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FIRST INTERNATIONAL SCHOOL ON COMPUTER NETWORK ANALYSIS AND MANAGEMENT

(3 - 14 December 1990)

DECnet/OSI
The Foundation for Open Networking

E. Sarissamlis

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DEC - 1
Digital Equipment
BOLOGNA

DECnet/OSI

The Foundation for Open Networking

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DECNET/OSI PRODUCT STRATEGY

- **Release interim products for OSI Lower Layers**
- **Provide Upper Layer OSI functionality on top of the interim products**
- **Prepare DNA and OSI integration and replace interim products with DECnet/OSI**
- **Integrate the Internet protocol suite**
- **Integrate standards with proprietary technology**
- **Expand network size for OSI Global networks**
- **Enhance network management capabilities based on OSI standards**

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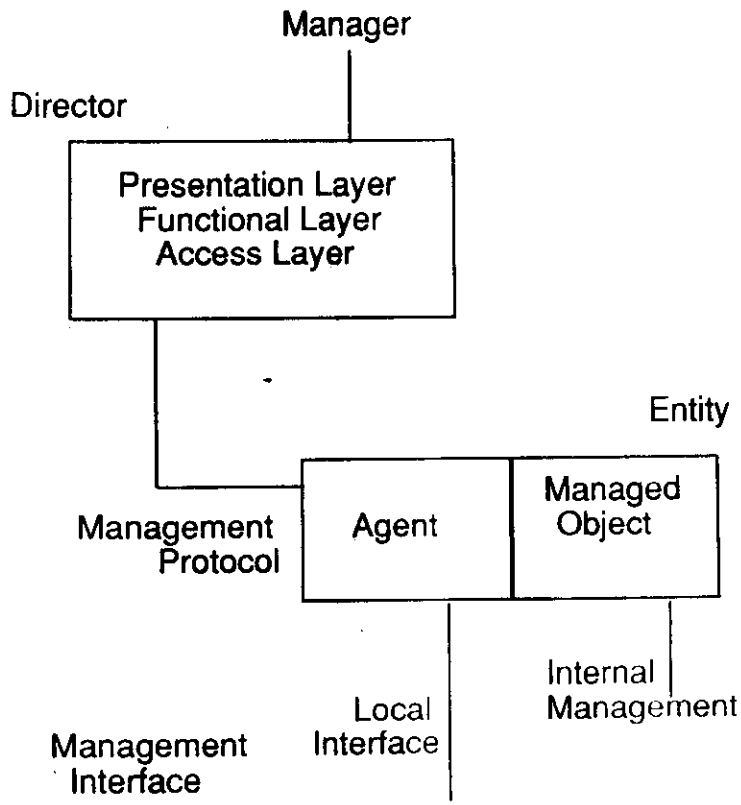
Structure of an Entity



Dr. E. Sarissamlis
Networking Technology Consultant

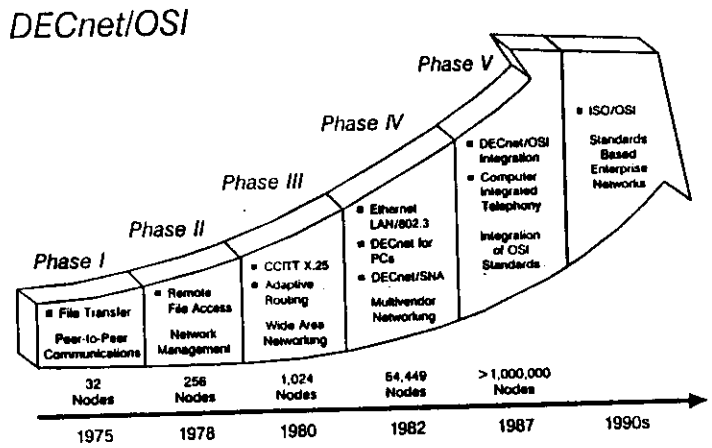
WHAT IS DECNET/OSI

- A family of products implementing DNA phase V
- Supports the integration of OSI protocols while enhancing DECnet phase IV and providing compatibility with DECnet phase IV and Internet protocol suite
  - OSI standards and applications are used wherever they exist
  - Dual IS-IS routing for both OSI and IP packets
  - DECnet proprietary solutions are provided to improve functionality and performance
- DECnet/OSI facilitates resource sharing regardless of size, distance, medium or vendor. In particular, it supports a number of operating systems including
  - VAX/VMS
  - ULTRIX
  - OS/2
  - MS/DOS

WHAT IS DNA PHASE V

- DNA is a cost-effective, layered architecture for building from small to very large, standards-based, global networks. It specifies
  - Protocols for information exchange
  - Interfaces for the services provided by the protocols
  - Policies and procedures for adapting to change
  - Management of distributed, multivendor environments
- The DNA phase V architecture provides the means for the
  - Integration of technological change via the addition of new or alternative protocols and/or interfaces
  - Sharing of information in a multivendor environment
  - Design of system independent functions
  - Management of systems in a networked environment

DECNET/OSI EVOLUTION



DNA PHASE V PHYSICAL LAYER

Concerned with the transmission and reception of data. It provides the means to activate, maintain and deactivate physical connections between directly connected computing systems

- **Over a variety of media including: cable, switched and leased lines, microwave, satellite, fiber optics, baseband/broadband, thinwire and packet switch**
- **LAN connectivity and conformance to standards**
- **WAN connectivity across PSDN for cost-effective public network alternative**
- **Multivendor connectivity for next generation LANs via FDDI**
- **Implements the following standards:**
  - **ISO 8802-3/IEEE802.3 Ethernet**
  - **EIA RS-232C/RS-422/RS-423 hardware devices**
  - **ISO 9314-1 FDDI PHY**
  - **ISO 9314-3 FDDI PMD**
  - **ISO DIS 9314-4 ANSI X3T9.5/84-89 FDDI SMT**

