

# Network Management

## Lecture 1

### Data Communications and Network Management Overview

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- Telecommunications overview
  - Data communications overview
  - Evolution of converged networks
  - Desktop processors and LAN technology
  - Client-Server architecture in networking
  - Internet and intranet
  - Network communication protocols
  - OSI and Internet standards
  - Broadband networks and services
  - Need for network management and NMS
  - Operations, Administration, Maintenance, and Provisioning
  - Network management architecture and organization
  - Concept of Network Operations Center
  - Perspectives of network management
  - Network management system
  - Look-ahead of network management technology

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## **Notes**

# 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

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## Notes

# Telephone Network Model

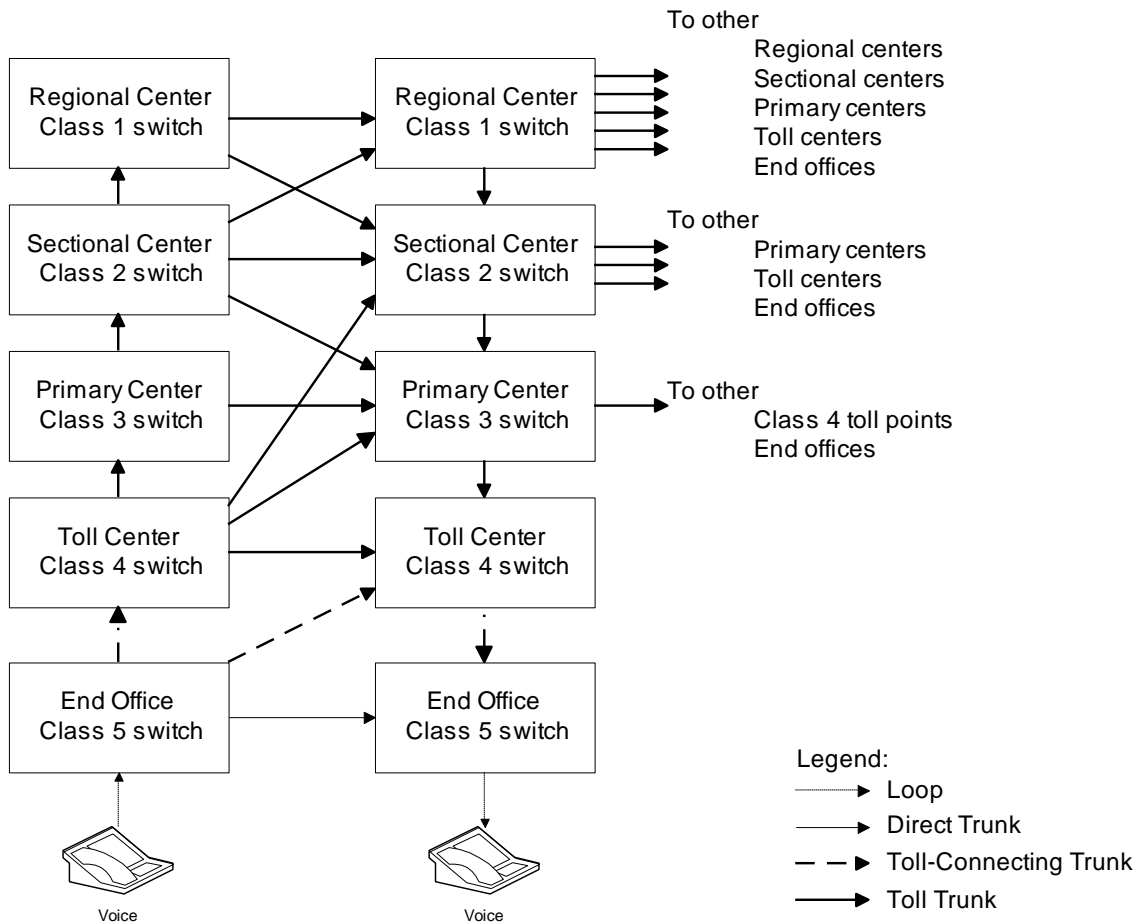


Figure 1.1 Telephone Network Model

## Notes

- Notice the hierarchy of switches
- Primary and secondary routes programmed
- Automatic routing
- Where is the most likely failure?
- Use of Operations Systems to ensure QoS

