SOA in Healthcare:

The Role of Systems Oriented Architecture (SOA) in Near-Term Evolution of Electronic Health Records (EHR)

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Hypothesis

- Systems Oriented Architecture (SOA) principles can assist in meeting short-term objectives while building the foundation for future state health architectures
  - Short-term objectives:
    - Reduce the number of interfaces between systems
    - Discover, expose and share common business logic embedded in our legacy systems
    - Establish enterprise level discipline, standards and governance required to share services between applications
    - Create standard information exchange services with external health organizations
  - Long-term objectives is to create a lean IT enterprise

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Why a Service Oriented Architecture

MHS Enterprise Level - System View 1
System to System Documented Interfaces
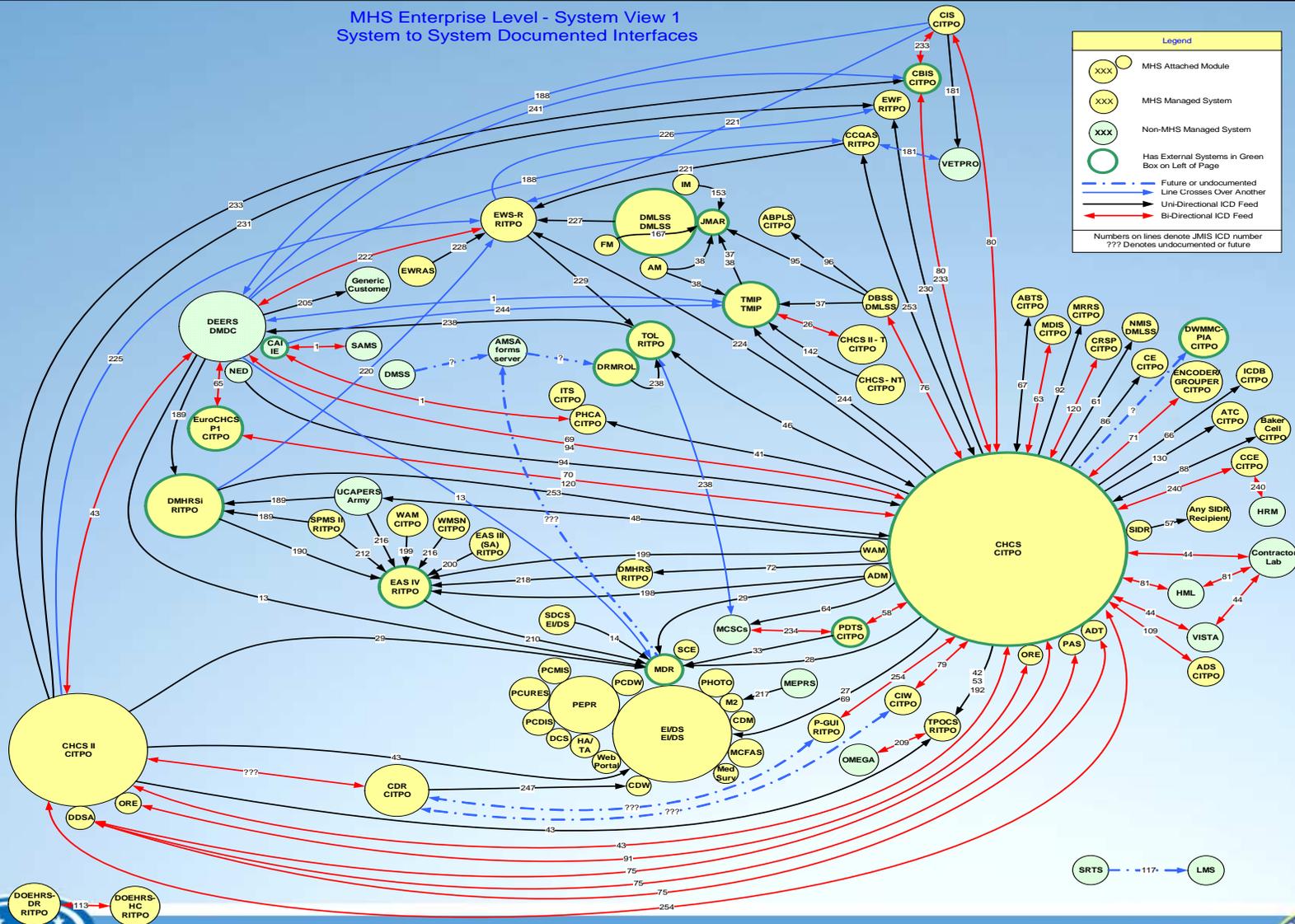
Current State of Integration