DNA PHASE V DATA LINK LAYER

The Data Link Layer provides the means to establish, maintain and release the data link connections between two directly connected computing systems

- **Defines the following protocol modules:**
  - **Carrier Sense Multiple Access with Collision Detect (CSMA/CD)**
  - **Fiber Distributed Data Interface (FDDI)**
  - **Higher-Level Data Link Control (HDLC)**
  - **Digital Data Communications Message Protocol (DDCMP)**
- **Implements the following standards:**
  - ISO 8802-2 LAN Logical Link Control (LLC)
  - IEEE802.2 LAN Logical Link Control (LLC)
  - IEEE802.1 Bridging Algorithm
  - ISO 9314-2 FDDI MAC
  - ISO DIS 9314-4 ANSI X3T9.5/84-89 FDDI SMT
  - ISO 4335 HDLC
  - ISO 7809 HDLC
  - ISO 7776 LAPB

DNA PHASE V NETWORK LAYER

Responsible for routing data between computing systems employing a routing algorithm and intermediate routing systems.

- **Provides multivendor interoperability via OSI and Internet**
- **Accomodates next generation routing advances**
- **Implements the following standards:**
  - **ISO 8348 Connection-mode Network Service (CONS)**
  - **ISO 8348/AD2 Addressing Format**
  - **ISO 8348/AD1 Connectionless-mode Network Service (CLNS)**
  - **ISO 8208 Packet Level Protocol (PLP)**
  - **ISO 8473 Internetwork protocol**
  - **ISO 8878 X.25 to provide CONS**
  - **ISO 8880 Network Service**
  - **ISO 8881 X.25 packet Level Protocol in LANs**
  - **ISO 9542 EI-IS Routing**
  - **ISO DP 10589 IS-IS Routing**

DNA PHASE V TRANSPORT LAYER

The Transport Layer provides a reliable end-to-end service between computing systems, by employing protocols that enhance the Network Layer Service.

- **Provides multivendor interoperability via OSI and Internet**
- **Operates three different protocols**
  - **ISO 8073 Transport Protocol**
    - **Class 0 minimal features used for X.4000**
    - **Class 2 multiplexing (CONS)**
    - **Class 4 Error Detection and recovery (CLNS)**
  - **Transmission Control Protocol/Internet Protocol (TCP/IP)**
  - **Network Services Protocol (NSP)**
- **Implements the following standards:**
  - **ISO 8072 Transport Services**
  - **ISO 8373 Transport Protocol**

DNA PHASE V SESSION LAYER

Organises the structures and interactions between communicating applications regardless of their location.

- **Provides more flexibility for distributed applications**
- **Uses a Naming Service as the basis for interoperation**
- **Integration of Upper Layer API with common Transport Interface**
- **Implements the following standards:**
  - **ISO 8326 Session Services**
  - **ISO 8327 Session Protocol**

DNA PHASE V PRESENTATION LAYER

Coordinates the conversion of data and data formats to meet the needs of individual application processes

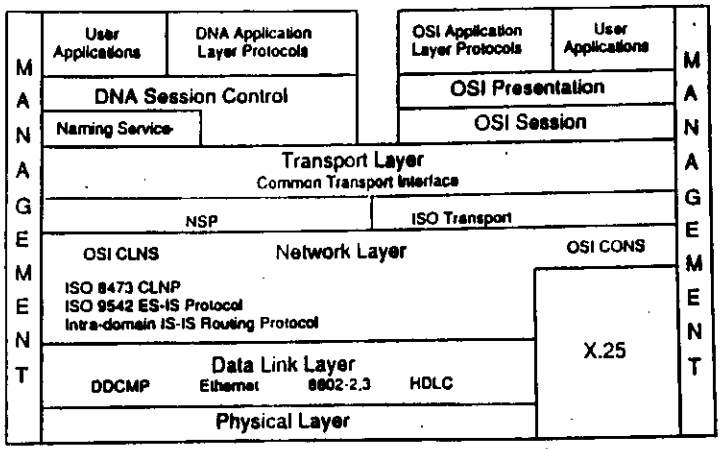
- **Concerned only with syntax and not with its semantics**
- **Provides common representation to be used between applications**
- **Provides syntax independence**
- **Implements the following standards:**
  - **ISO 8822 Connection-oriented Services**
  - **ISO 8823 Connection-oriented Protocol**
  - **ISO 8824 Abstact Syntax Notation One (ASN.1)**
  - **ISO 8825 Encoding Rules for ASN.1**

DNA PHASE V APPLICATION LAYER

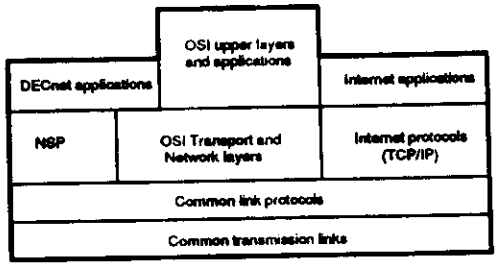
Defines the semantics for information exchange between end systems. OSI Application processes exchange information by means of Application Entities, Application Protocols and Presentation Services.

