Chapter 1

Data Communications and Network Management Overview

Telephone Network

- Modern network evolution from Telephone / Telecommunications Network

- Characteristics of Telephone network
    - Reliable - does what is expected of it
    - Dependable - always there when you need it (remember 911?)
    - Good quality (connection) - hearing each other well

- Reasons for QoS:
    - Good planning, design, and implementation
    - Good operation and management of network
    - Migration to new technologies –
        - e.g., From analog to digital technology

Telephone Network Model

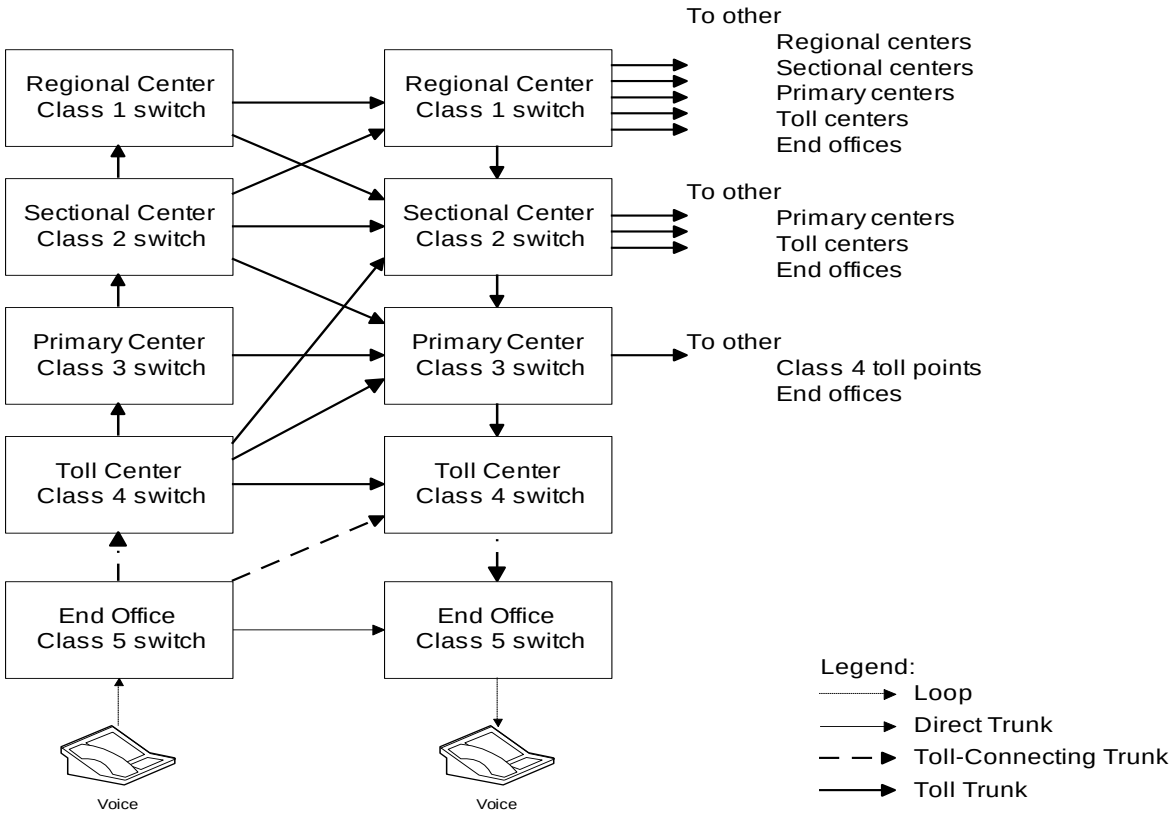


Figure 1.1 Telephone Network Model

OSSs / NOC

- Operations Support Systems (OSSs) help manage the operation of networks
- OSSs in telecommunications monitor:
    - Analog network parameters:
        - S/N ratio, transmission loss, call blockage, etc.
    - Digital network parameters:
        - Packet loss, Packet delay, Throughput, QoS, etc.
- Real-time management of network
- Trunk (logical entity between switches / nodes) maintenance system measures loss and S/N Trunks not meeting QoS removed before customer notices poor quality
- Traffic measurement systems measure call drops and blockage. Additional switches or routers planned to keep the call blockage or drops below acceptable level
- OSSs distributed at central offices and customer premises
- Network management done centrally from Network Operations Center (NOC)

