
  - ❖ Operational nodes or elements
  - ❖ Information exchange requirements between nodes
- **Contains:**
  - ❖ Graphical and textual descriptions of the operational nodes and elements, assigned tasks and activities, and information flows required between nodes
- **Defines:**
  - ❖ Types of information exchanged
  - ❖ Frequency of exchange
  - ❖ Which tasks and activities are supported by the information exchanges
  - ❖ Nature of information exchanges

[Adapted from Draft DoD Architecture Framework V2.1]

# Systems Architecture View (SV)

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- **Graphical and textual description of systems and interconnections used to satisfy operational needs**
  - ❖ Associates physical resources to the **operational view** and its requirements
  - ❖ Per standards defined in the **technical view**
- **For a domain**
  - ❖ Shows how multiple systems link and interoperate
  - ❖ May describe the internal construction and operations of particular systems within the architecture
- **For the individual system**
  - ❖ Includes the physical connection, location, and identification of key hardware and software
  - ❖ May also include data stores, circuits, and networks
  - ❖ May specify system and component performance parameters

[Adapted from Draft DoD Architecture Framework V2.1]

# Technical Architecture View (TV)

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- **Is the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements**
- **Provides the technical systems-implementation guidelines upon which**
  - ❖ Engineering specifications are based
  - ❖ Common building blocks are established
  - ❖ Product lines are developed
- **Includes a collection of the technical standards, conventions, rules, and criteria**
  - ❖ Organized into profile(s)
  - ❖ That govern system services, interfaces, and relationships for particular **systems views**
  - ❖ That relate to particular **operational views**

[Adapted from Draft DoD Architecture Framework V2.1]

# Joint Architectures

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- **Joint Operational Architecture (JOA)**
  - ❖ Intended to represent the entire spectrum of joint operations
  - ❖ Subdivided into a set of Joint Mission Areas
- **Joint Systems Architecture (JSA)**
  - ❖ Identifies and describes all DoD systems and their interconnections necessary to accomplish the tasks and activities described in the Joint Operational Architecture
- **The Defense Information Infrastructure (DII) Common Operating Environment (COE) is a fundamental JSA component**
- **Joint Technical Architecture (JTA)**
  - ❖ The primary source document for the mandatory and supporting technical architecture products
  - ❖ One of the reference resources identified in the Architecture Framework

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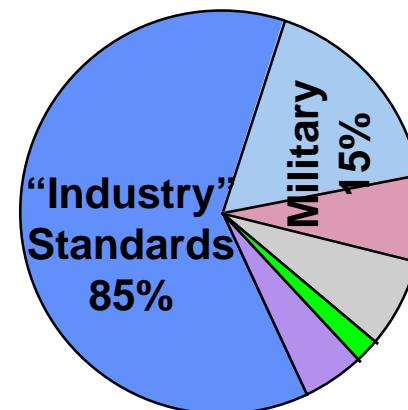
# Policy for JTA Compliance

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- **DoD 5000.2-R (Jun 2001)**
  - ❖ JTA is required for all new, or changes to existing, Information Technology (IT), including National Security Systems
  - ❖ DoD Component Acquisition Executive or cognizant OSD Principal Staff Assistant may grant a waiver if the use of a JTA mandated standard will negatively impact cost, schedule, or performance - waiver requests must detail impact
- **CJCSI 6212.01B (8 May 2000)**
  - ❖ National Security Systems and Information Technology Systems must comply with applicable IT standards contained in the current DoD JTA
- **Service- and Agency-specific implementation**

# DoD JTA

- **DoD mandate for interoperability standards and guidelines at system/component interfaces**
  - ❖ Facilitates joint and coalition force operations
  - ❖ Communicates DoD's preference for open system, standards-based products and implementations
  - ❖ Reduces the cost of weapon systems and materiel
- **DoD JTA defines the common interface standards for IT**
- **All standards/guidelines in JTA must be stable, technically mature, and publicly available**
  - ❖ Most are commercial standards