- **Implements the following standards:**
  - **ISO 8571 File Transfer, Access and Management (FTAM)**
  - **ISO 8649 Association Control Service Element (ACSE)**
  - **ISO 8650 Application Service Element (ASE)**
  - **ISO 9072 Remote Operations Service Element (ROSE)**
  - **ISO 10021 Mesage-oriented Text Interchange System (MOTIS)**
  - **CCITT X.400 Message Handling System (MHS)**
  - **ISO 9506 Manufacturing Message Specification (MMS)**

PUTTING IT ALL TOGETHER...



Distributed Systems Architecture



DNA Phase V and TCP/IP Internetworking

WHAT DOES DECNET/OSI OFFER

DECnet/OSI includes enhancements in the following areas:

a. Network Configurations

b. Internetwork Communications

1. **Internet**
2. **X.25 PSDN**
3. **IBM SNA**

c. Applications and Services

1. **OSI Interconnection**
2. **Integrated Personal Computing**
3. **DECnet System Services**
4. **Business Communications**

d. Network Management

e. Routing

A. NETWORK CONFIGURATIONS

DECnet/OSI networks can be configured in numerous ways:

- **Extended Local and Local Area Networks**
- **Wide Area Networks**
- **Single Area Networks**
- **Multiarea Networks**
- **Multivendor Networks**

B. INTERNETWORK COMMUNICATIONS

DECnet/OSI provides internetwork communications with the Internet, X.25 PSDN and IBM SNA networking environments.

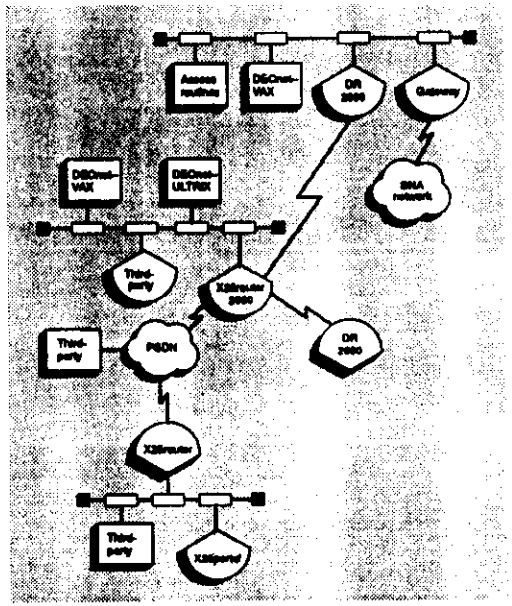
1. **Digital interoperates with Internet networks via ULTRIX, DECnet-Ultrix, Internet Portal and VMS/Ultrix Connection.**
2. **Interconnection to X.25 PSDN is performed directly (PSI) or via the Gateway products**
3. **Interoperation with IBM SNA networks is offered by the DECnet/SNA Gateway products**

B1. TCP/IP INTERNETWORKING

- ULTRIX provides the Internet communications protocol stack which includes:
  - Internet subnet routing
  - Berkley extensions (rlogin, rwho, etc)
  - Concurrent operation of DECnet/OSI and TCP/IP
  - File Transfer Protocol (FTP)
  - Virtual Terminal (TELNET)
  - Simple Mail Transfer Protocol (SMTP)
  - Network File System (NFS)
- DECnet-Ultrix Gateway provides interoperability between FTP/DAP, TELNET/CTERM and SMTP/MAILbus
- Internet Portal allows logically separated Internets to transparently communicate via a DECnet/OSI backbone
- VMS/Ultrix Connection provides the means for
  - Interoperability between VMS, ULTRIX and other UNIX systems
  - Design of Internet applications using VAX/VMS services
  - Management of Internet and NFS servers from VAX/VMS

B2. X.25 PSDN INTERNETWORKING

- DECnet/OSI allows for statically and dynamically defined circuits
- Provides remote access to X.25 PSDN through the Gateway function
- Supports CONS over X.25 directly or via a Gateway
- Supports CLNS over X.25 using the Router products



B3. IBM SNA INTERNETWORKING

Solutions range from single-function, point-to-point protocol emulation to multifunction network-to-network communications

- **VMS/SNA provides system-to-network connection**
- **DECnet/SNA Gateway for Synchronous Transport for network-to-network communications**
- **DECnet/SNA Gateway for Channel Transport, suitable for heavy traffic between the two networking environments**

Applications include:

- Gateway Management
- 3270 Terminal Emulator
- 3270 Data Stream Programming Interface
- Remote Job Entry
- Printer Emulator
- Data Transfer Facility
- DISOSS Document Exchange Facility
- Distributed Host Command Facility
- Application Programming Interface
- Advanced Program-to-Program Communication/LU6.2
- Data Access

C. APPLICATIONS AND SERVICES

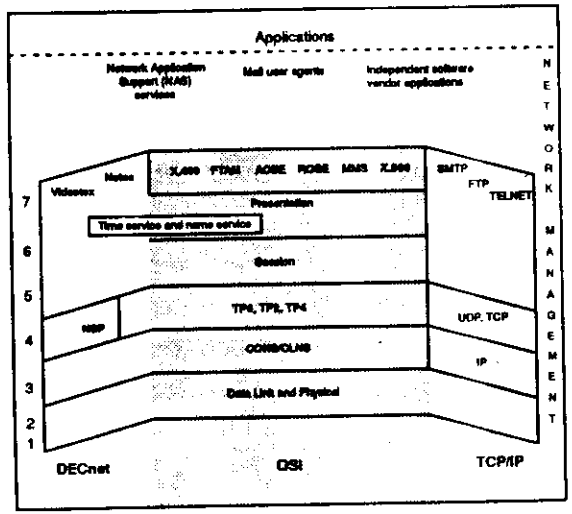
Above the Transport layer, DECNET/OSI allows for three alternative modes of access - DNA, OSI and Internet

Allows for mix-and-match to support flexibility and complexity

A variety of operating systems work together to form an integrated, multiprotocol, standards-based open networking environment

Allows for the following business application areas:

1. **Open Systems Interconnection**
2. **Integrated Personal Computing**
3. **DECnet System Services**
4. **Business Communications**



C1. OPEN SYSTEMS INTERCONNECTION PRODUCTS

Digital as part of its committement to OSI and GOSIP, is actively involved in the ISO standardisation process at all levels.