Integration Defined

- "Ability of information systems to communicate with each other and exchange information."

- "Conditions, achieved in varying levels, when information systems and/or their components can exchange information directly and satisfactorily among them."

- DoD Global Information Grid (GIG) Definition

Current Situation	Problems Created
• Generally successful developing and fielding autonomous solutions • Acquisition cycle does not incorporate an overarching integration strategy • Integration is addressed at the project level rather than at the Enterprise level	• Data integrity • Poor user acceptance • Fragility • Lack of agility • Duplication of business rules • Chaotic cost estimation • Unidentified gaps • Competition between program offices • Difficulty specifying future acquisition • Communication between systems has been lacking, resulting in important information being unavailable, incomplete, or erroneously presented, directly impacting the mission

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New Approach to Enterprise Integration

| Previous Approach	New Approach
Procedural implementations	Process orchestration
Tightly coupled	Loosely coupled
Components	Services
Request-response (Synchronous)	Message-based (Synch. and Asynch.)
Data translation and transformation	Standardized subject-area data model
Use of traditional EAI approach	Interoperability and open standard basis
Business and infrastructure functions encapsulated within the architecture	Separation of business and infrastructure services
Application silos	Shared services strategy
Reactive	Proactive

Enterprise Strategy for Near-Term Migration to SOA

- Change paradigm in the way systems are designed, developed, realized, and supported
  - Enterprise-wide Systems Engineering discipline based on SOA principles
  - Buy-In from Functional and Technical community
- Creation of a To-Be architecture based on SOA principles
  - Establish a clear migration strategy and execution plan
  - Multi-year programmatic approach
- A system design process that simultaneously examines functional and technical requirements from an enterprise perspective
- Emphasis establishing industry standards
- Create internal and external incentives to work within the SOA framework

Near-Term Approach for Enterprise Integration

Current Approach to SOA

- Bottom up – Creation of Services as means to fulfill application centric requirements
  - Leverage existing program efforts to realize application and utility service components
  - Early high value net-centric SOA components to be extracted from current systems as the new capability is developed
    - Security
      - SSO (Authentication and Authorization)
      - Data in transit; Data at rest
    - Lexical services
    - Messaging
    - Scheduling Registration
    - Common Files and Tables
    - Workflow

- Top Down – Analyze the business process and develop an overall business model based on Services
  - PIDS
 - Order Entry