Data and Telecommunication Network

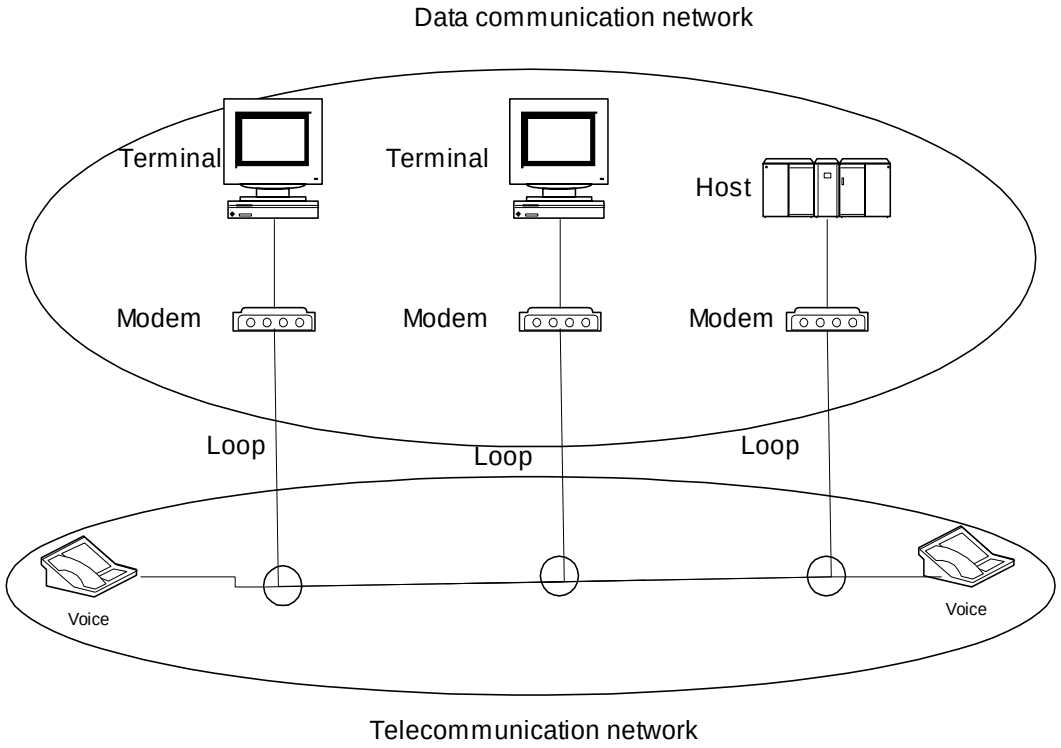


Figure 1.3 Data and Telecommunication Networks

Migration to Digital Technology

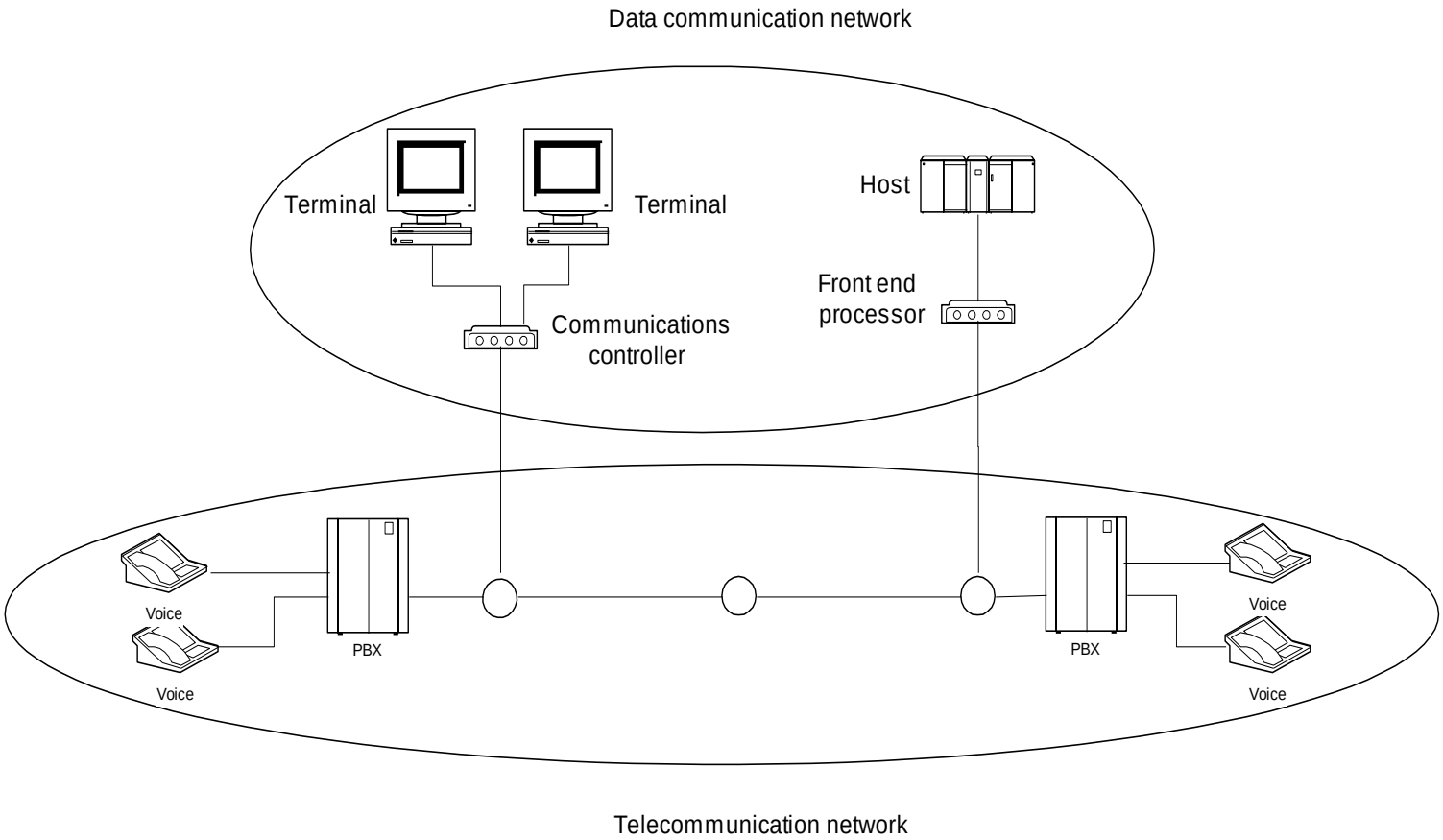
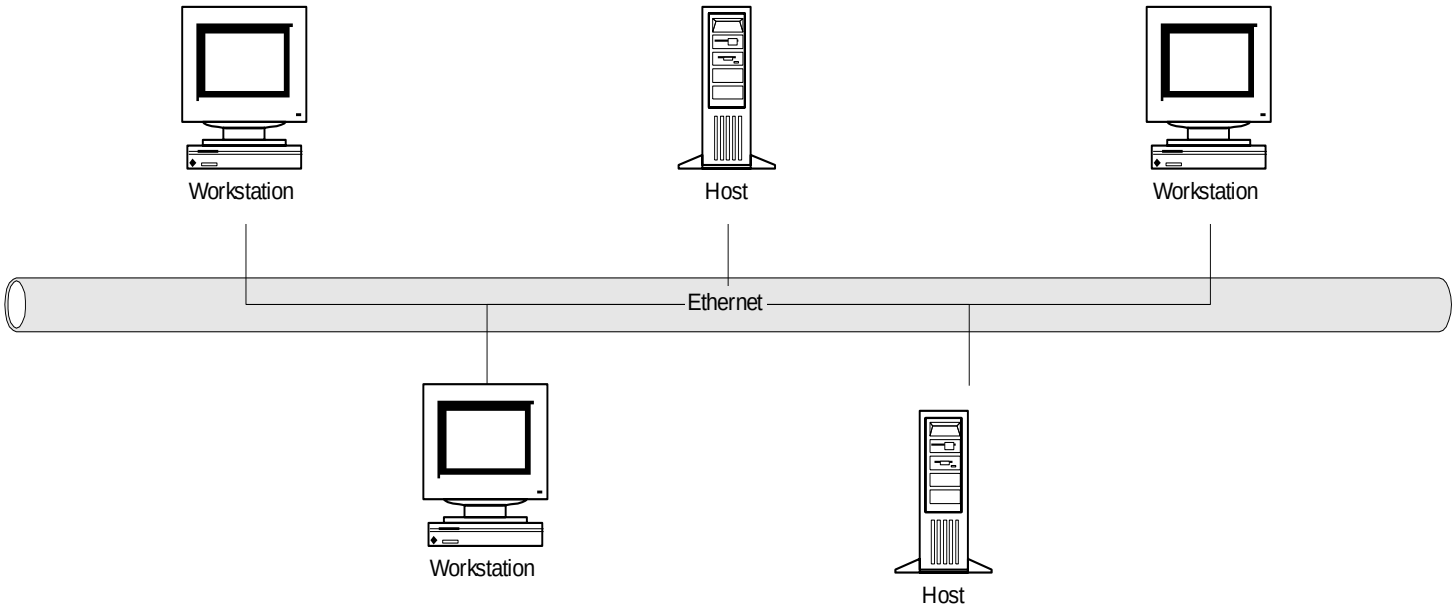