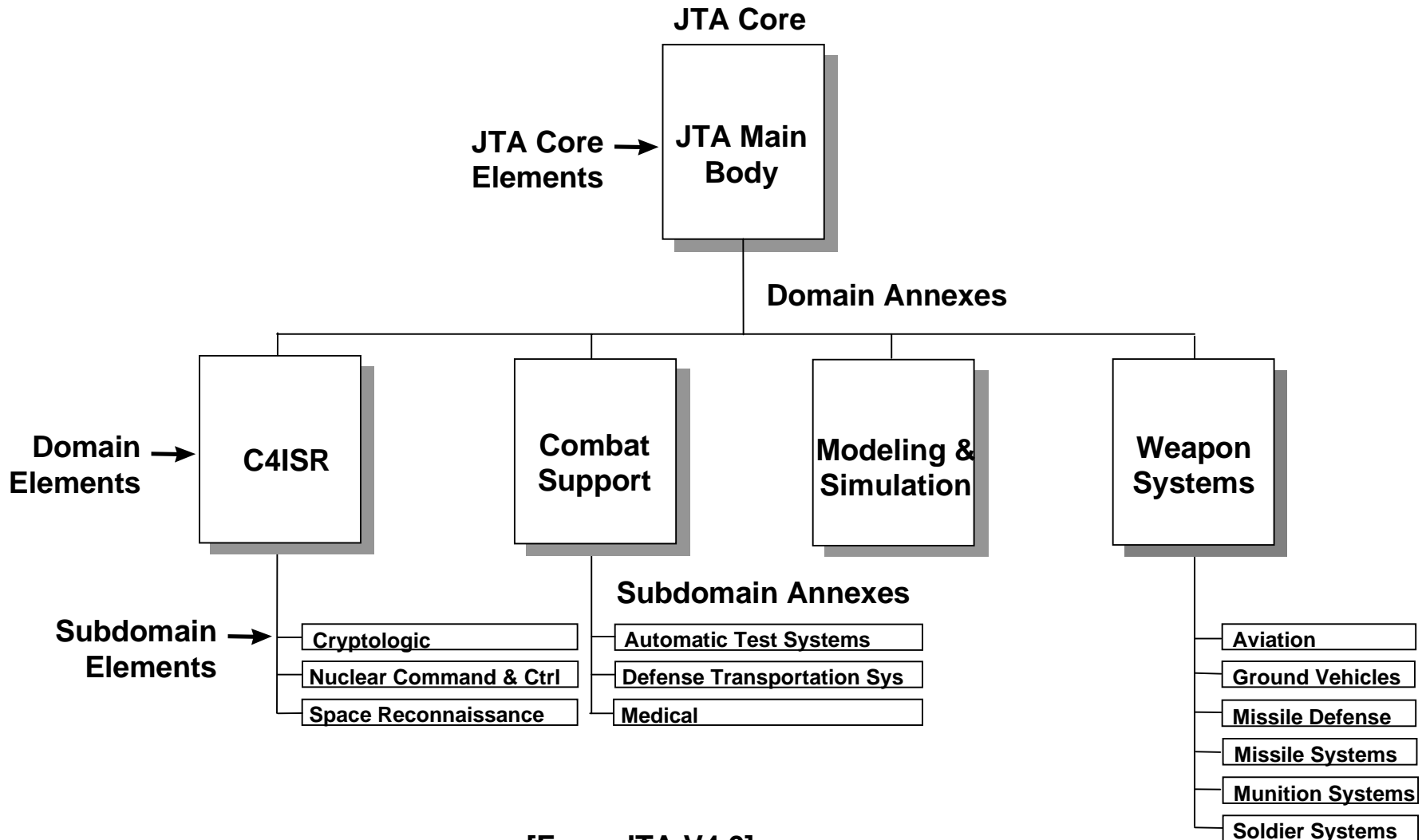


# JTA Evolution and Status

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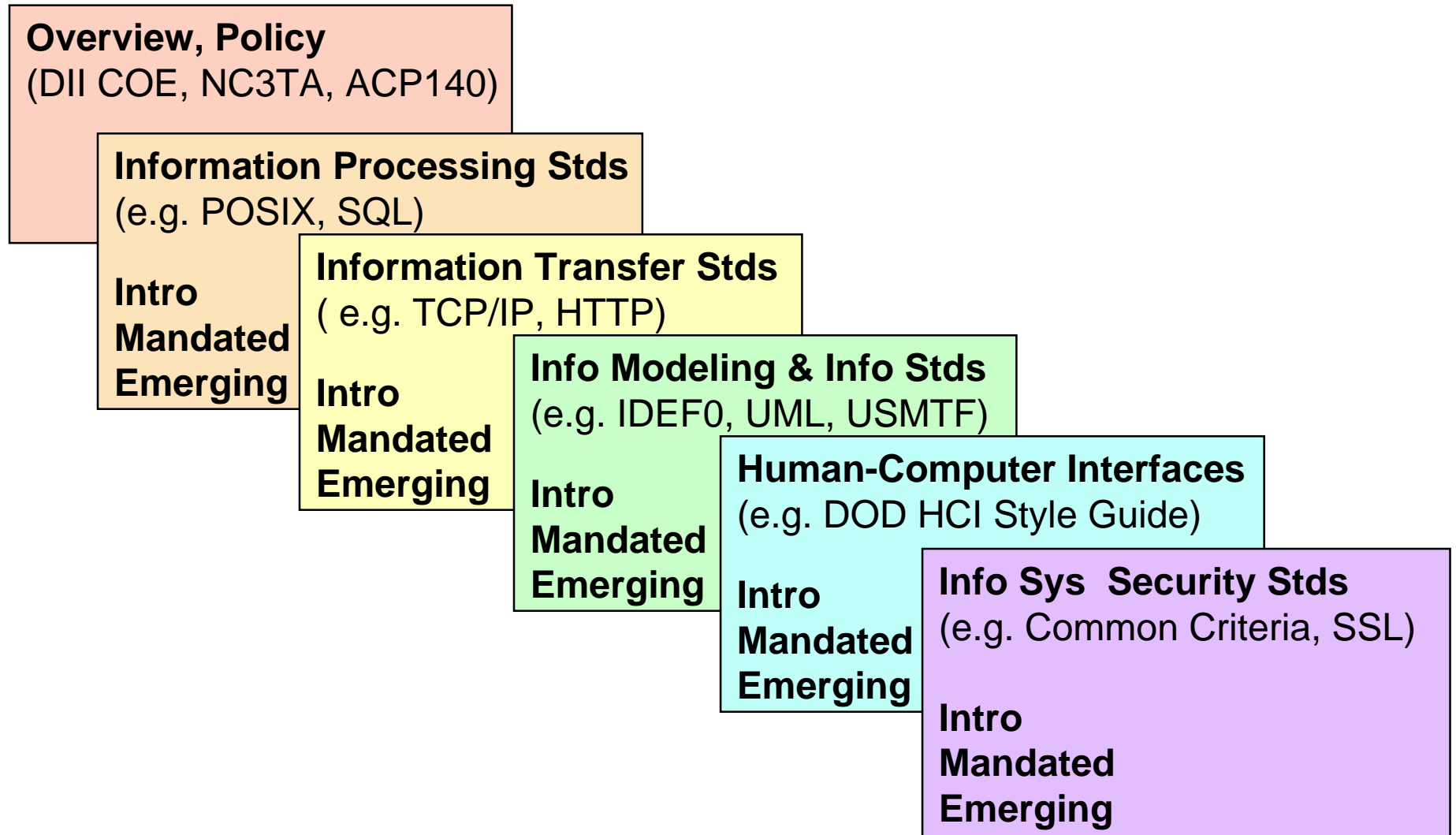
- **JTA Version 1.0, August 1996**
  - ❖ C4I systems only
- **JTA Version 2.0, May 1998**
  - ❖ “... mandates the minimum set of standards and guidelines for the acquisition of all DoD systems that produce, use, or exchange information” [From Implementation Memo for DoD JTA Ver. 2.0]
- **JTA Version 3.0, November 1999**
  - ❖ Implementation memo incorporated JTA V2.0 memo
  - ❖ JTA V3.1 published March 2000
    - ❖ Only significant change was to move Gigabit Ethernet from Emerging status to Mandated status
- **Final JTA Version 4.0 put out on DISA Website April 2001**
  - ❖ *Promulgation memo not yet released*
- **JTA Version 5.0 development in progress**
  - ❖ Now in second of three phases, focusing on content

