Networking Standards
Mark Davies, Digital Equipment Corporation

ABSTRACT

The enterprise network is currently a multivendor environment consisting of many defacto and proprietary standards. During the 1990s, these networks will evolve towards networks which are based on international standards in both the LAN and WAN space. Also, you can expect to see the higher level functions and applications begin the same transition.
The Open Network Advantage
Market Requirements

OPEN NETWORKS!!!

- Multi-protocol, multi-platform, multi-vendor networks working together
- International AND defacto standards
- Effortless communications within and between enterprises
- Ability to move to standards at own pace
What is an Open System?

Defined as:

A vendor-neutral computing environment:

- compliant with International and defacto standards
- permits system and network interoperability or software applications portability
- includes consistency of data and human access
- satisfies one or more of a business’s functional requirements
Standards

Benefits from networks based on international and defacto standards

- Vendor independence
- Applications portability
- Investment protection
- Improved communications leading to increased productivity
- Network flexibility
Network Architectures:
DECnet, OSI, TCP/IP

**DECnet**
- Application
- DNA Session Control
- Transport (NSP)
- Network (CLNS)
- Data Link
- Physical

**OSI**
- Application
- Presentation
- Session
- Transport (TP 0,2,4)
- Network (CLNS/CONS)
- Data Link
- Physical

**IP**
- Internet Applications Protocols
- Transport (TCP / UDP)
- Network (IP)
- Data Link
- Physical
What is TCP/IP?

- a.k.a. ----> The Internet Protocol Suite
- In use since late 1970s
- Developed for Advanced Research Project Agency Network (ARPANET)
- Used to allow interaction of many private ARPA subnetworks in government and research
- Inclusion with Berkeley UNIX encouraged rapid growth
- Growth of UNIX-based workstations and multivendor networking, in lieu of OSI, insures a long life for TCP/IP
The Internet Protocols

- Physical/Datalink (Ethernet, X.25)

- Network Layer
  -- Internet Protocol (IP)
  -- Internet Control Message Protocol (ICMP)
  -- Address Resolution Protocol (ARP)
  -- Internet Gateway

- Transport Layer
  -- Transmission Control Protocol (TCP)
  -- User Datagram Protocol (UDP)

- Applications Layer
  -- Simple Mail Transfer Protocol (SMTP)
  -- File Transfer Protocol (FTP)
  -- Virtual Terminal (TELNET)
  -- Network File System (NFS)
<table>
<thead>
<tr>
<th>Layer</th>
<th>FTP</th>
<th>telnet</th>
<th>SMTP</th>
<th>r-Commands</th>
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<tr>
<td>7 - Application</td>
<td>FTP</td>
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<td>6 - Presentation</td>
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<td>XDR</td>
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<td>3 - Network</td>
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<td>2 - Data Link</td>
<td>Ethernet / Point-to-Point</td>
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<tr>
<td>1 - Physical</td>
<td>Ethernet / Point-to-Point</td>
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What is OSI?

- Emerging technology
- a.k.a. --- Open Systems Interconnection
- A layered network architecture based on a seven-layer model
- Developed by the International Organization for Standardization (ISO)
- OSI defines the standards for communications between open systems on a global scale
- Supported by governments and major computer vendors (Digital, IBM, HP, Sun, UNISYS, Siemans, etc)
- Required by Government OSI Profiles (GOSIP)
- Foundation for global addressing and new distributed applications (EDI)
GOSIP in the Open Systems Environment

Elements of a standards based "Open System":

### APPLICATION SOFTWARE

1. Operating System Services
2. User Interface Services
3. Program Services
4. Data Management Services
5. Data Interchange Services
6. Graphics Services
7. Network Services

### APPLICATION PLATFORM

1. POSIX.1, POSIX.2, GNMP, POSIX.6
2. FIPS 158 - X Window System
3. Ada, C, COBOL, FORTRAN, PASCAL, PCTE+, SCCS
4. IRDS (Data Dict/Dir Component), SQL, RDA
5. ODA/ODIF, SGML, CGM, IGES, STEP
6. GKS, PHIGS
7. FIPS 146 - GOSIP
U.S. GOSIP STANDARDS BASED APPLICATIONS

SERVICES OFFERED:

CORPORATE MESSAGING
FILE TRANSFER
VIRTUAL TERMINALS
USER INTERFACES
DIRECTORY SERVICES
TRANSACTION PROCESSING
REMOTE PROCEDURE CALLS
APPLICATION PORTABILITY
INTER-NETWORK
LOCAL AREA NETWORK
OFFICE AUTOMATION
CIM

STANDARDS:

X.400/EDI
FTAM
VTP
X WINDOWS/MOTIF
X.500
ISO TP
RPC
X/OPEN
ISO IS - IS (DP 10584)
ISO ES - IS (ISO 9542)
ISO 8802
ODA/ODIF
MMS/MAP
U.S. GOSIP Standards Based System Elements