Figure 1.4 Digital Data and Telecommunication Networks

DCE with LAN

DCE.. Distributed Computing Environment



Fgure 1.5(a) Hosts and Workstations on Local LAN

LAN-WAN Network

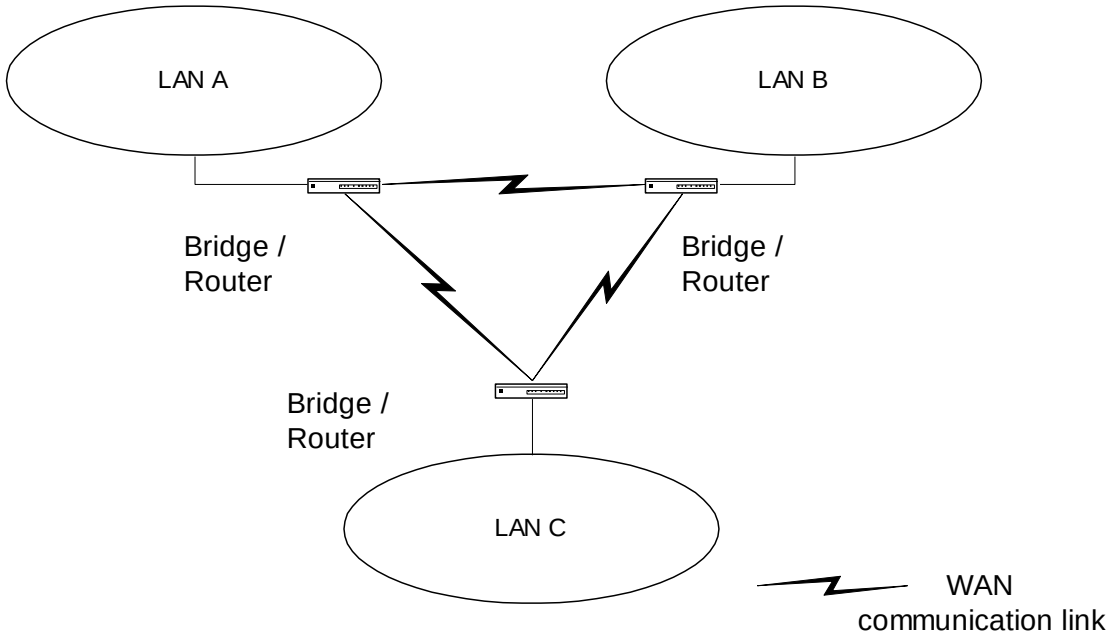


Figure 1.5(b) Remote LANs Interconnected by WAN

Client/Server Model

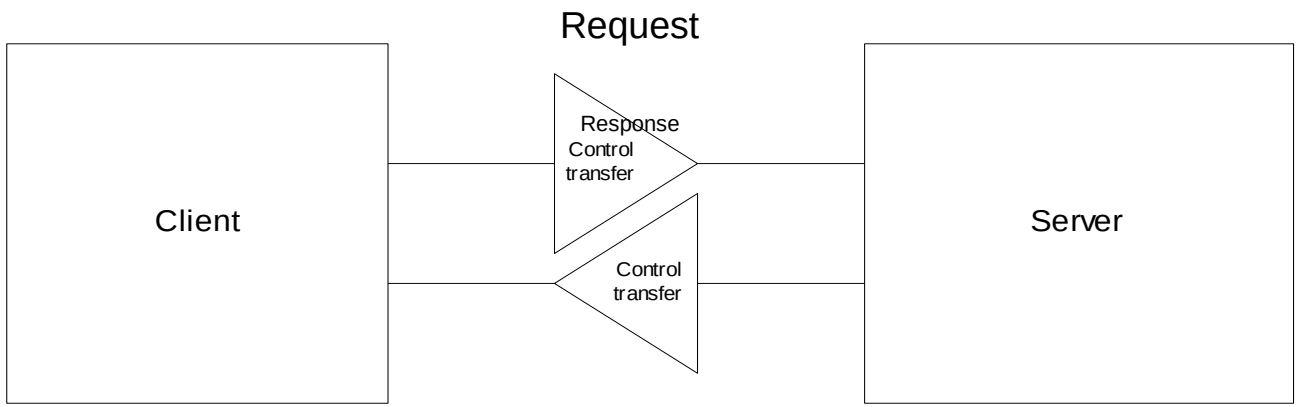


Figure 1.6 Simple Client-Server Model

Client/Server Examples

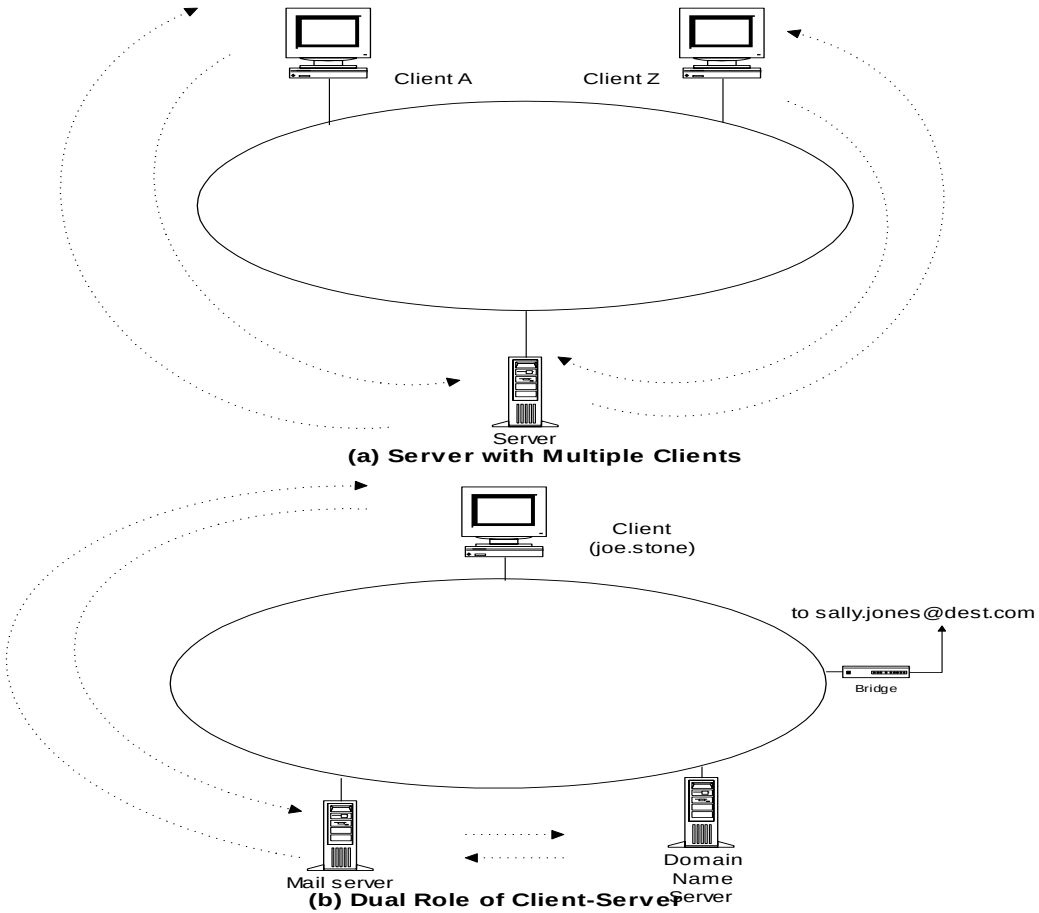


Figure 1.7 Client-Server in Distributed Computing Environment

TCP/IP Based Networks

- TCP/IP is a suite of protocols
- Internet is based on TCP/IP
- IP is Internet protocol at the network layer level
- TCP is connection-oriented transport protocol and ensures end-to-end connection
- UDP is connectionless transport protocol and provides datagram service
- Network mgmt. messages are based on UDP/IP
- ICMP part of TCP/IP suite

Internet Configuration

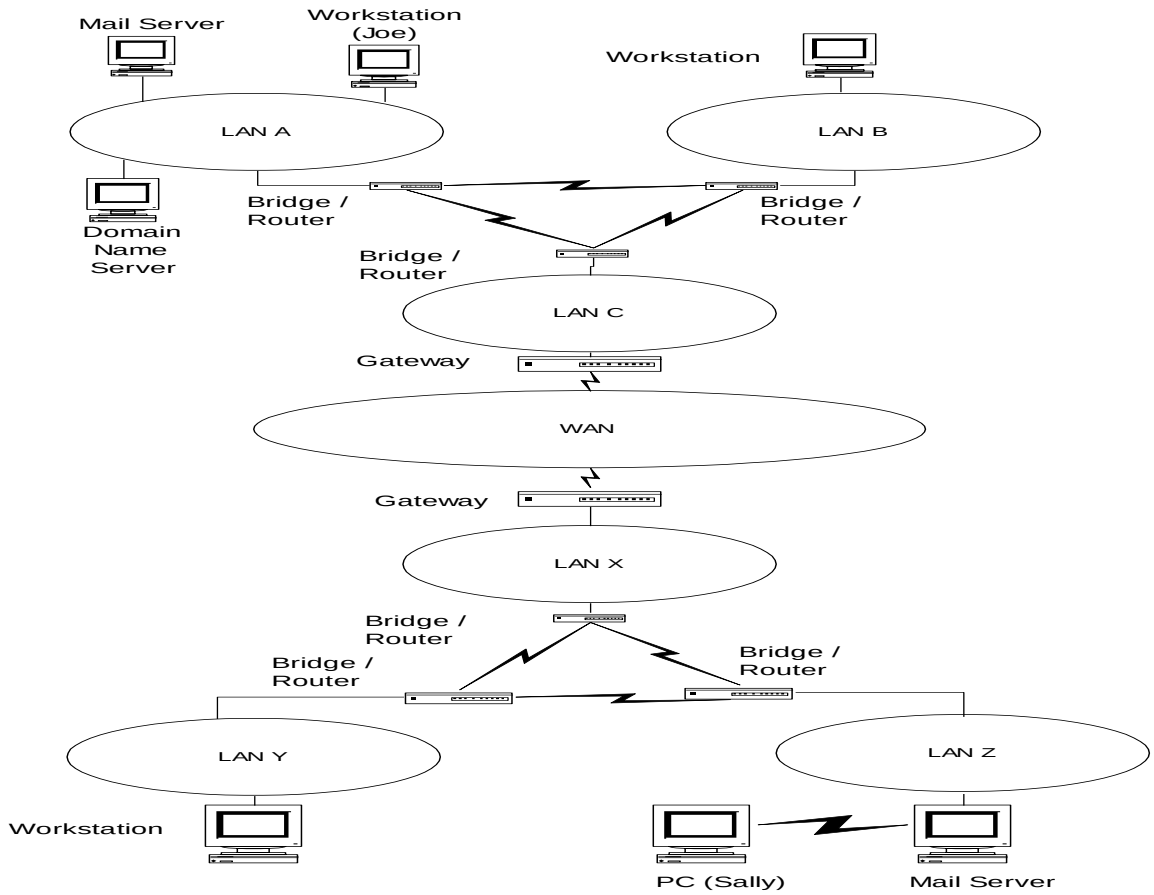


Figure 1.8 Internet Configuration

Architecture, Protocols and Standards

- Communication architecture
    - Modeling of communication systems, comprising
        - Functional components
        - Operations interfaces between them
- Communication protocols
    - Operational procedures
        - Intra- and inter-modules
- Communication standards
    - Agreement between manufacturers on protocols of communication equipment on
        - Physical characteristics
        - Operational procedures