Digital's offers the following OSI products:

- VAX FTAM OSI FILE TRANSFER

  Offers flexibility by supporting several file types of ISO 8571:

  - FTAM document type 1 - unstructured files containing ASCII data having stream record formats
  - FTAM document type 2 - sequential text files with variable record formats and carriage-return attributes
  - FTAM document type 3 - unstructured files containing binary data

  VAX FTAM includes the following protocols and services:

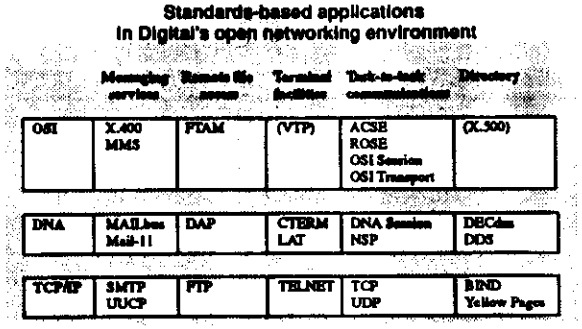
  - Application Layer - ISO 8571 (FTAM), ISO 8649 and ISO 8650 (ACSE)
  - Presentation Layer - ISO 8822 and ISO 8823
  - Session Layer - ISO 8326, ISO 8327
  - Transport Layer - ISO 8072, ISO 8073
  - Network Layer - ISO 8473 (with Addendum 1)

C1. OPEN SYSTEMS INTERCONNECTION PRODUCTS

- VAX OSI Application Kernel (OSAK) conforming to the following standards:
  - ISO 8073 CONS Transport Protocol Specification
  - ISO 8326, ISO 8327 CONS Session Protocol Specification supporting all three functional subsets
    - Basic Combined Subset (BCS)
    - Basic Synchronous Subset (BSS)
    - Basic Activity Subset (BAS)
  - ISO 8473 for CLNS Network Services
- VAX Message Router X.400 Gateway

  Provides a communications path between a Message Router -based messaging network and any other message transfer service that conforms to CCITT X.400 (1984)

  Message Router supports messages defined in the profiles produced by CEPT (A311), CEN/CENELEC (A3211) and NBS/X.400



C2. INTEGRATED PERSONAL COMPUTING

Extends the power of DECnet/OSI to leading MS/DOS, OS/2 and Macintosh Personal Computers

Provides greater functionality and better communication capabilities than those of conventional PC LANs

Merges different architectures without sacrificing the benefits of industry-standard personal computing

C3. DECNET SYSTEM SERVICES

Provide network transparency to both end users and applications - the network appears to be a single computing system for many networking functions.

- VAX Distributed Name Service (DNS)

  VAX DNS uses the client/server model

  A global, highly scalable directory system, which provides fast translation of network-wide names into values for the objects, offering the following benefits:

  - **Stores enough names to be scalable for large networks**
  - **Robust, Self-configuring, reliable and highly available**
  - **Fast so that distributed applications rely on it**
  - **Allows for distributed management**
  - **Provides security mechanisms**

- VAX Distributed Time Service (DTS)

  Provides a well-integrated means of synchronising time among distributed applications.

  Permits coordination of distributed computing functions

  - Name-service operations
  - Event-logging
  - Error recovery
  - Distributed applications

C3. DECNET SYSTEM SERVICES

- VAX Distributed File Services (DFS)
  - High-speed transparent access to files via VAX DNS
  - Access of remote files as if they were local
  - Eliminates the need for multiple copies of files
  - Ensures accuracy and integrity of data
- VAX Distributed Queuing Services (DQS)
  - Extends print queue service for distributed printers
  - Operates according to the client-server model
  - Supports both printer sharing and report distribution
- VAX Remote System Manager (RSM)

  Provides system management for distributed computing

  In particular, a VAX RSM server automates the recurring system management tasks of:
  - Operating system installation
  - Software distribution
  - File backup and restore
  - System administration

C4. BUSINESS COMMUNICATIONS

Business Communications include the following:

- VIDEOTEX
  - For building large infobases - full-screen pages of information- that can be easily accessed by end users
  - Can combine text and graphics allowing the distribution of time-critical information to a wide audience
  - Eliminates printing and related costs
  - Helps preventing the use of outdated material
  - The VAX VTX facility is compliant with CCITT F.300
- ELECTRONIC CONFERENCING

  Electronic conferencing allows remotely located end users to create, access and discuss topics of mutual interest on line.

  VAX Notes can be used in a variety of ways :
  - Electronic bulletin board
  - Collaborative documentation for authoring and reviewing
  - Internal seminars
  - Provision of expertise to groups that lack resources
  - For conferences, helping individuals to form virtual workgroups

C4. BUSINESS COMMUNICATIONS

- VOICE RESPONSE SYSTEMS

  Enable callers to use the telephone apparatus for retrieving and/or entering information into computing systems

  DECvoice incorporates speech synthesis, digitised voice and voice recognition within a single integrated system

  It allows for over-the-telephone transaction processing and access to information services

- COMPUTER INTEGRATED TELEPHONY

  Integrates the features of the telephone and telephone switching with the data processing capabilities of computing systems

  The integration of voice and data provide numerous benefits

  - Telemarketing
  - Credit card verification
  - Telephone answering service
  - Dispatch/order entry

C4. BUSINESS COMMUNICATIONS

- ELECTRONIC MAIL

  Diffrent electronic mail applications within the enterprise are integrated into one manageable entity that enables end users to exchange mail and messages

  Based on the CCITT X.400 recommendations for MHS

  MAILbus components include User Agents, a Message Transfer Services and gateways to non-Digital mail applications.