<table>
<thead>
<tr>
<th>Layer</th>
<th>Standards/Protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APPLICATION LAYER</strong></td>
<td>MHS X.400, FTAM ISO 8571, ODA ISO 9041, VTP ANSI X.12, EDI MHS X.500 ISO 9594</td>
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<tr>
<td><strong>PRESENTATION LAYER</strong></td>
<td>ISO 8823</td>
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<td><strong>SESSION LAYER</strong></td>
<td>ISO 8327</td>
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<tr>
<td><strong>TRANSPORT LAYER</strong></td>
<td>TRANSPORT CLASS 4: ISO 8073, TRANSPORT CLASS 0: ISO 8073, CONNECTIONLESS ISO 8602</td>
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<tr>
<td><strong>DATA LINK LAYER</strong></td>
<td>802.2, LLC TYPE 1 CLASS 1 ISO 8802/2, HDLC LAPB ISO 7776, ISDN LAPD Q.921</td>
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<tr>
<td><strong>PHYSICAL LAYER</strong></td>
<td>802.3, RS-232 V.35 ISDN FDDI</td>
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</tbody>
</table>
U.S. GOSIP Version 1.0

Requirements Summary:

- Issued January 1989 as FIPS-146
- Mandatory in RFPs as of August 1990
- FTAM- Phase 2
  - Limited Purpose
    T1 Simple File Transfer
    M1 Management
  - Full Purpose
    T2 Positional File Access
    A1 Simple File Access
    M1 Management
- Initiator/responder, Sender/Receiver
- Transport Protocol Class, Connectionless Network Service
- MHS
  - CCITT X.400 MHS 1984
  - P1, P2
  - TP 0, CONS, X.25 or TP4, CLNS
U.S. GOSIP Version 2.0

Requirements Summary:

- Issued March 1991 Revision to FIPS 146
- Mandatory in RFPs as of October 1992
- FTAM Phase 2
  - Full Purpose
    T1,T2 Simple, Positional File Access
    A1 Simple File Access
    M1 Management
    FTAM 1,2,3 Document Types
    Initiator/Responder, Sender/Receiver
- VTP
  - Telnet
  - Forms (optional)
  - TP4, CLNS
- MHS
  - CCITT X.400 MHS 1984
  - P1,P2
  - TP 0, CONS, X.25 or TP4, CLNS
- Office Document Architecture
## OSI Model

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<th>OSI Model</th>
<th>Internet</th>
<th>DECnet</th>
<th>OSI</th>
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<tr>
<td>Application</td>
<td>FTP</td>
<td>DAP</td>
<td>FTAM</td>
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<td>TELNET</td>
<td>CTERM</td>
<td>VTP</td>
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<td>MAIL11</td>
<td>X.400</td>
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<td>Presentation</td>
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<td>NSP</td>
<td>TP4</td>
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<td>TP0, CLTS</td>
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<tr>
<td>Session</td>
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<tr>
<td>Transport</td>
<td>IP</td>
<td>Routing</td>
<td>CLNP, IP</td>
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<td>ICMP, ARP</td>
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<td>ESIS</td>
</tr>
<tr>
<td>Network</td>
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Coexistence and Transition Techniques

Protocol Based:
- Dual Stacks
- Hybrid Stacks
- Transport Gateway
- Applications Gateways
- Transport Layer Interfaces
- Multi-Protocol Routers

Service Based:
- Transport Service Bridge
- Portals or Tunnels
FDDI and OTHER LAN STANDARDS

IEEE 802.1

IEEE 802.2 LLC
Logical Link Control

DATA LINK LAYER

MAC

IEEE 802.3
CSMA/CD

PHY

IEEE 802.4
TOKEN BUS

SMT

IEEE 802.5
TOKEN RING

PMD

FDDI
Estimated time frames for commercial introduction of new public network services
What is DECnet / OSI Phase V?
Next Generation Networking Environment for the 1990s

Based on 15 years of DECnet experience in peer to peer networking

One framework for Small to Large Heterogeneous Networks

Set of Common Network Services and Applications across Digital and industry standard operating environments

Base for Key Layered Services
What is Digital Doing?

- Integration
- Products
digital™

Integration

- Provide coexistence of standard and proprietary protocols
- Provide transparency of OSI and TCP/IP network to the user
- Expand network address size in anticipation of global OSI networks
- Enhance network management capabilities based on network management standards
DECnet / OSI Phase V
Foundation for Network Application Support

OSI SYSTEMS
VAX SYSTEMS
RISC SYSTEMS

Network Application Support

DECnet / OSI Phase V

VMS
UNIX
MS-DOS
OS/2
MAC
Terminals

IBM
Other OSI vendors
### DECnet / OSI: Foundation for Network Application Services

**Services offered:**
- Windowing Services
- Messaging Services
- Data Access Services
- Terminal Services
- Directory Services
- Office Automation
- Forms
- Transaction Processing
- SNA Connectivity

**Products:**
- DECwindows, X Windows / Motif
- MAILbus™ Family, EDI, X.400
- SQL/Services, RDB, DBMS, VIDA for DB2, FTAM
- LAT, TELNET, CTERM, VTP
- DECdns, X.500
- All-IN-1™ Phase II, CDA VAX Notes, VTX
- DECforms
- DECtp
- DECnet/SNA Products
Open Systems Networking

- VMS (TCP & OSI)
- Vendor X TCP
- ULTRIX (TCP & OSI)
- PC LAN (TCP or OSI)
- MP Router
- APPL GWY
- Vendor Y OSI
- DECnet/OSI Subnet
- Open Systems Backbone (OSI and TCP/IP)
- TCP/IP Subnet
- VMS (TCP & OSI)
- MP Router
- ULTRIX (TCP & OSI)
- PC LAN (TCP or OSI)
- Vendor X OSI
- Vendor Y TCP
- APPL GWY