Communication Architecture

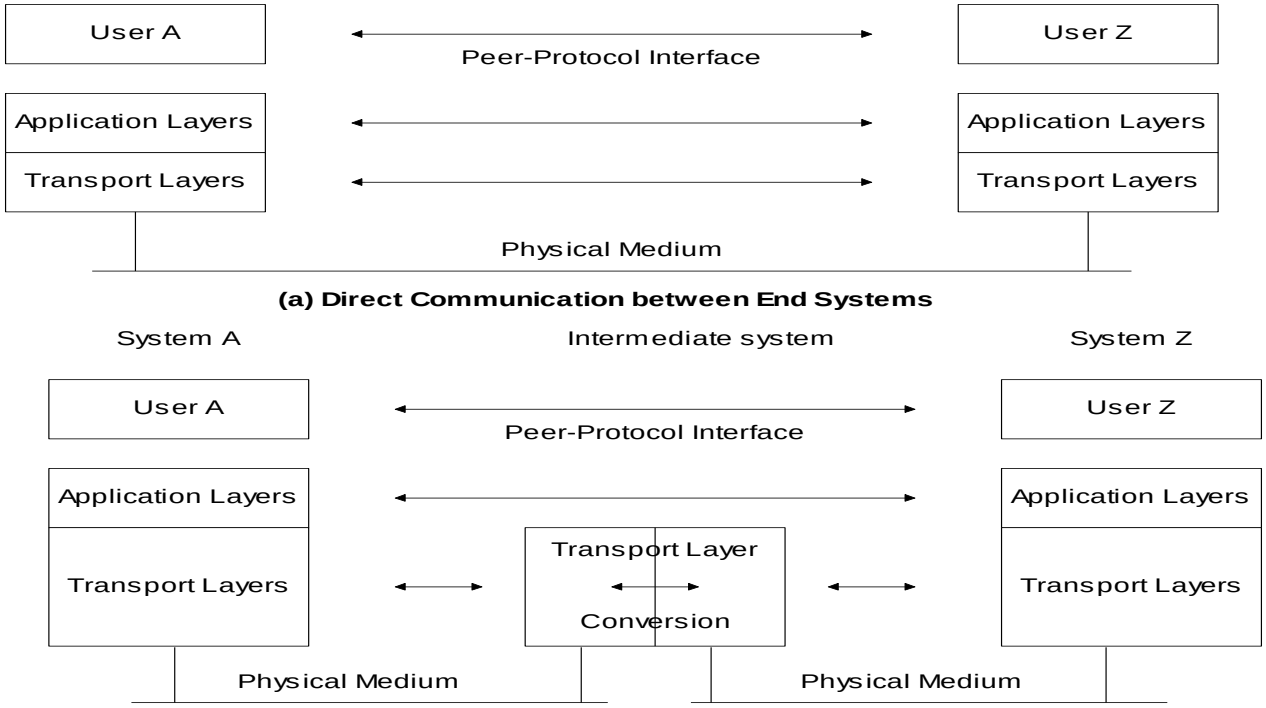


Figure 1.10 Basic Communication Architecture

OSI Reference Model

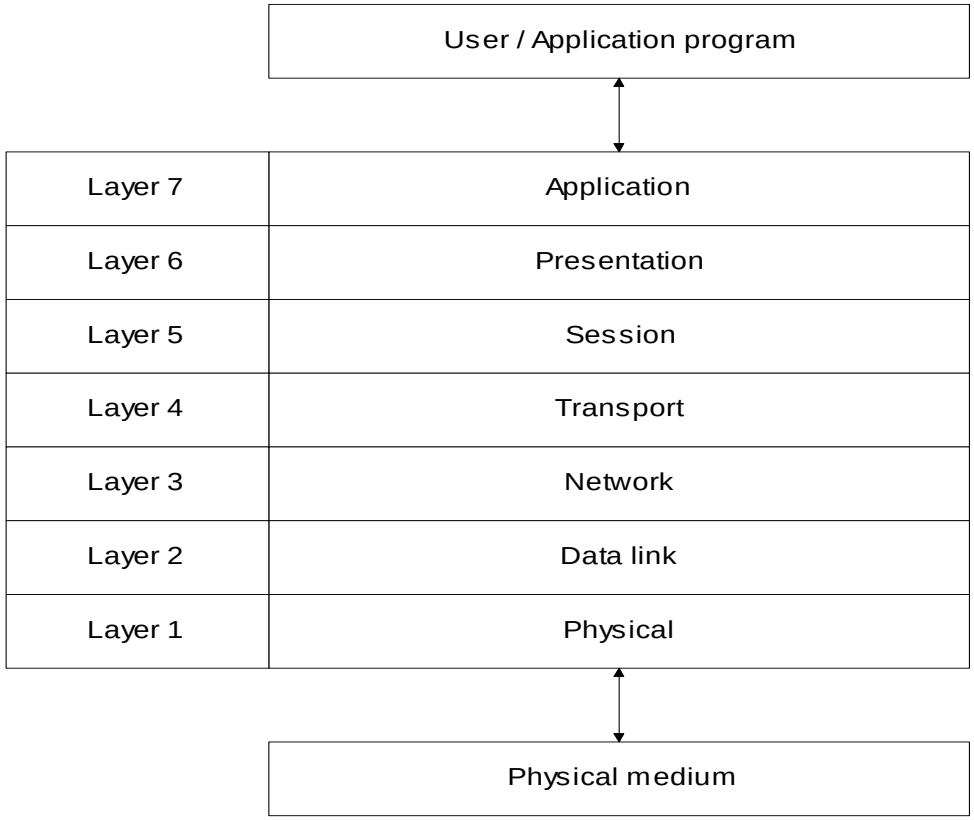


Figure 1.11 OSI Protocol Layers

OSI Layers and Services

Layer No.	Layer Name	Salient services provided by the layer
1	Physical	-Transfers to and gathers from the physical medium raw bit data -Handles physical and electrical interfaces to the transmission medium
2	Data link	-Consists of two sublayers: Logical link control (LLC) and Media access control (MAC) -LLC: Formats the data to go on the medium; performs error control and flow control -MAC: Controls data transfer to and from LAN; resolves conflicts with other data on LAN
3	Network	Forms the switching / routing layer of the network
4	Transport	-Multiplexing and de-multiplexing of messages from applications -Acts as a transparent layer to applications and thus isolates them from the transport system layers -Makes and breaks connections for connection-oriented communications -Flow control of data in both directions
5	Session	-Establishes and clears sessions for applications, and thus minimizes loss of data during large data exchange
6	Presentation	-Provides a set of standard protocols so that the display would be transparent to syntax of the application -Data encryption and decryption
7	Application	-Provides application specific protocols for each specific application and each specific transport protocol system