# JTA 4.0 Hierarchy Model



[From JTA V4.0]

# Structure of JTA Core



# Example Standards in the JTA

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- **JTA Core**
  - ❖ Sect. 2: POSIX, SQL, NITF, XML, HTML, WGS84
  - ❖ Sect. 3: FTP, TCP/IP, SONET, GPS User Interface, CCSDS standards
  - ❖ Sect. 4: IDEF0, UML, USMTF
  - ❖ Sect. 5: DoD HCI Style Guide, MIL-STD-2525B (Warfighting Symbolology)
  - ❖ Sect. 6: Common Criteria, Fortezza, S/MIME, SSL
- **C4ISR Domain**
  - ❖ CGMTI, NITF Extensions, SONET
- **Weapon Systems Domain**
  - ❖ Identification of Friends and Foes (IFF), SCSI-2
- **Modeling & Simulation Domain**
  - ❖ HLA
- **Combat Support Domain**
  - ❖ CALS, medical standards

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# COE Compliance is Among JTA Requirements

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- **DoD JTA Version 4.0 (and earlier versions)**
  - ❖ In the absence of a JSA, the JTA mandates that at a minimum, all Command and Control (C2), Combat Support, and Intelligence Systems supporting the Joint Task Forces (JTFs) and Combatant Commands will use the DII COE
  - ❖ All applications of a system that must be integrated into a DII platform shall be at least DII COE I&RTS Level 5-compliant ... with a goal of achieving Level 8
- **Mandate reiterated in 1999 ASD(C3I) memo**
- **DII COE specification:**
  - ❖ Defense Information Infrastructure Common Operating Environment Integration and Runtime Specification (I&RTS), Version 4.1, 3 Oct 2000

# Complying with JTA

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- **Implementation of the JTA means use of *applicable* standards cited as mandated in the JTA**
  - ❖ Required for *new programs* and *major upgrades*
- **Impact of compliance with all applicable JTA standards must be assessed**
  - ❖ Migration plans or waiver requests may be required
- **JTA contains many industry standards that will be implemented regardless of the mandate**
  - ❖ SQL, HTML, TCP/IP, etc.
- **DII COE compliance at any level is not sufficient to ensure JTA compliance**
  - ❖ But COE is also required by JTA for many programs

# Implementing JTA on a Program

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- **Develop a JTA profile for the system**
  - ❖ To assess JTA compliance of an existing program
  - ❖ To plan for JTA compliance in a developing program
- **To do this:**
  - ❖ Create a table using the List of Mandated and Emerging Standards (LMES), formerly Appendix B
  - ❖ Use guidance provided in the JTA text to determine applicability:
    - ❖ For each service area, whether it is applicable to the program
    - ❖ For each applicable service area, which standard(s) within the service area are applicable
  - ❖ For each applicable standard, determine whether the system is/will be compliant with the standard
  - ❖ In the Comments column, note either the component/COTS product that implements the JTA standard, or the rationale for non-applicability/non-compliance

# Example JTA Standards Profile Entries

JTA Section	Currently Mandated Standard	Applicable ?	Comply ?	Alternate Standard	Comments
2.2.2.1.3 Data Management Services	ISO/IEC 9075:1992, Information Technology - Database Language - SQL with amendment 1, 1996, as modified by FIPS PUB 127-2:1993, Database Language for Relational DBMSs. (Entry Level SQL).	Y	Y		Using DataOre
	ISO/IEC 9075-3:1995, Information Technology - Database Languages - SQL - Part 3: Call-Level Interface (SQL/CLI).	Y	Y		Using DataOre
2.2.2.1.4.1 Document Interchange	ISO 8879:1986, SGML (with Amendment 1 and Technical Corrigenda 1 and 2)	N			No long-term document storage
	HTML 4.01 Specification	Y	Y		Help files
	XML 1.0	Y	N	Proprietary format	Will transition to XML in upgrade
2.2.2.1.4.2 Graphics Data Interchange	JPEG File Interchange Format (JFIF), Version 1.02	N			Not exchanging imagery