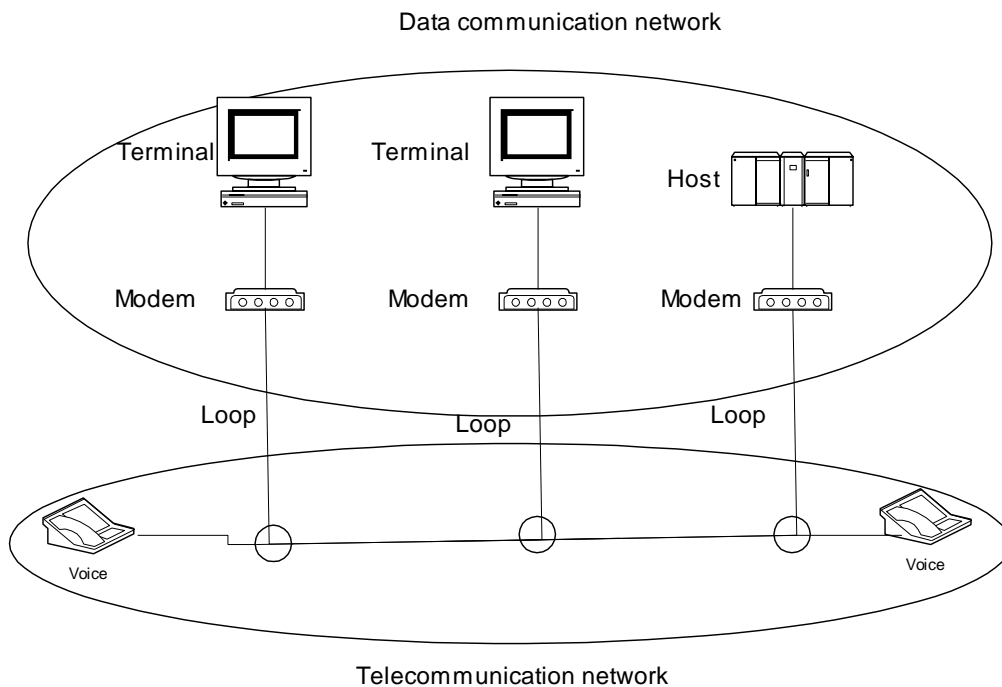
# OSSs / NOC

- 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)

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## Notes

# Data and Telecommunication Network



**Figure 1.3 Data and Telecommunication Networks**

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## Notes

- Computer data is carried over long distance by telephone (telecommunication network)
- Output of telephone is analog and output of computers is digital
- Modem is used to “modulate” and “demodulate” computer data to analog format and back
- Clear distinction between the two networks is getting fuzzier with modern multimedia networks