  - VAX Message Router/S Gateway to IBM DISOSS/SNADS
  - VAX Message Router/P Gateway to IBM PROFS
  - VAX Message Router X.400 Gateway for X.400 mail
  - VAX Message Router/P Gateway to Public Telex network

- ELECTRONIC DATA INTERCHANGE

  Allows for computer-to-computer exchange of structured business documents between the enterprise and its suppliers, customers and other trading partners.

  Supports EDIFACT, ANSI X12, ODETTE, CEFIC, EDIFICE, etc.

  DEC/EDI offers multi-VAN and direct communications via

  - Application interface - the link to business applications
  - Translation - converts transactions into EDI messages
  - Communications - Exchanges EDI messages
  - Management - of the EDI environment

D. DECNET/OSI FEATURES

- Integration of International and Industry Standards
  - Inter- and Intra-enterprise communications
  - Multivendor networking
  - Reduced complexity
  - Global Addressing
- OSI extended across computing system platforms
  - VAX/VMS, RISC/Ultrix
  - MS/DOS, OS/2
  - OSF and Macintosh
- New Technologies
  - High performance WAN communications
  - FDDI
  - ISDN

DECNET/OSI FEATURES

- Backwards Compatibility
  - DECnet phase IV
  - Non-OSI environments
  - Transition products (portals and gateways)
  - Investment protection in installed environments
- OSI Network Management
  - Foundation of increased functionality
  - Five areas: configuration, fault, performance, security and accounting
- Scaling and Growth
  - Extension of the DECnet IV model
  - Same model regardles of network size
  - Emcompasses future growth requirements

DECNET/OSI FEATURES

- End node Address Autoconfiguration
  - Easier installation
  - Improved name change management
  - Network topological changes transparent to applications
  - Reduced local naming database requirements
- Network-wide name space
  - Connections by application name rather than by node
  - Applications isolated from location change
  - Avoidance of single point of failure
  - Provision of High availability and reliability
- New routing technology
  - Interdomain routing
  - Link state algorithm
  - Congestion avoidance

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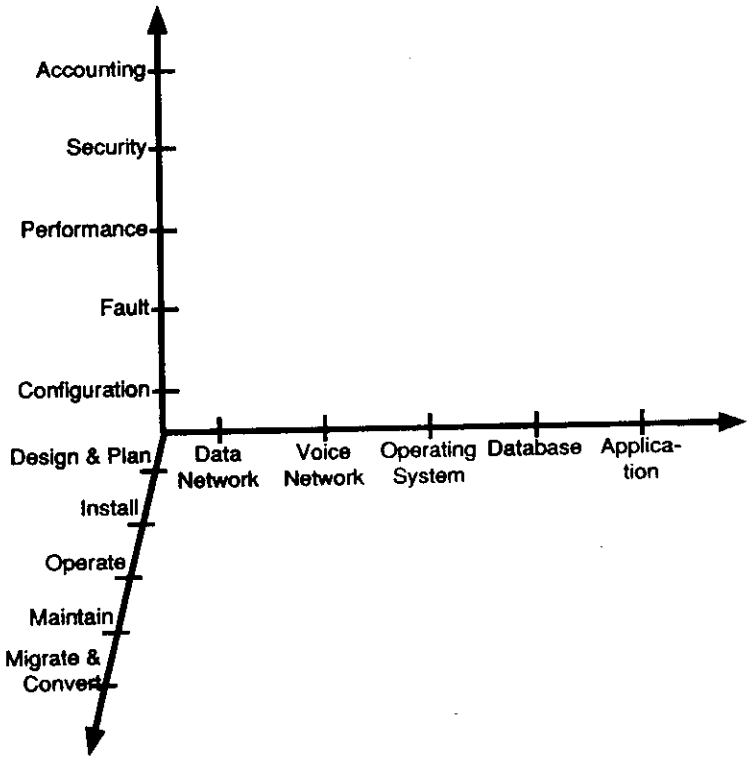
The 3D Management Problem Space



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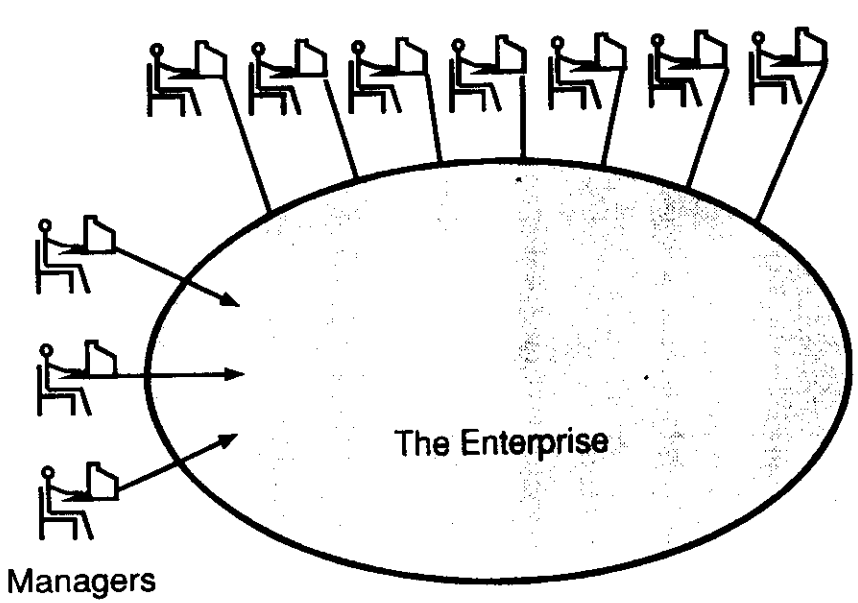
Enterprise Management



The Enterprise exists **only** to provide a service to its user's. Managers are those people responsible for ensuring that the Enterprise meets the user's needs.