# Next Steps in Implementing JTA

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- **JTA and COE compliance must be in RFPs and in all relevant contractual documents**
- **The JTA standards profile is a starting point for:**
  - ❖ Familiarizing designers with relevant standards
  - ❖ Serving as reference for implementors
  - ❖ Compliance criteria for testing
  - ❖ Customers' acceptance criteria
  - ❖ Waiver requests or migration plans if needed
- **Technical Architecture View (TV-1) contains the standards used to meet system and operational requirements**
  - ❖ From the JTA standards profile
  - ❖ From other sources

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# Summary

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- **JTA compliance is mandated by DoD policies**
  - ❖ Overarching guidance for technical architecture views
- **Systems:**
  - ❖ Are defined within the context of the JOA
  - ❖ Comply with standards in the JTA
  - ❖ May be described using Operational Architecture Views, System Architecture Views, Technical Architecture Views
- **COE is a fundamental component of the JSA**
  - ❖ Use of the COE is required by the JTA

# Web Sites

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- ASD(C3I): <http://www.c3i.osd.mil/>
- DoD JTA: <http://www-jta.itsi.disa.mil/>
- USAF TA: <https://www.afca.scott.af.mil/jta-af/>
- USA TA: <http://arch-odisc4.army.mil/>
- USN TA: <http://www.doncio.navy.mil/doncio/>
- COE: <http://diicoe.disa.mil/coe/>

# Government Documents

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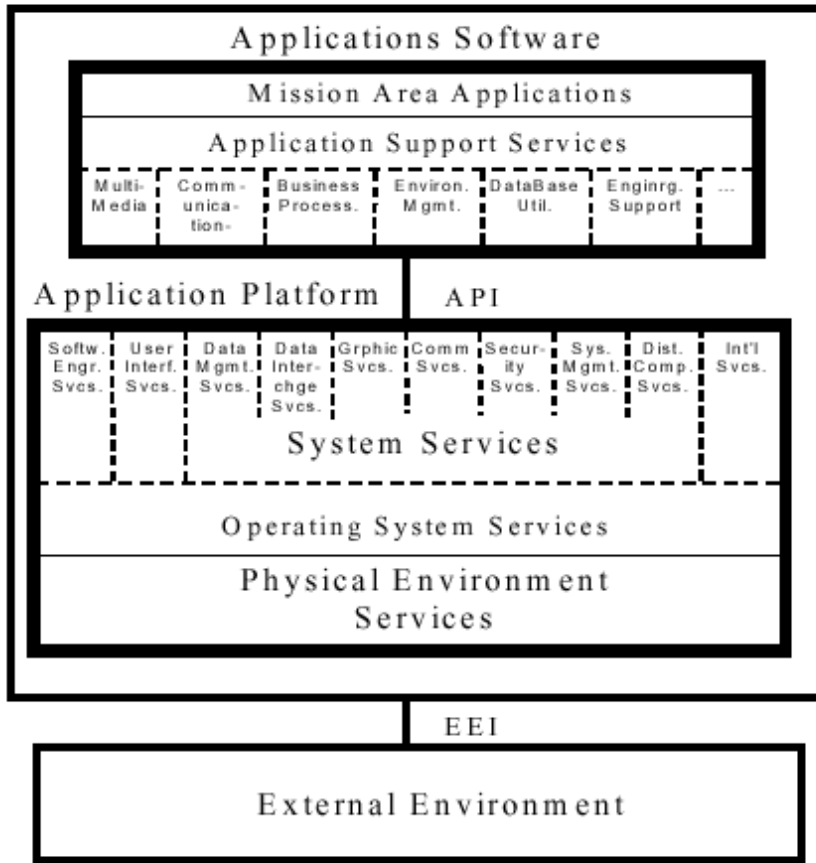
- **C4ISR Architecture Framework**
  - ❖ Version 2.0, 18 December 1997
- **DoD Architecture Framework**
  - ❖ Draft Version 2.1, 27 July 2000
- **DoD Joint Technical Architecture**
  - ❖ Version 3.1, 31 March 2000
  - ❖ Version 4.0, 2 April 2001
- **DII COE Integration and Runtime Specification**
  - ❖ Version 4.1, 3 October 2000
- **DII COE User Interface Specifications**
  - ❖ Version 4.0, October 1999
- **JTA User Guide and Component JTA Management Plan**
  - ❖ Version 1.0, 14 September 2001
- **DoD Technical Reference Model**
  - ❖ Version 2.0, 9 April 2001