Near-Term SOA Blueprint
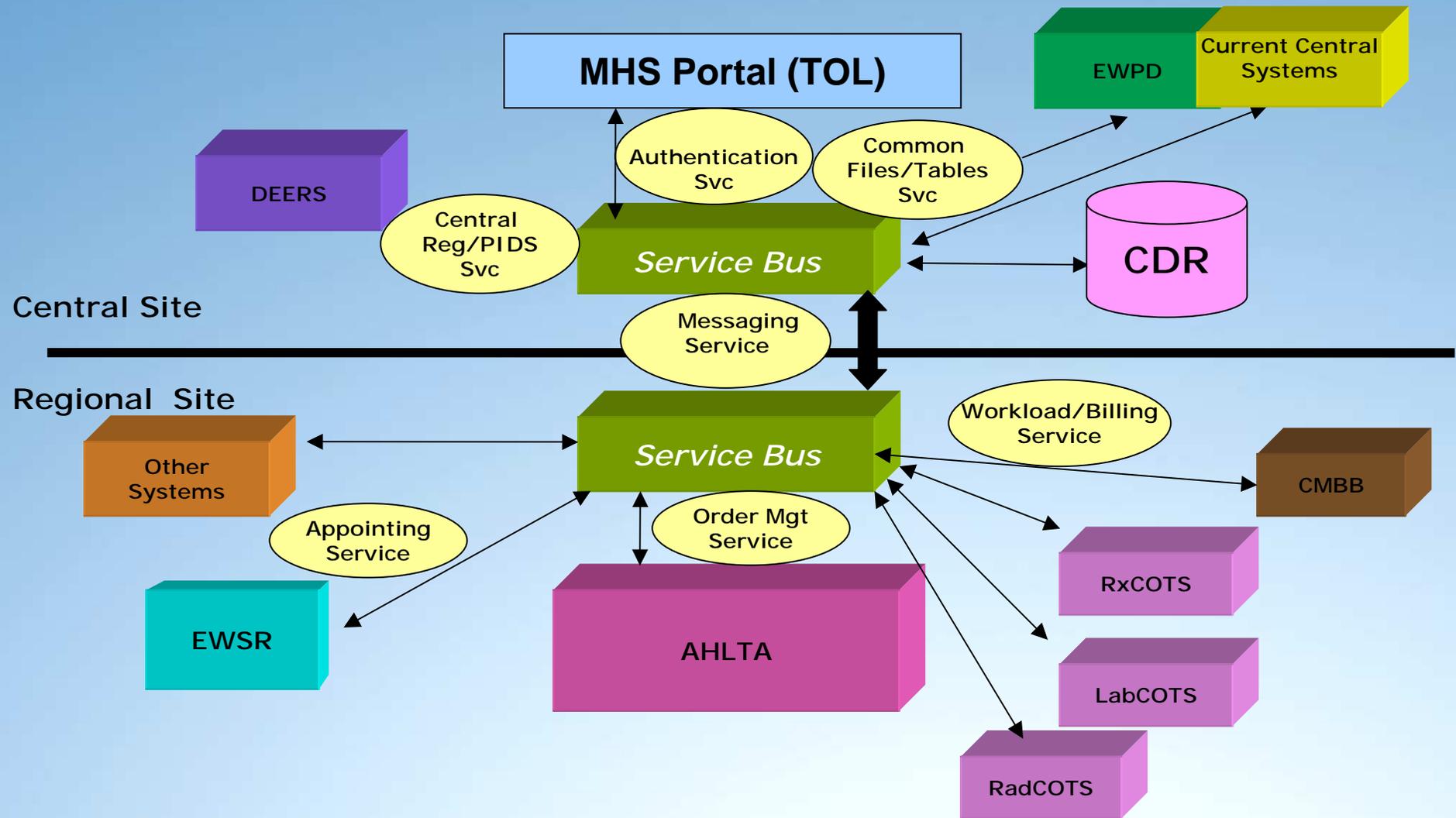
Enterprise Service Bus

- ESB is the communications nerve center for the enterprise
- Acts as the intermediary between SOA components, services, and business processes
- Moves Data: Connect, Enrich, Distribute
  - Connects: Adapters, Applications Events, Metadata, Security and WS Manager
    - Lightweight containers available for insertion into connected systems
  - Enriches: Transformation, Value Mappings, System Xref and Business Rules
  - Distributes: Provides Web service filtering and routing capabilities
- Supports component replacement based on standards and interoperability
- Comprised of several components
  - Interfaces, Messaging, Transformation, Metadata, Security
  - B2B, BAM, UDDI

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Enterprise Services Common Areas