# Migration to Digital Technology

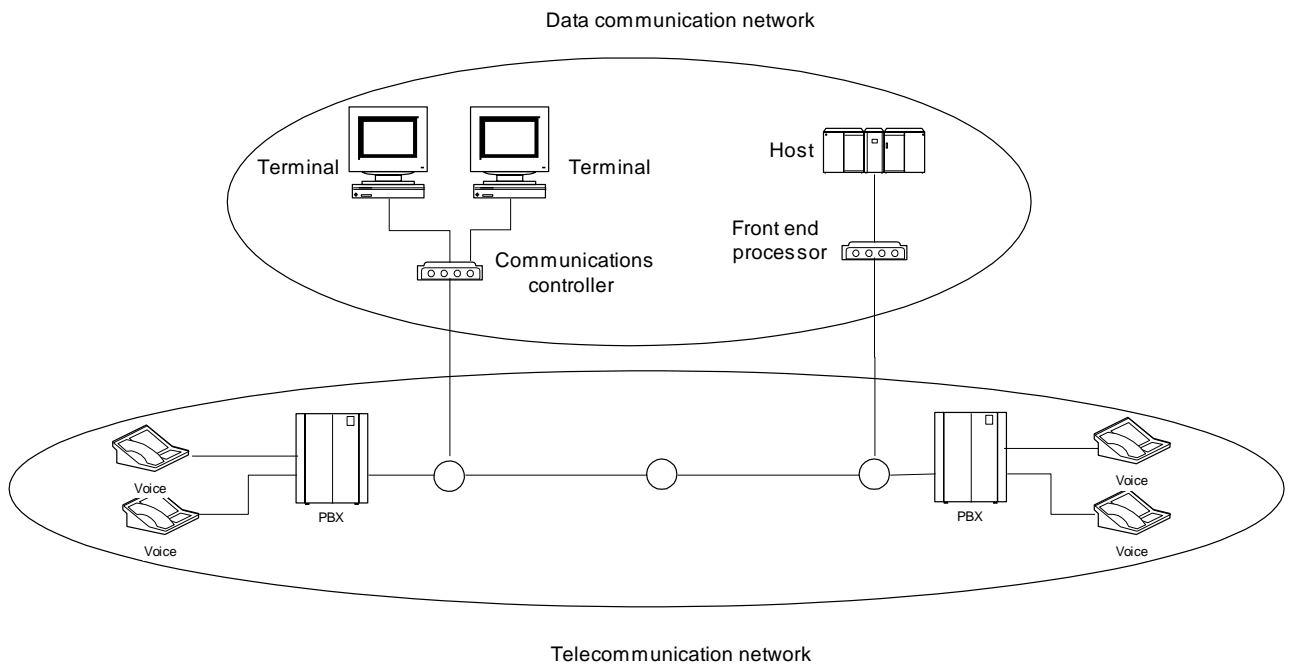


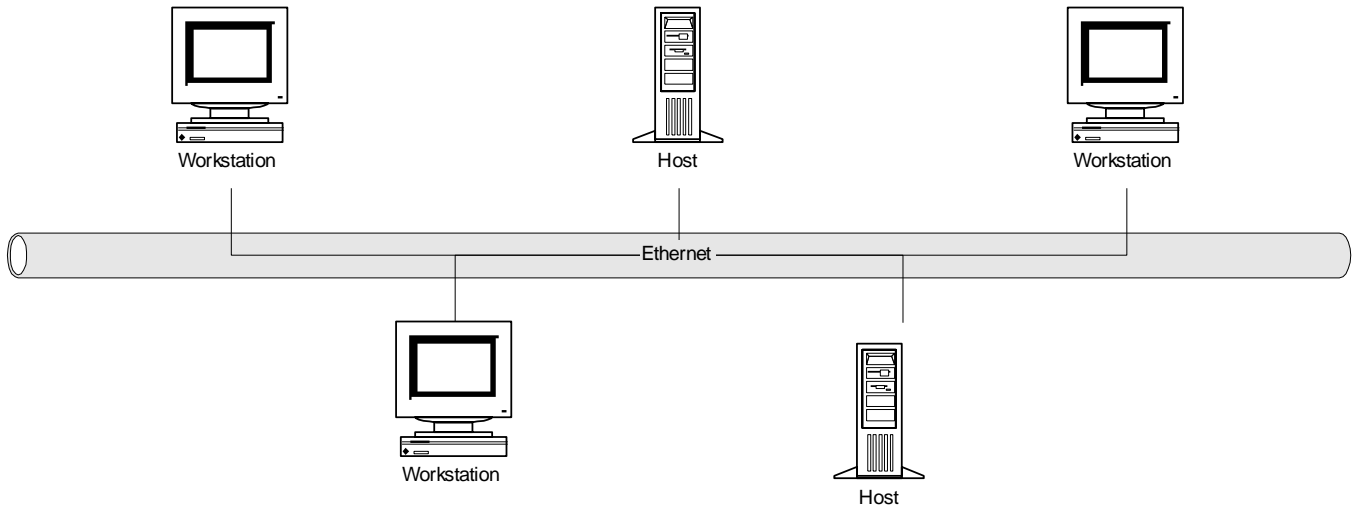
Figure 1.4 Digital Data and Telecommunication Networks

## Notes

- Analog transmission migrated to digital transmission
- Analog sources converted to digital signals
- CPE (Customer Premises equipment) included digital PBX (Private Branch Exchanges)
- Analog bandwidth hierarchy migrated to synchronous digital hierarchy

# DCE with LAN

DCE.. Distributed Computing Environment



**Figure 1.5(a) Hosts and Workstations on Local LAN**

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## Notes

- Driving technologies for DCE:
  - Desktop processor
  - LAN
  - LAN - WAN network