# Backup Charts and Acronym Lists

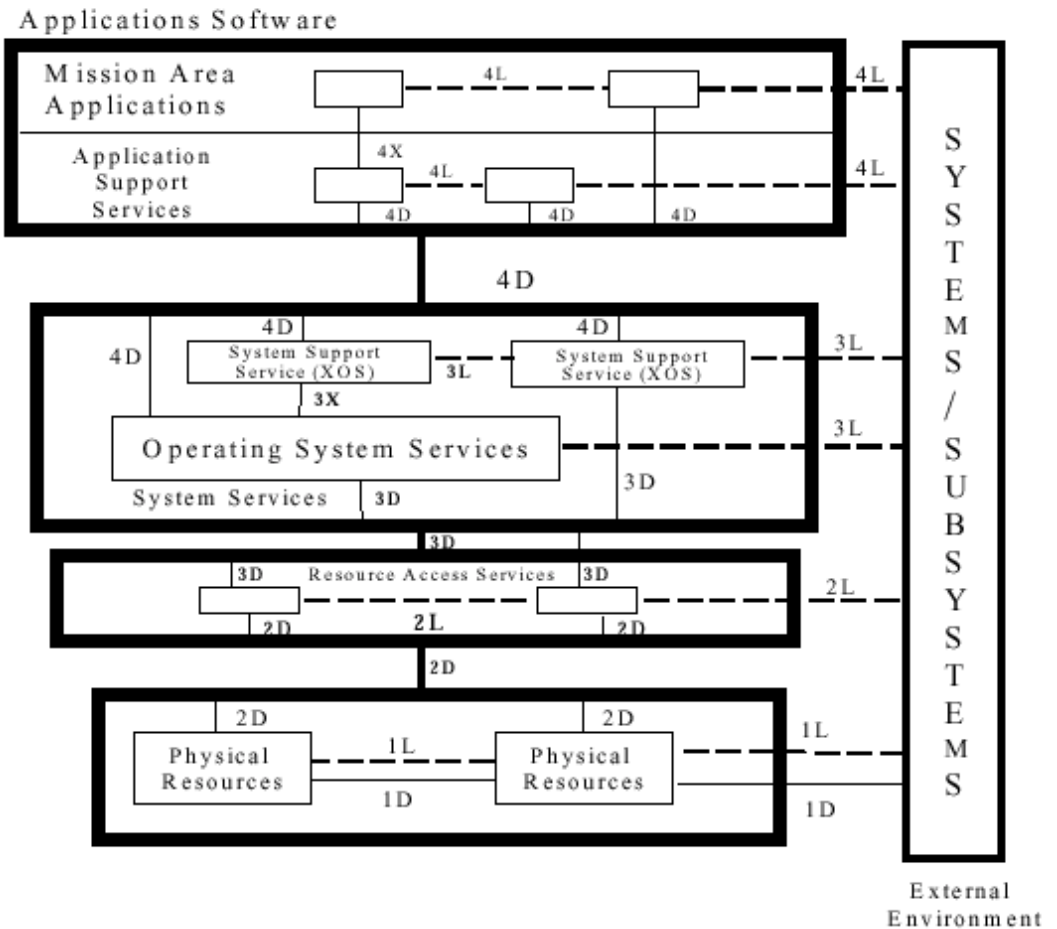
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# DoD Technical Reference Model

## Services View



## Interfaces View



# JTA in DoD 5000.2-R

## June 2001

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- **Implementation of the JTA is the use of applicable standards cited as mandated in the JTA.**
- **The implementation of the JTA is required for all new, or changes to existing, IT, including NSS.**
- **If the use of a JTA-mandated standard will negatively impact cost, schedule, or performance, a DoD CAE or cognizant OSD PSA may grant a waiver from use. For mission critical or mission essential programs, all granted waivers shall be submitted through ASD(C3I)/DoD CIO to USD(AT&L) for review.**
- **... all requests for a waiver shall state the cost, schedule, and performance impacts that will occur if the waiver is not granted, and any resulting operational limitations.**
  - ❖ **Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs, Par. 5.2.11.1.**

# **JTA in CJCSI 6212.01B**

## **8 May 2000**

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- **Chairman of the Joint Chiefs of Staff Instruction: Interoperability and Supportability of National Security Systems, and Information Technology Systems**
- **Information Technology Standards. New or modified NSS and ITS systems should be standards-based. NSS and ITS must comply with applicable information technology standards contained in the current DOD Joint Technical Architecture (JTA)**
  - ❖ **Interoperability and Supportability of National Security Systems, and Information Technology Systems, 8 May 2000, Sect. 5, Par. h**

# Definitions of ITS and NSS in CJCSI 6212.01B

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- **Information Technology System (ITS).** Any equipment or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. Information technology includes computers, ancillary equipment, software, firmware, and similar procedures, services (including support services), and related resources...
- **National Security Systems (NSS).** Telecommunications and information systems operated by the Department of Defense -- the functions, operation, or use of which (1) involves intelligence activities; (2) involves cryptologic activities related to national security; (3) involves the command and control of military forces; (4) involves equipment that is an integral part of a weapon or weapons systems; or (5) is critical to the direct fulfillment of military or intelligence missions...