PDU Communication Model

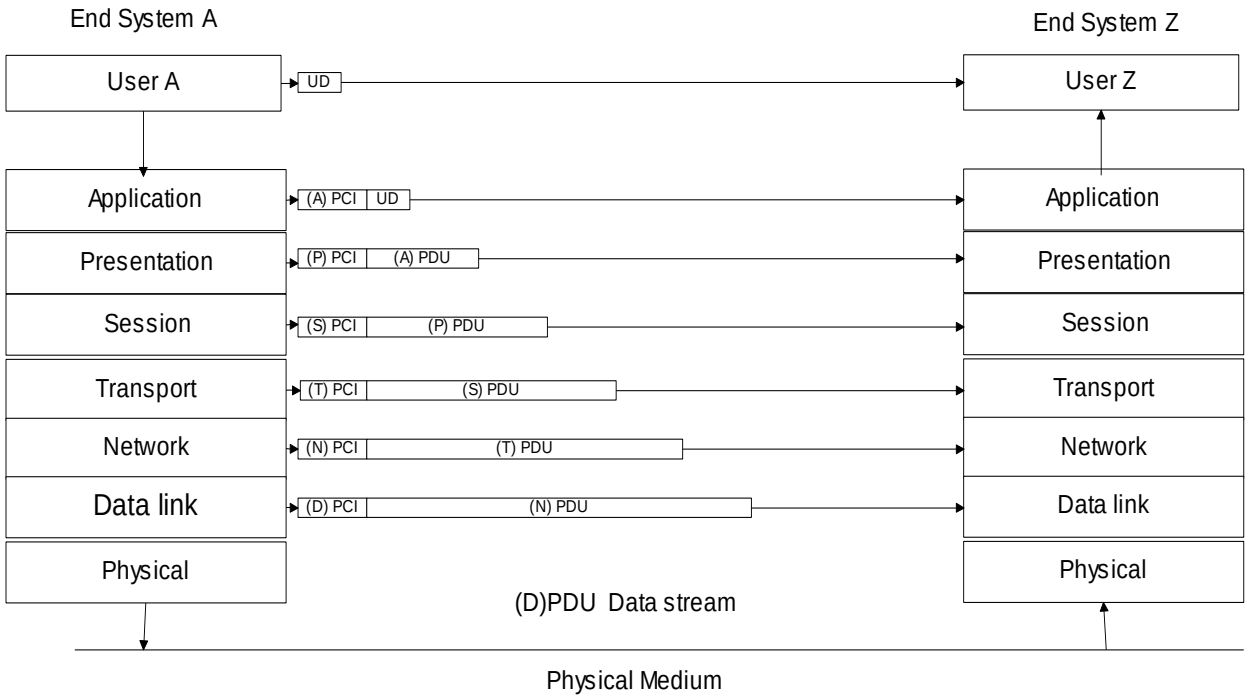


Figure 1.13 PDU Communication Model between End Systems

Gateway

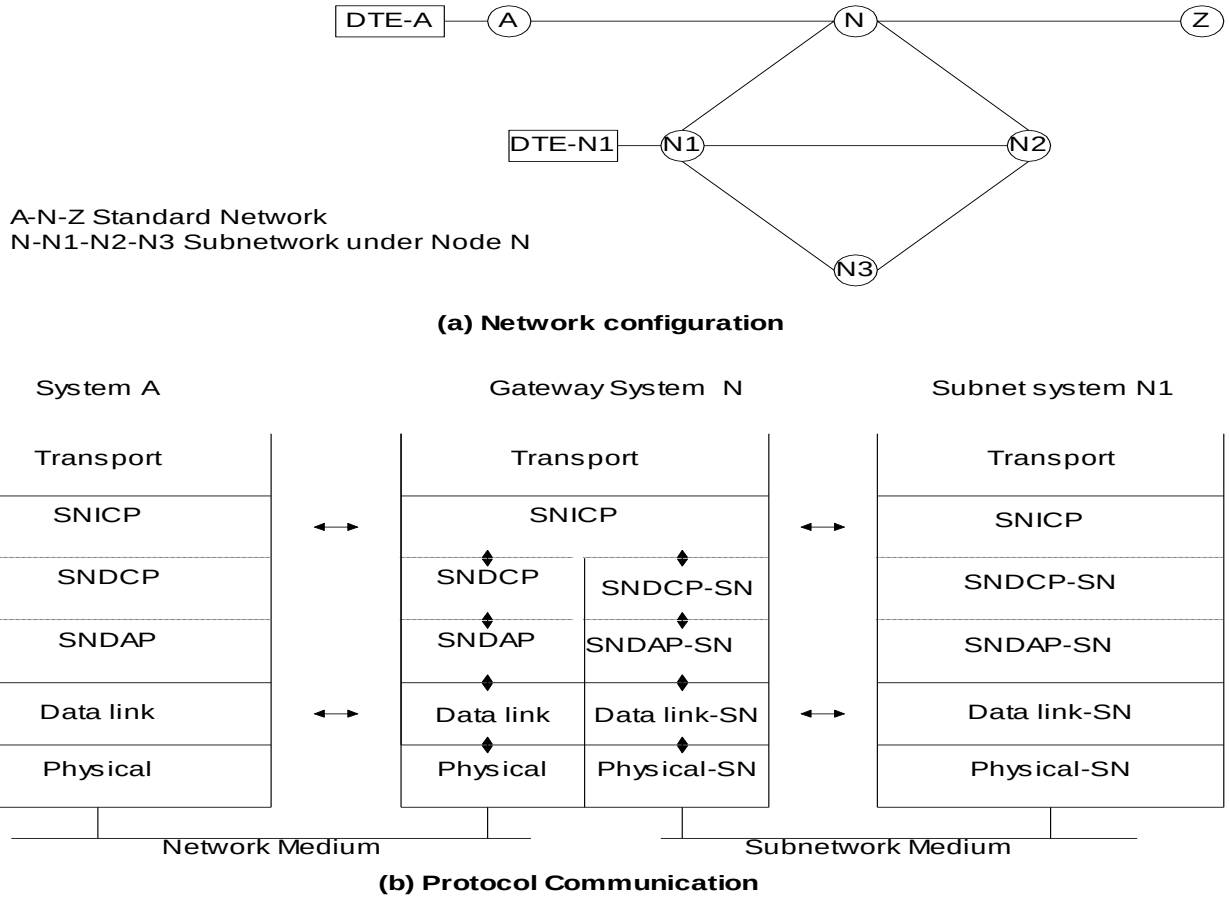


Figure 1.16 Gateway Communication to Private Subnetwork

OSI and Internet

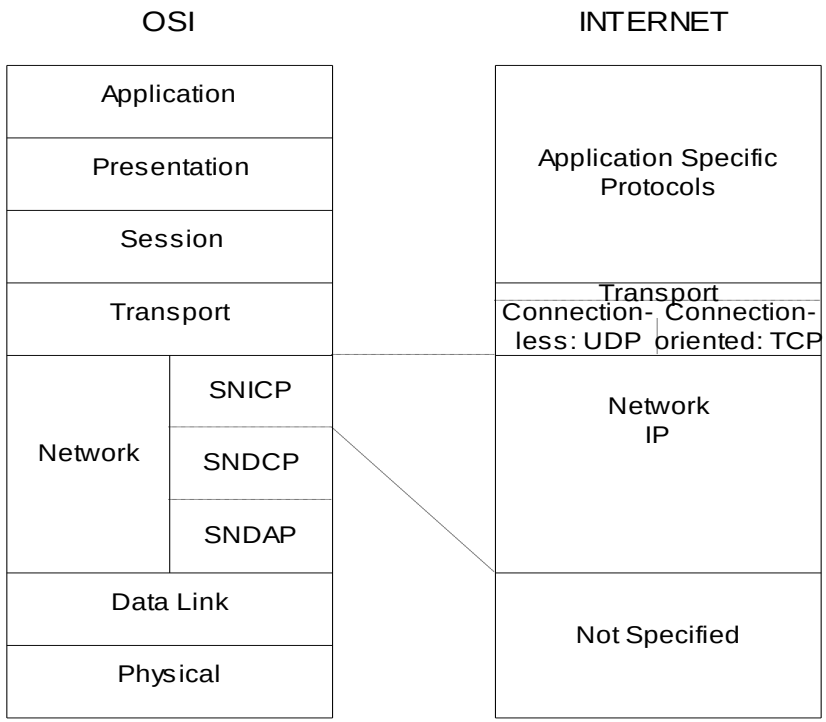