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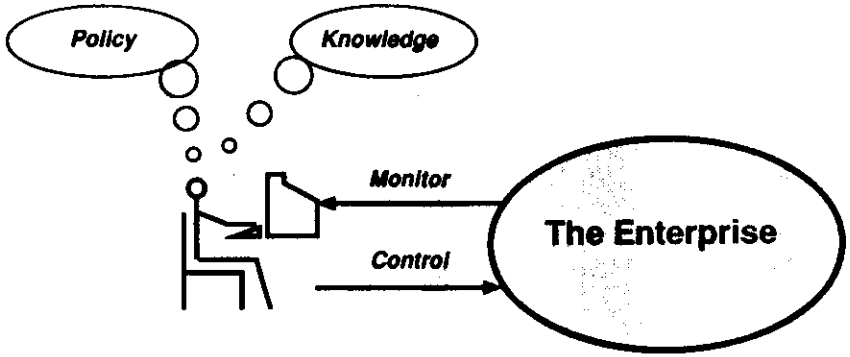
Control/Feedback Loop



1. Managers monitor what's going on in the Enterprise.
2. Managers decide what should be done about it based on:
   a. Knowledge - an understanding of how the enterprise really works.
   b. Policies - statements of goals about what sort of service the enterprise gives its users.
3. Managers control the Enterprise to make it better serve those goals.

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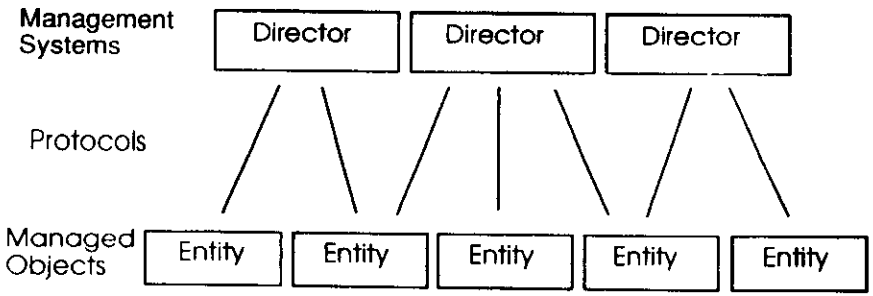
Director/Entity Concept

- EMA Framework specifies models for:
  --Directors (management systems)
  --Entities (managed objects)
- EMA Framework allows for:
  --Many Directors (management systems)
  --Many Entities (managed objects)
  --Many Directors managing the same Entities
  --Individual Directors managing many Entities



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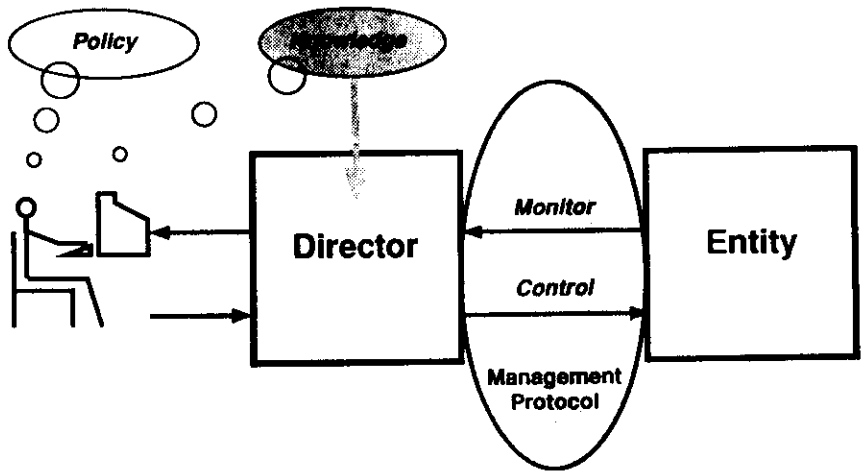
The Director Entity split



Directors can manage **remote** entities by using a well defined Management Protocol.

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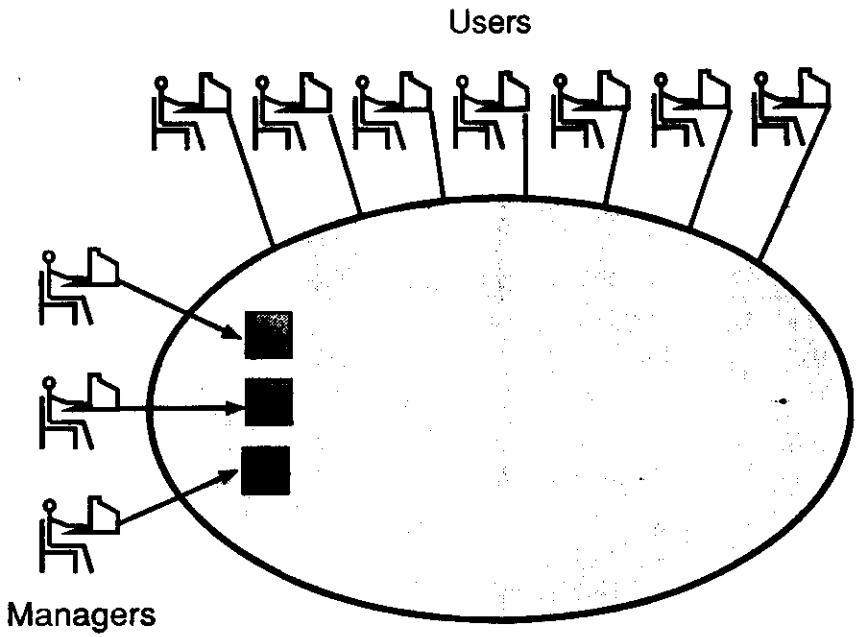
Directors



Directors are software systems used by managers to manage the enterprise.