# JTA Development Group Membership

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- **Ballistic Missile Defense Organization**
- **Defense Advanced Research Projects Agency**
- **Defense Information Systems Agency**
- **Defense Intelligence Agency**
- **Defense Logistics Agency**
- **Defense Modeling and Simulation Office**
- **Defense Threat Reduction Agency**
- **Joint Staff/J6**
- **National Imagery and Mapping Agency**
- **National Reconnaissance Office**
- **National Security Agency**
- **Office of the Assistant Secretary of Defense**
- **Office of the Under Secretary of Defense OSJTF**
- **U.S. Air Force**
- **U.S. Army**
- **U.S. Coast Guard**
- **U.S. Marine Corps**
- **U.S. Navy**
- **U.S. Special Operations Command**
- **U.S. Transportation Command**

# JTA Sect. 1

## Overview and Policy Statements

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- **This section contains the only policy in JTA:**
  - ❖ DII COE I&RTS is mandated for Command and Control, Combat Support, Intelligence Systems supporting the Joint Task Forces and Combatant Commands
    - ❖ Set of modular software that provides generic functions or services accessed by other software through standard APIs
  - ❖ Combined and Coalition Standardization and/or Interoperability documents are referenced
    - ❖ DoD Directive 2010.6 and CJCSI 2700.0 (governing)
    - ❖ NATO Consultation, Command and Control TA
    - ❖ ACP 140 Combined Interoperability TA
- **JTA Sects. 2 - 6, domain/subdomain annexes contain mandated and emerging IT standards**
  - ❖ Selected JTA standards are in the following charts

# Selected JTA Sect. 2

## Information Processing Standards

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- **User Interface: Motif, XCDE, X11R6**
- **Data Management: SQL**
- **Operating Systems: POSIX, Win32**
- **Remote/Distributed Computing: DCE, CORBA, IIOP**
- **Graphics: CGI, OpenGL**
- **Data/Video/Audio/Imagery Interchange: SGML, HTML, XML, GIF, RPF, VPF, WGS-84, CGM, JPEG, JFIF, NITF, MPEG-2, GRIB, BUFR**
- **Emerging Standards: SQL3, ODMG, XHTML™, XSL, VRML, PNG, RT POSIX, RT CORBA**

# Selected JTA Sect. 3 Information Transfer Standards

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- **E-mail: ACP123, SMTP, MIME**
- **Directory Services: X.500, LDAP, DNS**
- **Application Spt: FTP, TELNET, DHCP, HTTP, URL**
- **Protocols: TCP, IP, UDP, BOOTP, SNMP, OSPF, CSMA/CD, PPP**
- **Networking: ISDN, ATM, GbE, SONET**
- **Multimedia/Video/Audio Stds, Facsimile Stds**
- **Satellite Comm: GPS, MILSATCOM, CCSDS Stds**
- **Emerging Standards: IPv6, SCPS, SAASM, RSVP**

# **Selected JTA Sect. 4 Information Modeling, Metadata, and Information Exchange Standards**

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- **Modeling: IDEF0, IDEF1X, UML**
- **Data Definitions: DoD 8320.1-1M, DDDS**
- **Bit-Formatted Msgs: TADIL-J, LINK16, VMF**
- **Character-Formatted Messages: USMTF**
- **Emerging Standards: XMI, MIDS, LINK 22**

# Selected JTA Sect. 5

## Human Computer Interface Standards

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- **Style Guides:**
  - ❖ DOD HCI Style Guide
  - ❖ CDE 2.1/Motif Style Guides
  - ❖ Windows Style Guide
  - ❖ DII User Interface Specification
- **Human-Centred Design Processes: ISO 13407**
- **Symbology: MIL-STD-2525B**
- **Emerging Standards: GeoSym™**

# Selected JTA Sect. 6 Information Security Standards

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- **Security: Common Criteria, Fortezza, FIPS PUB 140**
- **Authentication: Kerberos, FIPS PUB 112, X.509**
- **Algorithms: DES, DSA, KEA, SKIPJACK**
- **Protocols: S/MIME, KMP, SSL**
- **Network: SDN, Common Security Label**
- **Emerging Standards: TLS, RADIUS, S/MIME V3, 3DES, AES, SSH, PKCS, Protection Profiles for VPN, Firewall, IDS**

# Selected Domain and Subdomain Mandated Standards

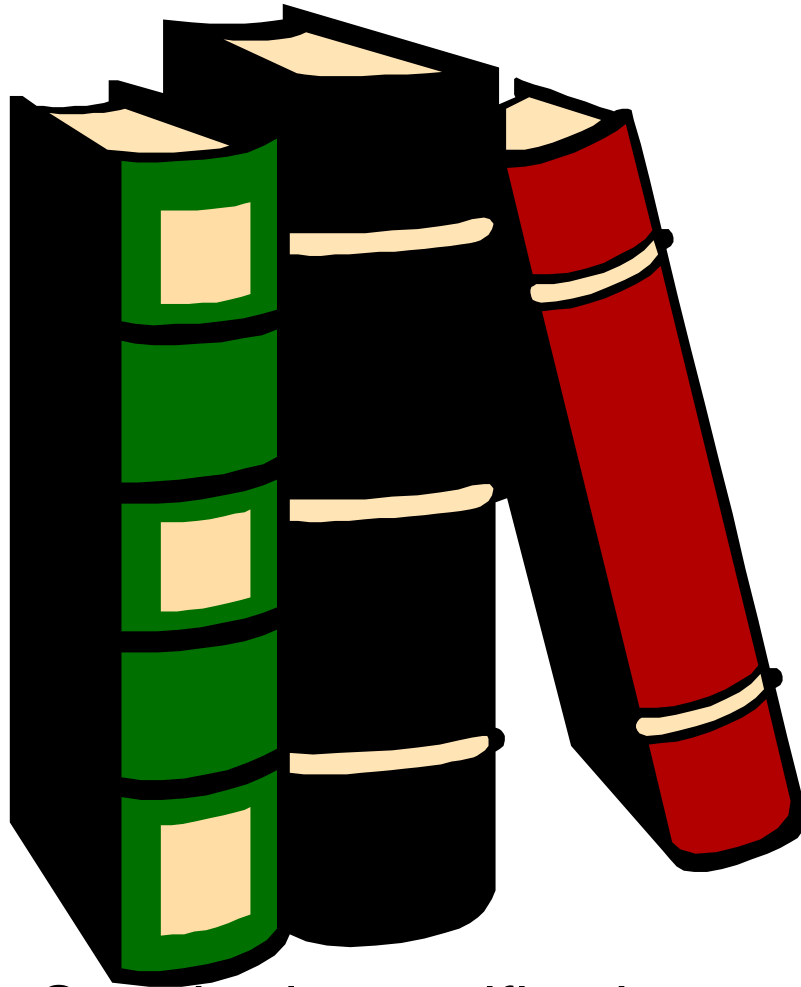
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- **C4ISR Domain: NITF Extensions, NTSDS**
- **Modeling & Simulation Domain: HLA**
- **Combat Support Domain: CALS, IGES**
- **Weapon Systems Domain: IFF Standards**
- **Some subdomain standards are unique:**
  - ❖ DICOM
- **Some standards are mandated in multiple subdomains:**
  - ❖ PCMCIA
  - ❖ SCSI-2