# LAN-WAN Network

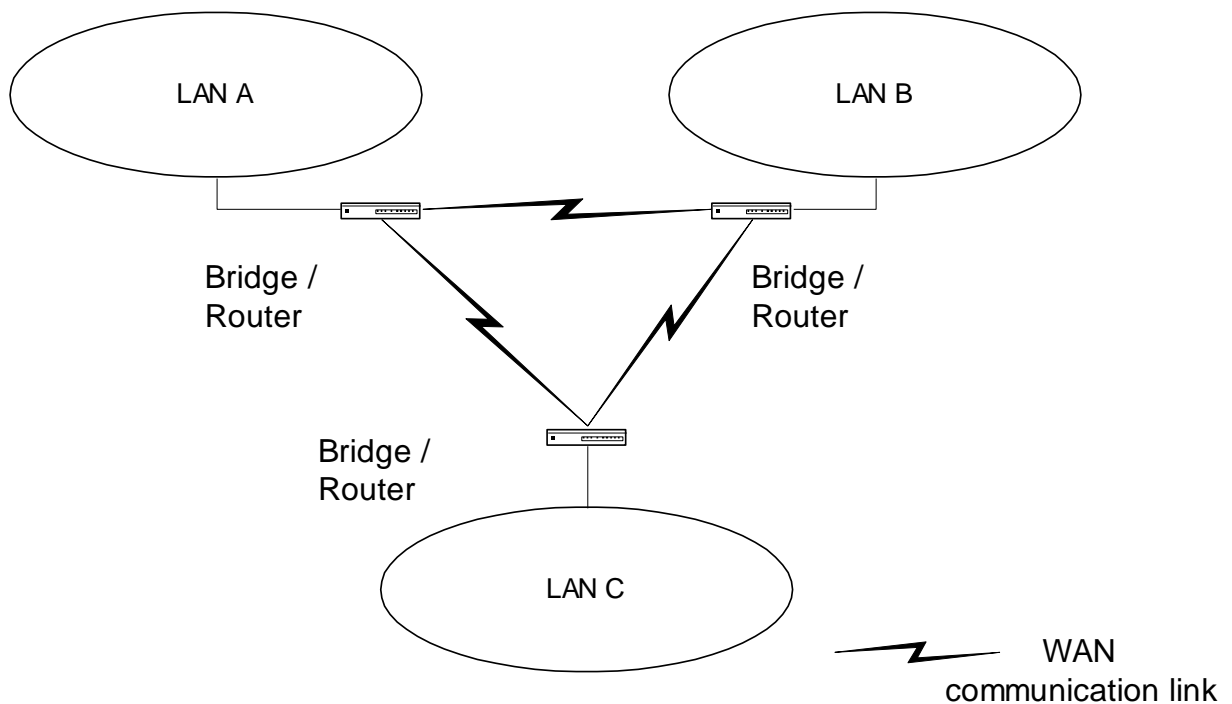


Figure 1.5(b) Remote LANs Interconnected by WAN

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## Notes

- Major impacts of DCE:
  - No more monopolistic service provider
  - No centralized IT controller
  - Hosts doing specialized function
  - Client/Server architecture formed the core of DCE network