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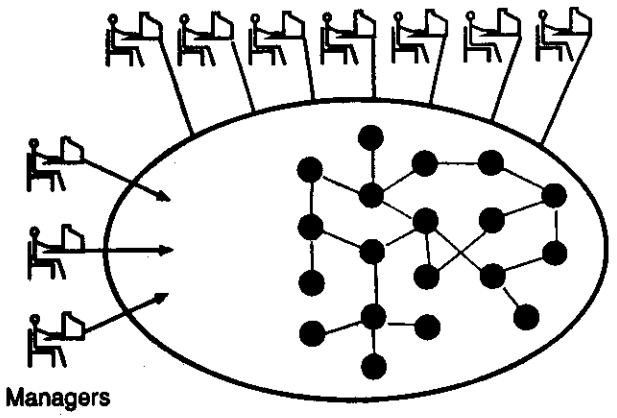
Entities



Entities include:

- Physical Network Components
- Logical Network Components
- Computer Systems
- Applications
- Databases

All put together.

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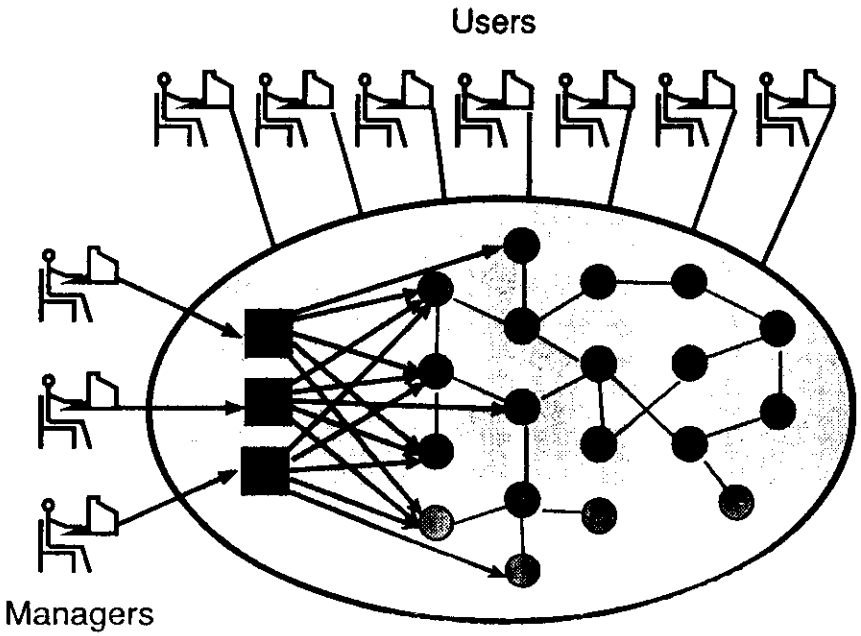
Anything from Anywhere

- Directors can manage lots of entities
- Entities can be managed by lots of directors



- But, You can't talk to everything!
- *Everything* in an enterprise is too **big** for one manager or one director!

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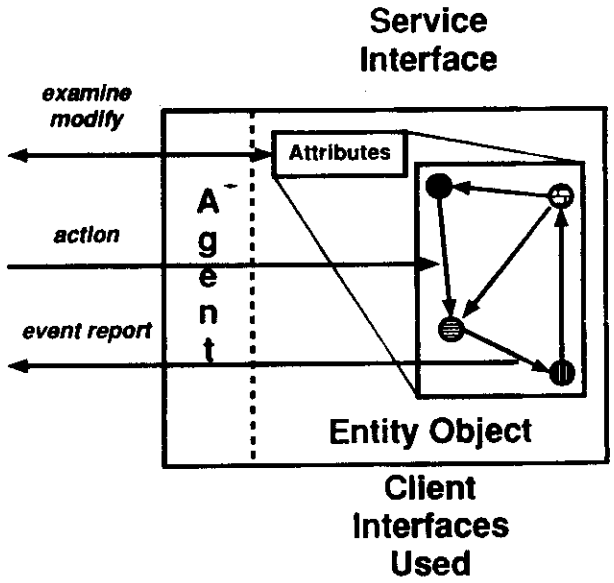
An Entity

- Is an individual manageable object (component) of the enterprise.
- Has a name.
- Has a collection of properties that define what a manager can monitor and control.
- Behaves in a specified manner, determined by its architectural specification.



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Structure of an EMA Director

- An EMA Director contains:

  -Executive
  --provides an environment for components to exist and inter-operate

  -Management Information Repository
  --provides structure and storage of management information

  -Management Modules
  --the components that provide the management capabilities of the Director.