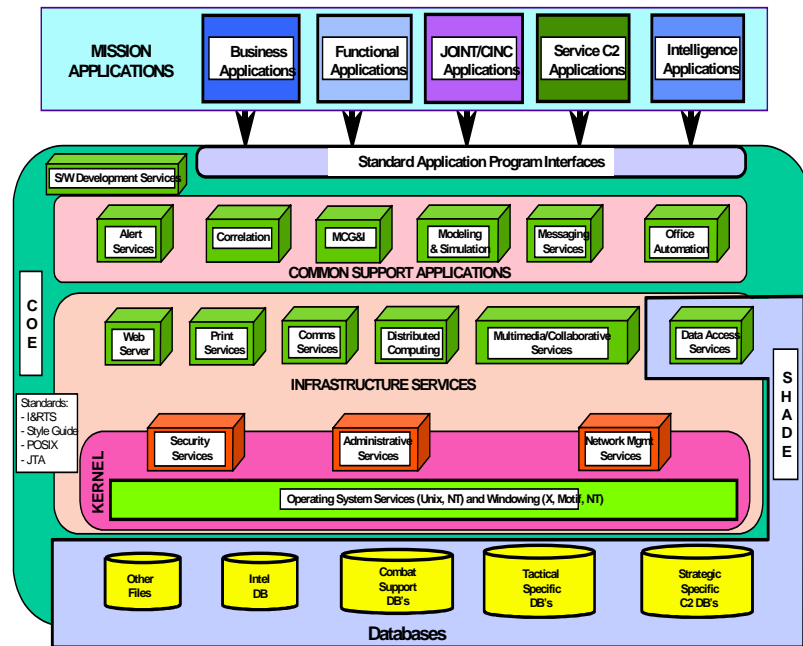
# JTA

# vs.

# COE



Standards specifications



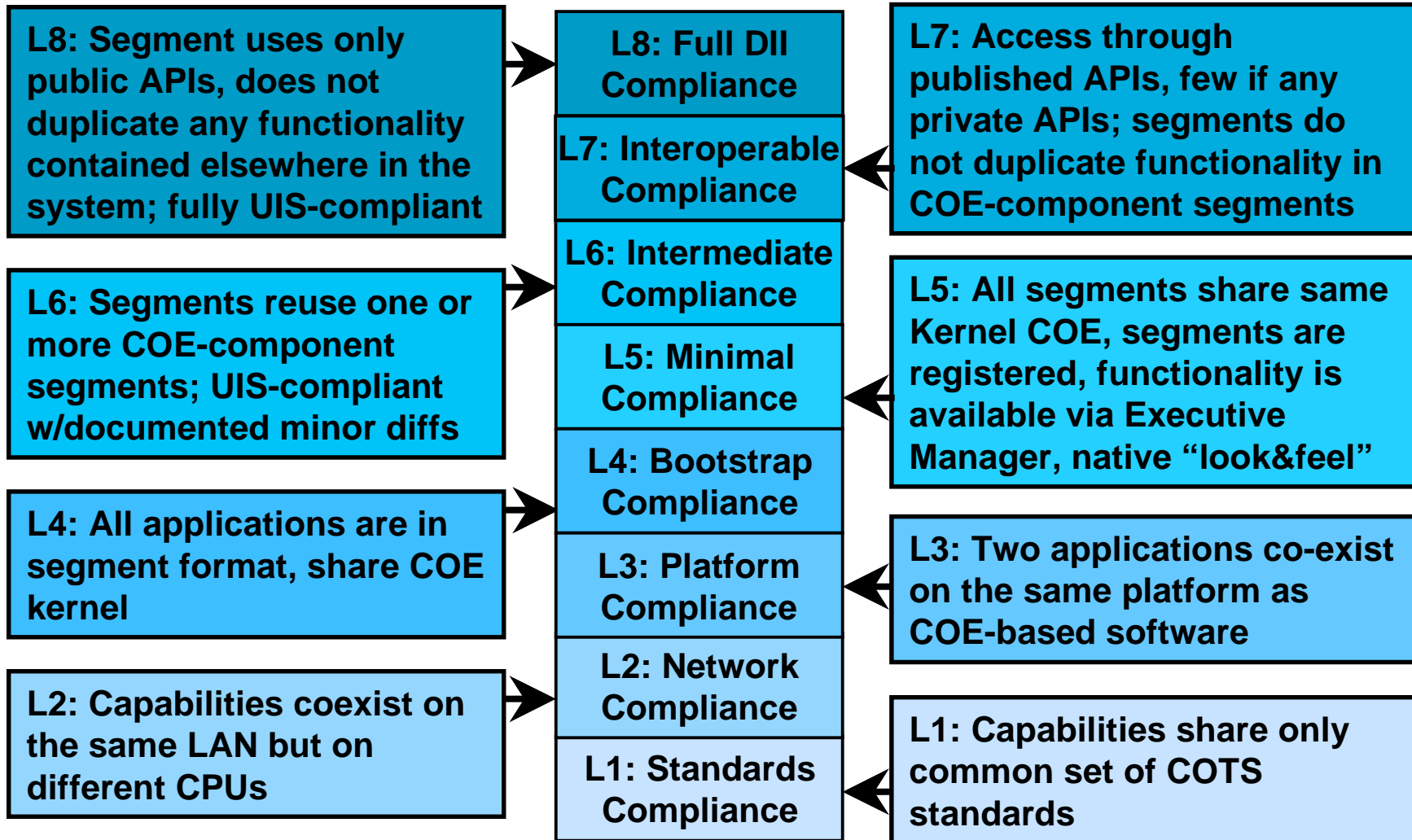
[From DII COE I&RTS V4.1]