# Client/Server Model

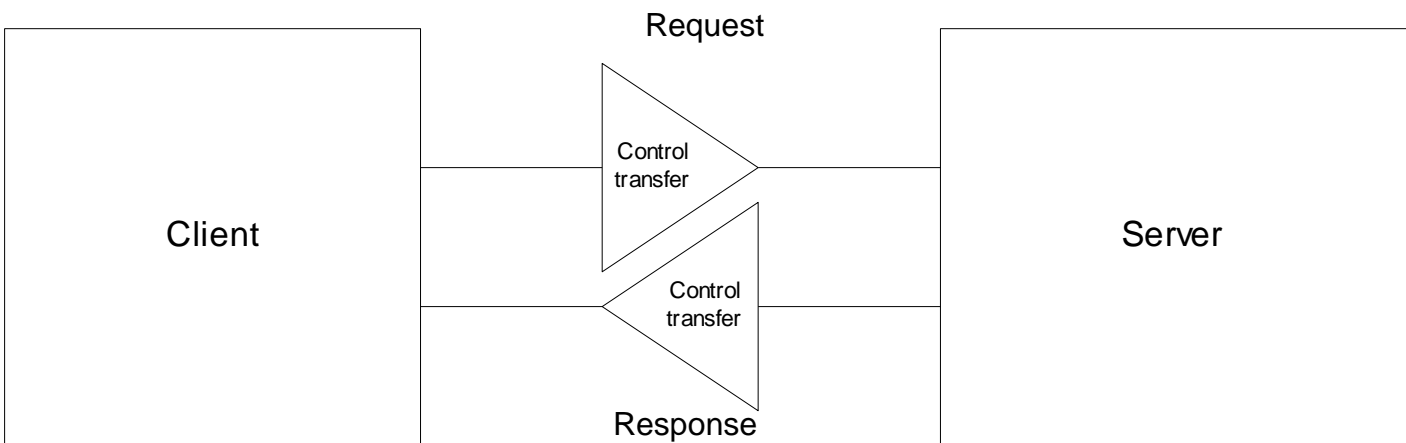


Figure 1.6 Simple Client-Server Model

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## Notes

- Post office analogy; clerk the server, and the customer the client
- Client always initiates requests
- Server always responds
- Notice that control is handed over to the receiving entity.