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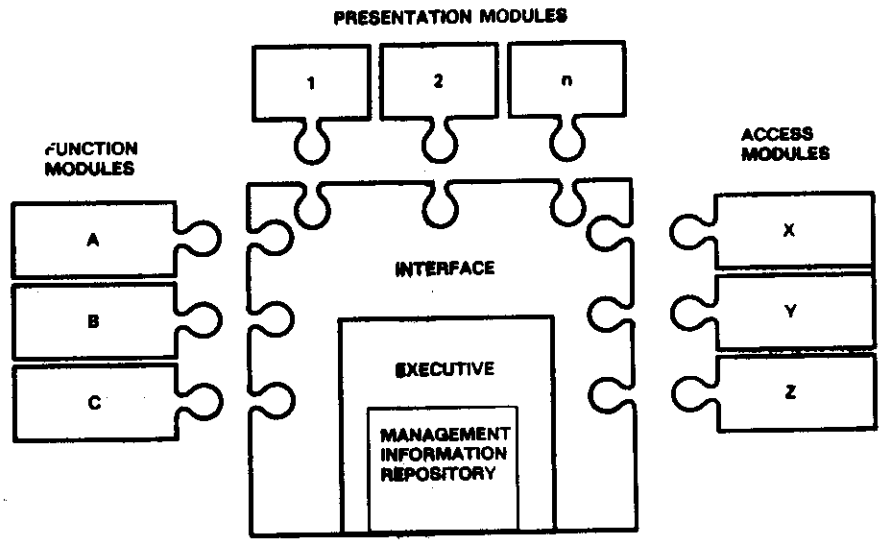
Enterprise Management Architecture



Management Modules

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EMA's Implementation of Director/Entity Concept

- Communication between Directors and Entities:
  --Does not have to adhere to the EMA Entity Model (e.g. existing devices)
  --Can use any management access protocol
  --Includes, but not limited to:
  --CMIP (OSI management protocol)
  --SNMP (TCP management protocol
  --Manage any Entity which can be managed remotely
- Two way communication (Control and Monitoring)
- DECnet/OSI Phase V management adheres to Director/Entity concept

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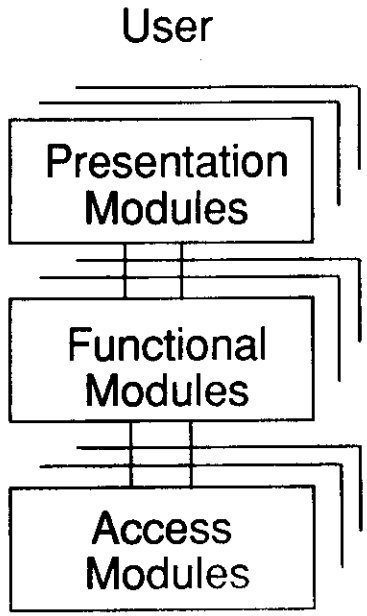
Layering of Management Modules



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Layering of Management Modules

- Management Modules are grouped by layer:

  --Access Modules
  --provide access path to, and specific management information about, specific classes of entities
  --Functional Modules
  --provide higher-level, added value management functions
  --Presentation Modules
  --provide presentation services to users on behalf of AMs and FM's
  --and an interface to other non-EMA directors and applications.

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Presentation Modules

- Provides presentation (e.g. user- interface) services for the management capabilities, independent of Functions and Entities
- Provides flexibility in input/output of management information
- Allows multiple user interfaces (graphics, icons, menus, command line)
- Allows multiple presentation devices (workstations, character cell terminals)
- Also provides a point of entry in the Director for non-EMA Directors and applications.

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Functional Modules

- Addresses user-visible portion of management applications, independent of Entities and Presentation
- Provides value-added management functions
- Functional modules may use each other's services to provide more sophisticated management capabilities
- Aligned with ISO/OSI management functional areas:
  --Configuration
  --Fault
  --Performance
  --Accounting
  --Security

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Access Modules

- Provides programmable pathway to entity, independent of Functions and Presentation
- Provides access to the primitive management operations for the entity
- Provides specific management information about the entity class
- Implements appropriate management access protocol
- Provides a consistent view of the entity to other management modules
- Hides any unusual characteristics of the entity

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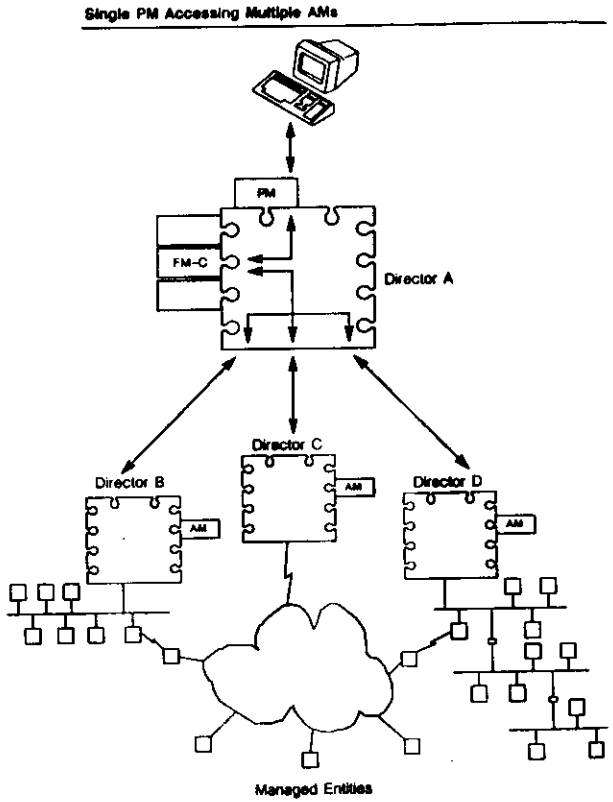
Enterprise Management Architecture



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