Common products

# JTA vs. COE

<b>Contents</b>	Industry and some military specifications and standards	Middleware and infrastructure software and utilities
<b>Features</b>	Interface specifications	Mostly open system products
<b>Software</b>	No software identified except COE	Implemented using DISA-approved COTS and GOTS software
<b>Implementation Context</b>	Compliance w/any std only if corresponding service is in system; additional applicability guidance for each std	I&RTS defines COE compliance levels and segmentation, provides rules for interaction among sw components
<b>Mandate</b>	Mandated in DoD and DoD Component policies	Mandated in JTA, for C2, combat support, and intelligence systems

# COE Levels of Runtime Compliance



# Acronyms

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- **ASD**                    **Assistant Secretary of Defense**
- **AT&L**                   **Acquisition, Technology, and Logistics**
- **C2**                      **Command and Control**
- **C3I**                     **Command, Control, Communications, and Intelligence**
- **C4I**                     **Command, Control, Communications, Computers, and Intelligence**
- **C4ISR**                **Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance**
- **CAE**                    **Component Acquisition Executive**
- **CALS**                   **Continuous Acquisition and Life Cycle Support**
- **CCSDS**                **Consultative Committee for Space Data Systems**
- **CGMTI**                **Common Ground Moving Target Indicator**
- **CIO**                    **Chief Information Officer**
- **CJCSI**                **Chairman of the Joint Chiefs of Staff Instruction**
- **COE**                   **Common Operating Environment**
- **COTS**                 **Commercial off the Shelf**

# Acronyms (cont.)

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- **DAC** Designated Acquisition Commander
- **DII** Defense Information Infrastructure
- **DISA** Defense Information Systems Agency
- **DoD** Department of Defense
- **FTP** File Transfer Protocol
- **GOTS** Government off the Shelf
- **GPS** Global Positioning System
- **HCI** Human Computer Interface
- **HLA** High-Level Architecture
- **HTML** Hypertext Markup Language
- **I&RTS** Integration and Runtime Specification
- **IDEF** Integration Definition
- **IFF** Identification of Friends and Foes
- **IP** Internet Protocol
- **IT** Information Technology
- **ITMRA** Information Technology Management Reform Act

# Acronyms (cont.)

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- **JOA** Joint Operational Architecture
- **JSA** Joint Systems Architecture
- **JTA** Joint Technical Architecture
- **JTF** Joint Task Force
- **MCG&I** Mapping, Charting, Geodesy, and Imaging
- **MDA** Milestone Decision Authority
- **NITF** National Imagery Transmission Format
- **NSS** National Security Systems
- **OA** Operational Architecture
- **OSD** Office of the Secretary of Defense
- **OSJTF** Open Systems Joint Task Force
- **OV** Operational Architecture View
- **PEO** Program Executive Officer
- **PM** Program Manager
- **POSIX** Portable Operating System Interface
- **PSA** Principal Staff Assistant

# Acronyms (cont.)

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- **RFP** Request for Proposal
- **SA** Systems Architecture
- **S/MIME** Secure/Multipurpose Internet Mail Extensions
- **SCSI-2** Small Computer Systems Interface
- **SONET** Synchronous Optical Network
- **SQL** Structured Query Language
- **SSL** Secure Sockets Layer
- **SV** Systems Architecture View
- **TA** Technical Architecture
- **TCP** Transmission Control Protocol
- **TV** Technical Architecture View
- **UML** Unified Modeling Language
- **USD** Undersecretary of Defense
- **USMTF** United States Message Text Format
- **WGS** World Geodetic System
- **XML** eXtensible Markup Language