- Security
- PIDS and Master Subject Index
- Terminology Services
- Clinical Operational Data Store
- Messaging and Logical Transformation
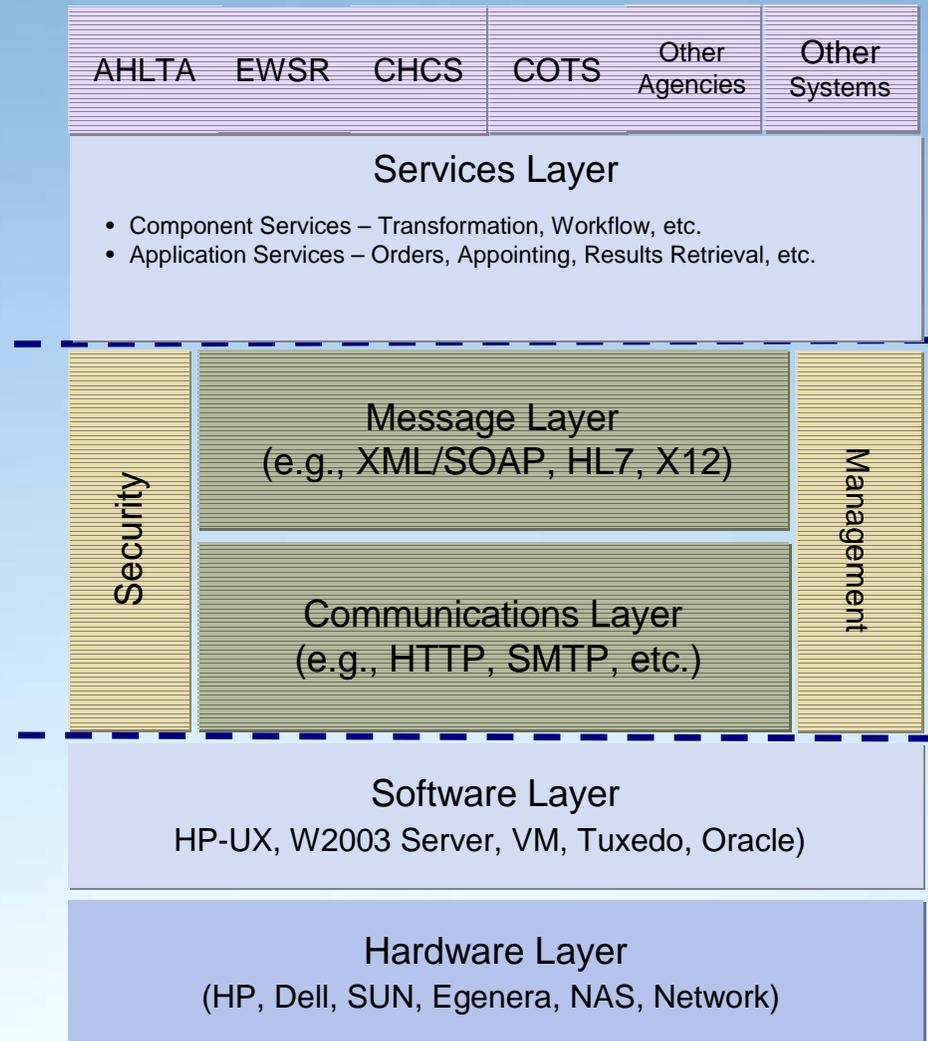
Security Services

- Technical security "services" should enable systemic approaches to core security functions
  - Access control, particularly on "Ports & Protocols", Encryption and Identification, Authentication and Authorization
    - Common Access Card and Public Key Encryption
    - "Role-based" Implementation Schemes
    - "Single Sign On" capability to facilitate and support compliance with logon policies
  - Auditing - FISMA, HIPAA and Information Assurance policies of DoD and each Military Service require auditing
  - Integrity Management refers to the accuracy and completeness of data or message content
    - Encryption constitutes a primary tool for technically protecting the integrity of messages or databases
    - Technically verifying the integrity of data or messages

PIDS/EMPI Service

Necessary for healthcare transactions dependent on the precise and unambiguous identification of the person

PIDS CORBAMED standard is designed to:

- Support both the assignment/management of IDs
- Support searching and matching of people, independent of matching algorithm
- Support federation of ID services in a topology-independent fashion
- Permit implementations to protect person confidentiality
- Enable plug-and-play PIDS interoperability
- Define the appropriate meaningful compliance levels

Terminology Services

- Describes the organization and logical structure of the medical data found in a clinical database. It is an integrated, structured terminology system which:
  - Describes clinical data in all forms
  - Supports encoding of clinical data to remove ambiguity
  - Exchanges and compares the data between independent systems
  - Provides structure and content for decision support
  - Enables users to query and report on the database
  - Supports standardization of clinical data across enterprises

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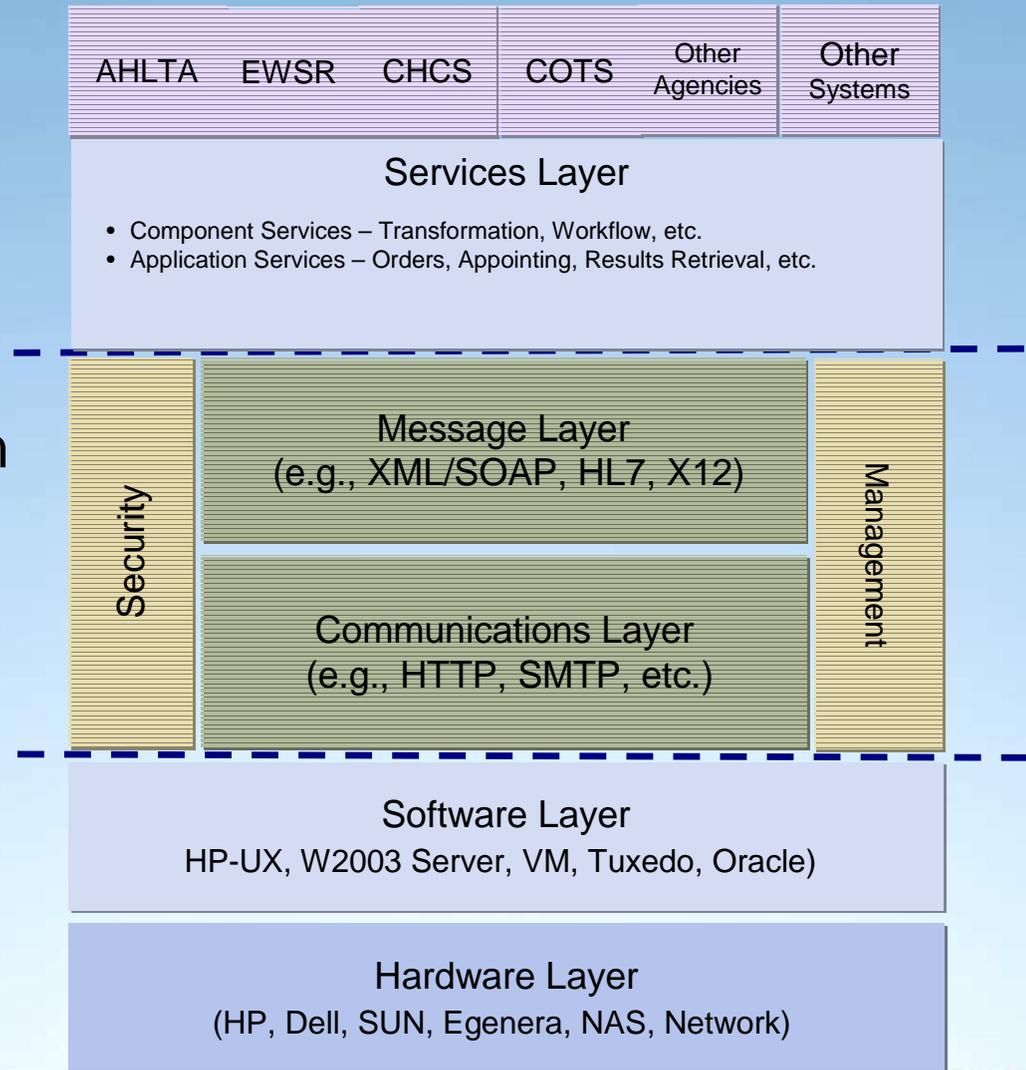# Clinical Operational Data Store