Figure 1.17 Comparison of OSI and Internet Protocol Layer Models

Application Protocols

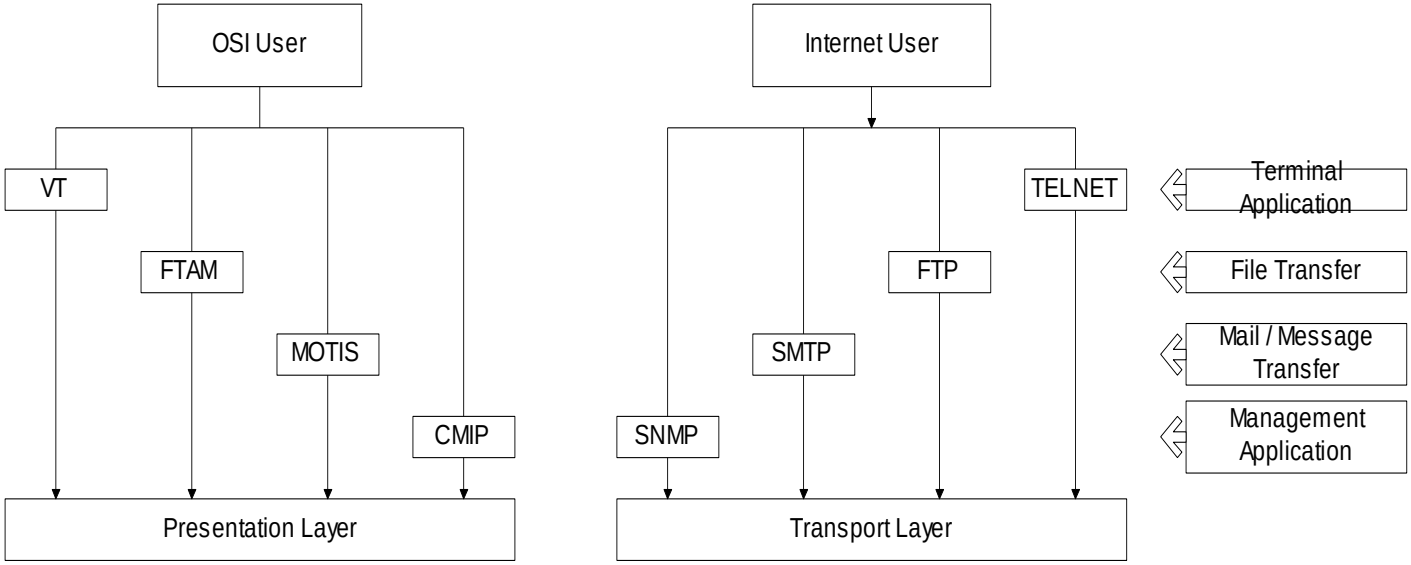


Figure 1.18 Application Specific Protocols in ISO and Internet Models

Broadband Network

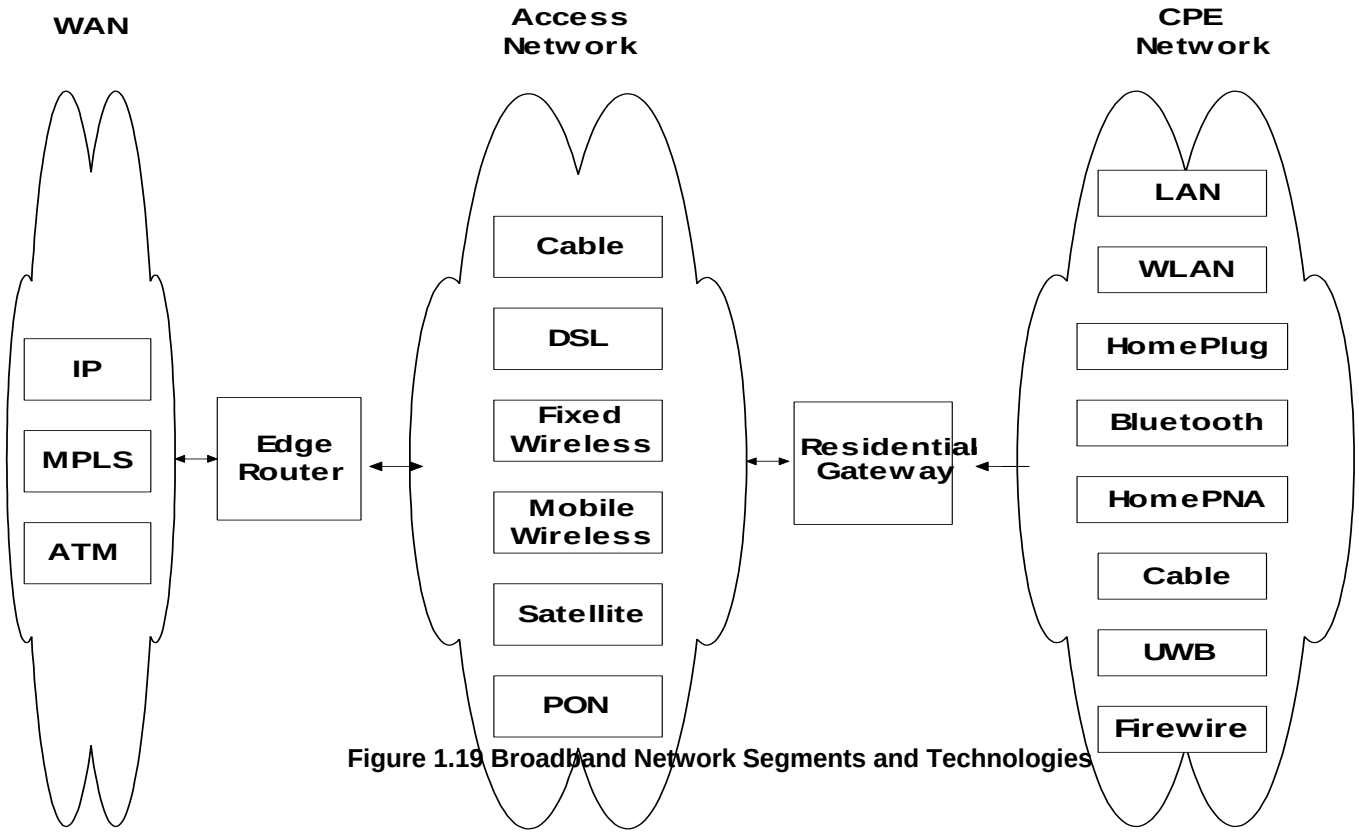
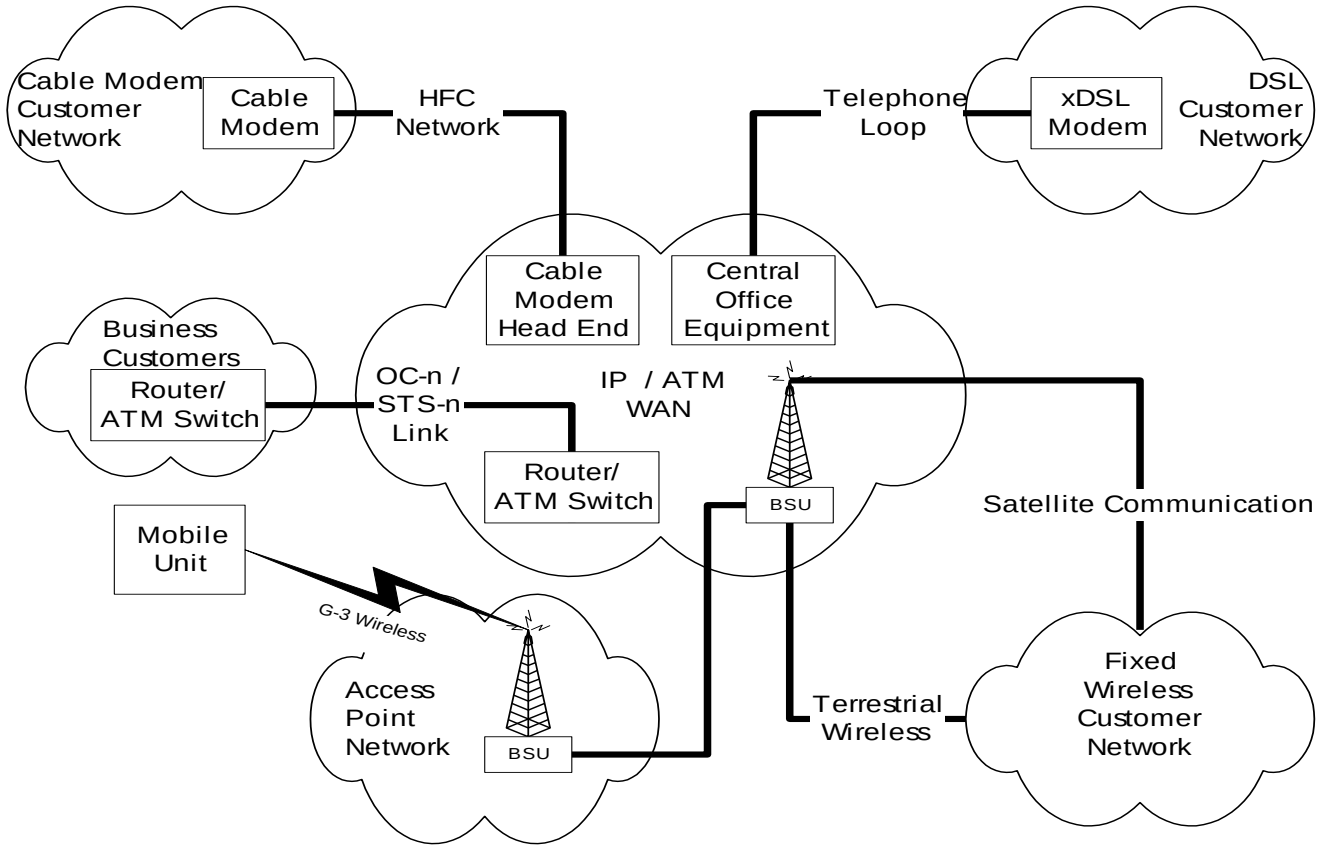