- Single instance of corporate data made available to enterprise and local applications for operational consumption
  - Delivers real-time data to both enterprise and federated enterprise applications
  - Reduces data synchronization errors, costs, and inefficiencies
  - Supports clinical decision by making integrated data available to all clinical information systems

Messaging and Logical Transformation

- Messaging services connects separate systems in a network by carrying and distributing messages between them. The messages may contain data, software instructions, or both together

- Legacy systems have hundreds point-to-point interfaces that generate an unmanaged and currently an unmanageable messaging flow

- MHS currently supports messages in the following message formats:

    - Clinical Information EDI - HL7 v2.4

    - Medical EDI - ANSI ASC X12N 270, 271, 276, 277, 278, 820, 834, 835, 837; FIPS Pub 161-2; NCPDP Telecom Standard Implementation Guide v5.1; HL7 v2.4

    - Medical Still-Imagery - EDI DICOM v3.0; JPEG 2000

    - Immunizations - HL7 v2.3.1

Application Services Common Areas

- Workflow Service
- Order Entry/Results Retrieval
- Appointing/Scheduling
- Encounter Documentation

AHLTA	EWSR	CHCS	COTS	Other Agencies	Other Systems

Services Layer
- Component Services – Transformation, Workflow, etc.
- Application Services – Orders, Appointing, Results Retrieval, etc.

Security

Message Layer
(e.g., XML/SOAP, HL7, X12)

Communications Layer
(e.g., HTTP, SMTP, etc.)

Management

Software Layer
HP-UX, W2003 Server, VM, Tuxedo, Oracle)

Hardware Layer
(HP, Dell, SUN, Egenera, NAS, Network)

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Workflow Service

- Workflow is predominately an issue for departmental information systems (e.g. radiology workflow), but the workload balancing within healthcare applications and between healthcare organizations is expected to play an increasingly important role

- Workflow implementation is very different between a monolithic information system and an open system that incorporates best of breed commercial subsystems

- Standards in this area need to be developed

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Order Entry and Results Retrieval Service

- This service provides a consistent, uniform ordering and results retrieval function for all clinical services (e.g. labs, pharmacy, radiology, etc)
  - Usually a core function of the ambulatory or inpatient electronic medical record system
  - Often includes order management and clinical decision support
- Not typically seen as a separate service in healthcare, however, for the DoD, this service is vital
  - Supports a best of breed approach for clinical applications
  - Allows a smooth transition from legacy systems that contain order entry, decision support, and result retrieval

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Appointing/Scheduling Service

- This service provides a consistent, uniform scheduling function for all clinical services (e.g. labs, pharmacy, radiology, etc.)

- Since COTS ancillary information systems (e.g. RIS, LIS) normally include a scheduling component and a global workflow, the function of the ancillary scheduling components must be defined

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Encounter Documentation Services

- Provide the functionality to capture encounter notes, H&P, etc. in a variety of settings: Ambulatory care; Nursing; Patient Charting

- The soon to be standardized second version of HL7 Clinical Document Architecture (CDA) may be appropriate for interoperability with external systems

SOA Lessons Learned

- We have had limited success due to:
  - Organizational challenges
  - Hidden business rules in legacy applications
  - Failure to transcend perception of SOA as a technology instead of a set of principles that redefine organizational decision making, business relationships, and Governance
  - Focus on meeting current operational needs
  - Commercial Health Market just now embracing SOA for the integration of clinical applications and products (commercial SOA health IT systems are not available)

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Must Haves in Developing SOA for MHS

- Executive Sponsorship

- Enterprise Governance

- Programmatic Approach to Build

  - Must be funded

- Agile Approach

- Enterprise System Engineering

- Change in Support Model

  - Guaranteed level of Service

Thank You

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