Figure 1.19 Broadband Network Segments and Technologies

Broadband Access Networks



Figue 1.20 Broadband Access Networks

Centrally Managed Network Issues

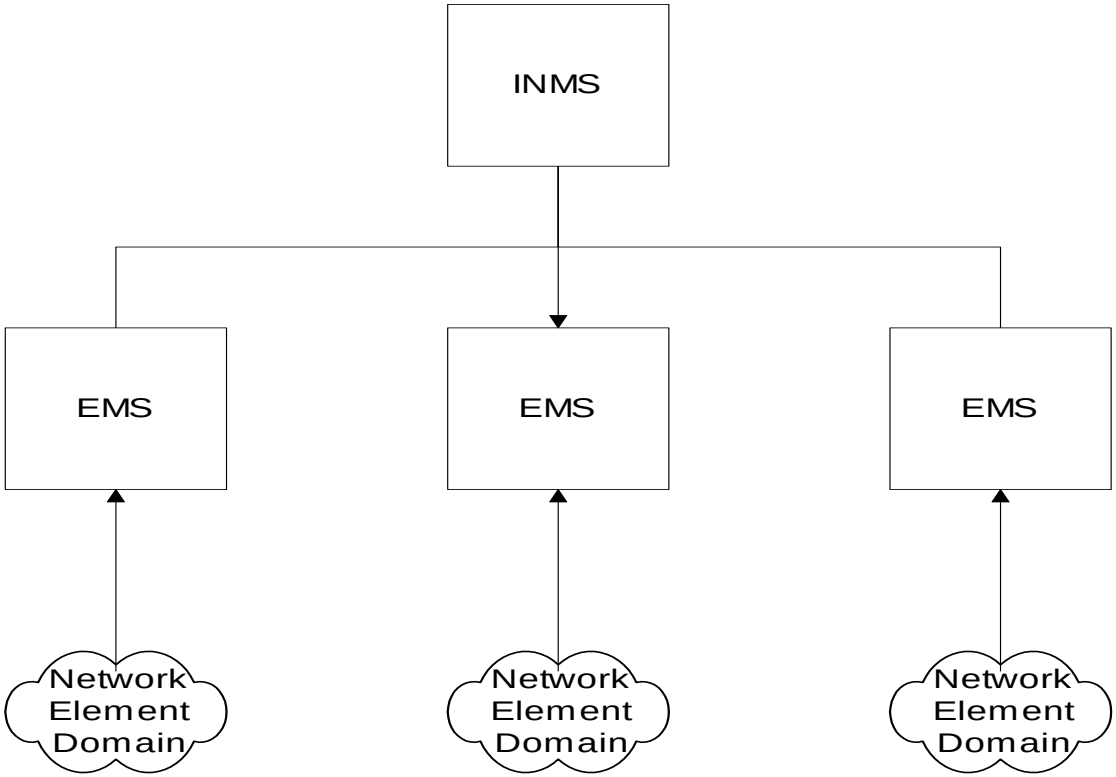


Figure 1.21 Case History 2: Centrally Managed Network Issues

Some Common Network Problems

- Loss of connectivity
- Duplicate IP address
- Intermittent problems
- Network configuration issues
- Non-problems
- Performance problems

Challenges of IT Managers

- Reliability
- Non-real time problems
- Rapid technological advance
- Managing client/server environment
- Scalability
- Troubleshooting tools and systems
- Trouble prediction
- Standardization of operations - NMS helps
- Centralized management vs. “sneaker-net”

Network Management

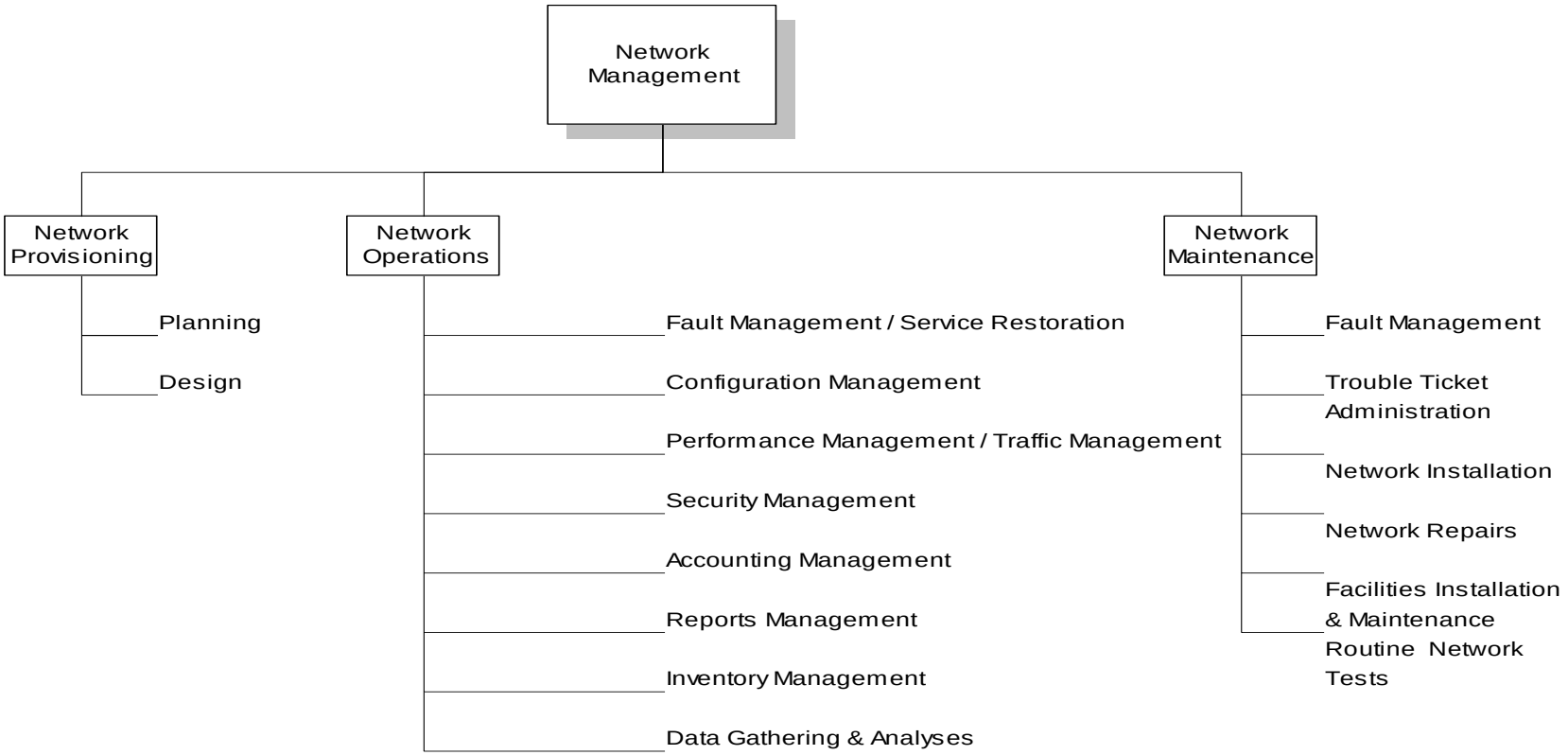


Figure 1.22 Network Management Functional Groupings

NM Functional Flow Chart

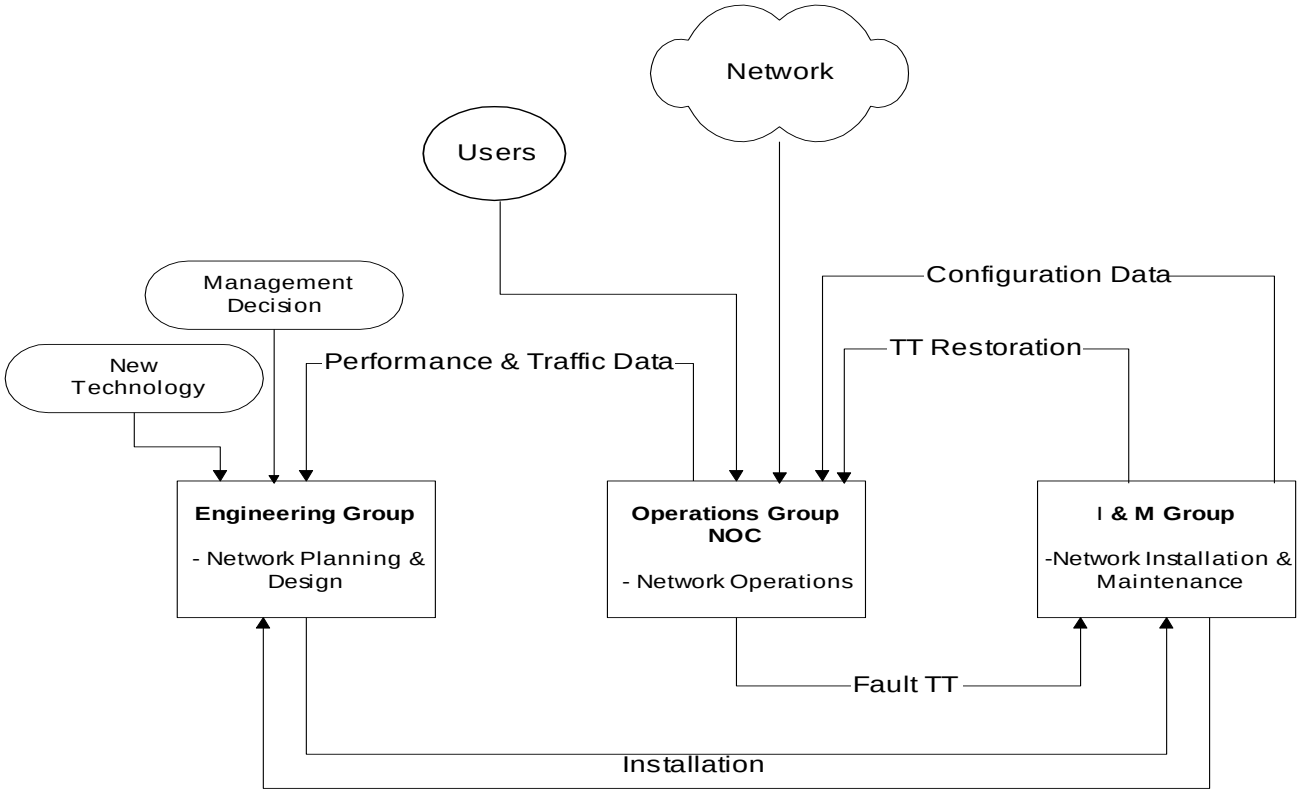
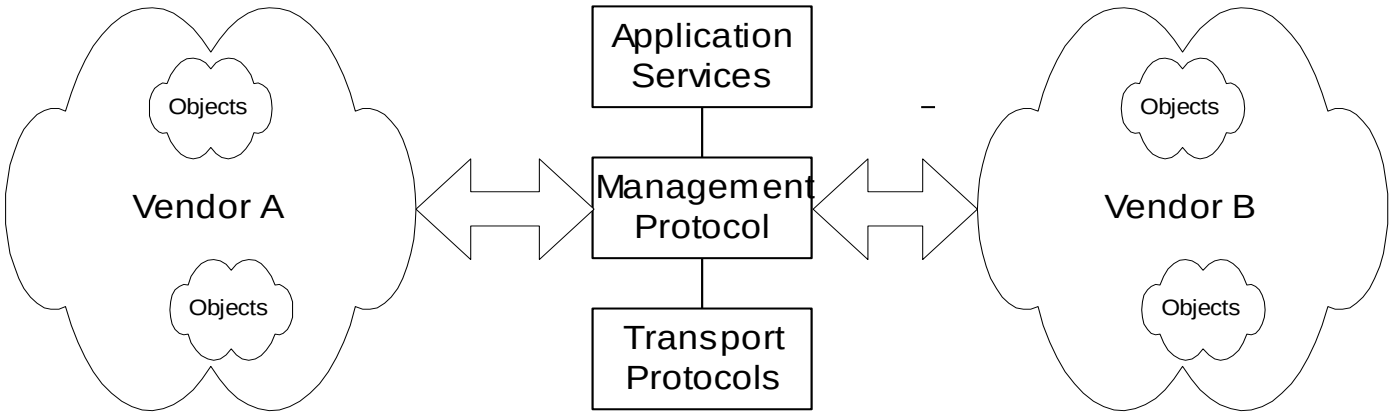


Figure 1.23 Network Management Functional Flow Chart

Dumbbell Architecture



(b) Services and Protocols

Figure 1.24 Network Management Dumbbell Architecture

NM Components

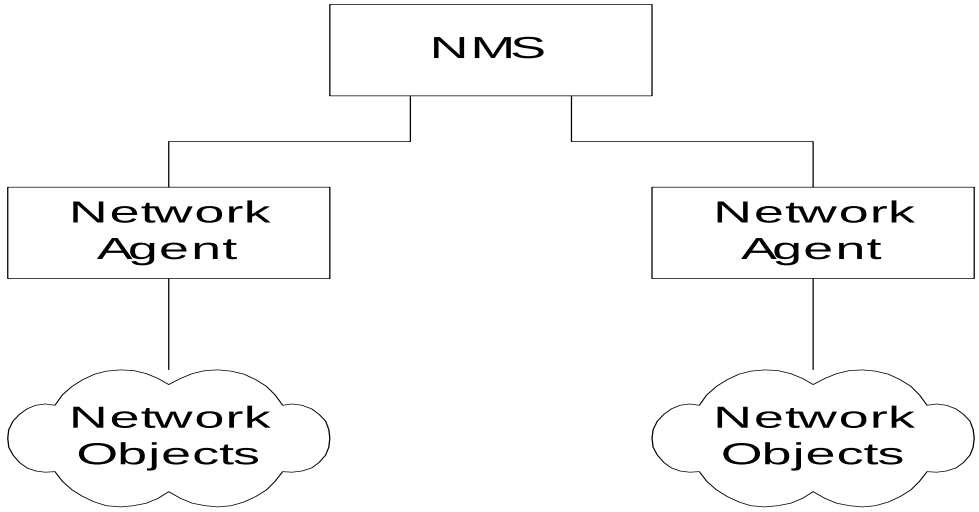


Figure 1.25 Network Management Components

Interoperability

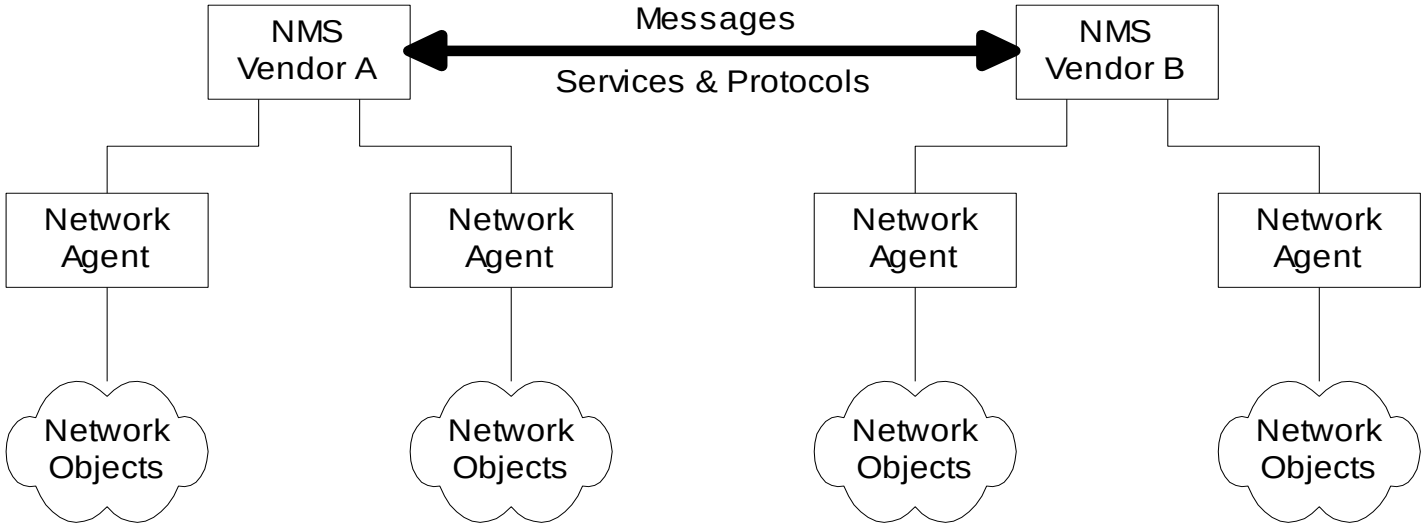


Figure 1.26 Network Management Interoperability

Network Management Perspectives

- Network Management
- Service Management
- Service and Network Provisioning
- Application Management
- e-Commerce Management
- Inventory Management
- Integrated Management
- Business Management
- Information Management
- Management Protocols
- Management Technologies

Infrastructure Perspective

- Domains
- Protocols
- Technologies
- Transmission Media
- Transmission Modes
- Service Functions

Service Perspective

- Communication Services
- Computing Services
- Content Services
- IT Services
- Application Services

Status and Future Trends

- Status:
  - SNMP management
  - Limited CMIP management
  - Operations systems
  - Polled systems
- Current Focus:
  - Object-oriented approach
  - Service and policy management
  - Business management
  - Web-based client management
- Future Trends
  - Web-based management?
  - XML based management