# Client/Server Examples

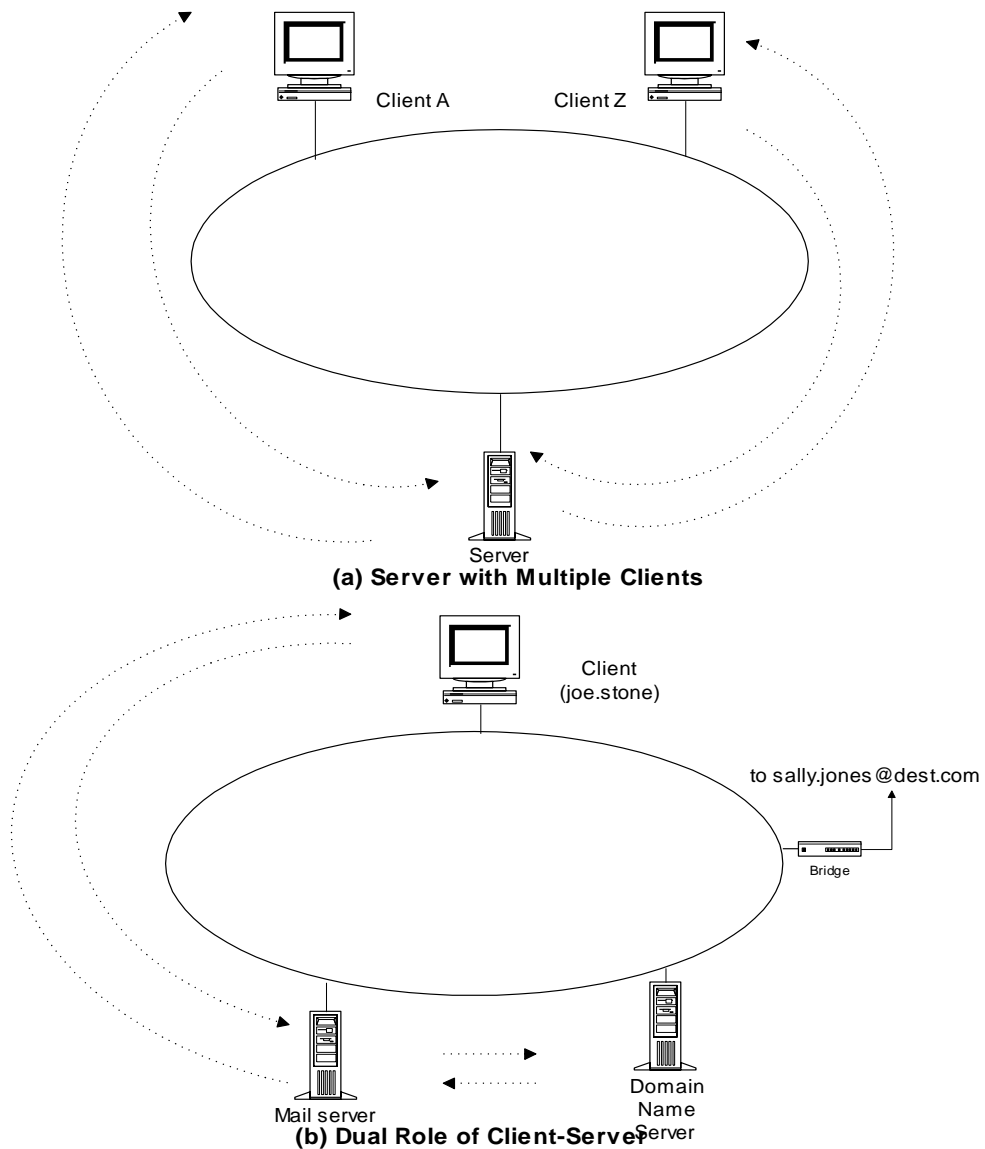


Figure 1.7 Client-Server in Distributed Computing Environment

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## Notes

# 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
- Internet email and much of the network mgmt. messages are based on UDP/IP
- ICMP part of TCP/IP suite

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## Notes

# Internet Configuration

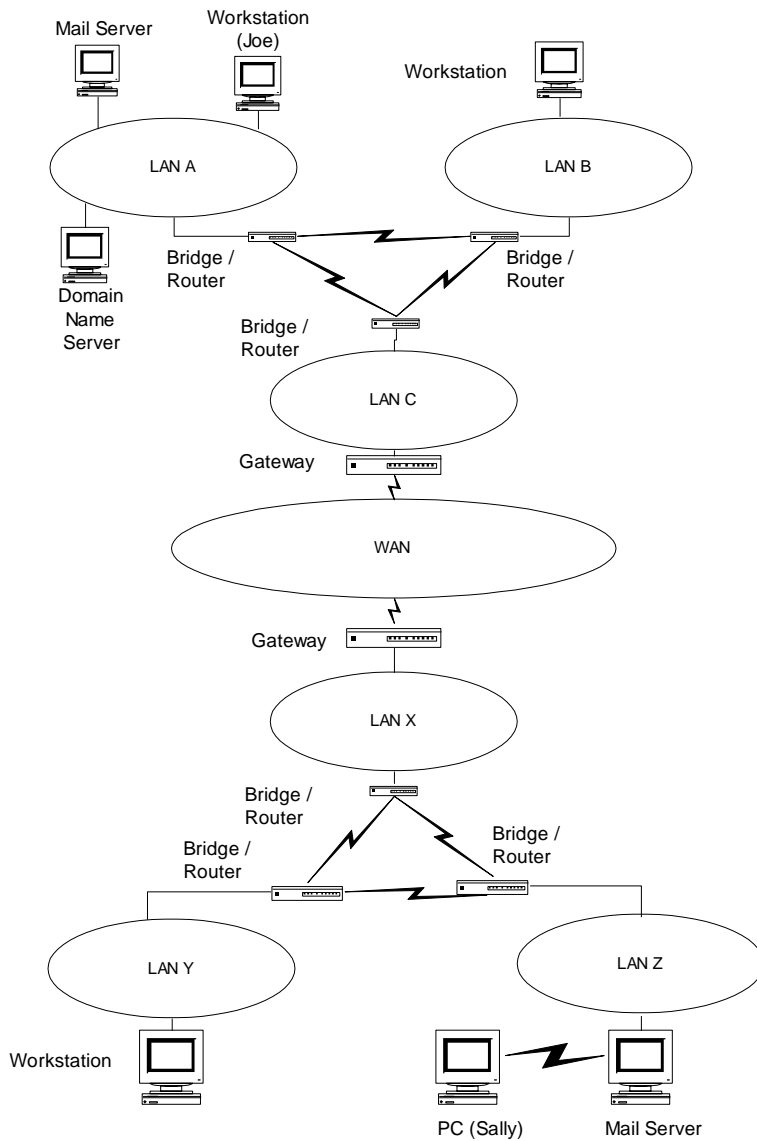


Figure 1.8 Internet Configuration

## Notes

- Walk through the scenario of email from Joe to Sally

# Architecture, Protocols and Standards

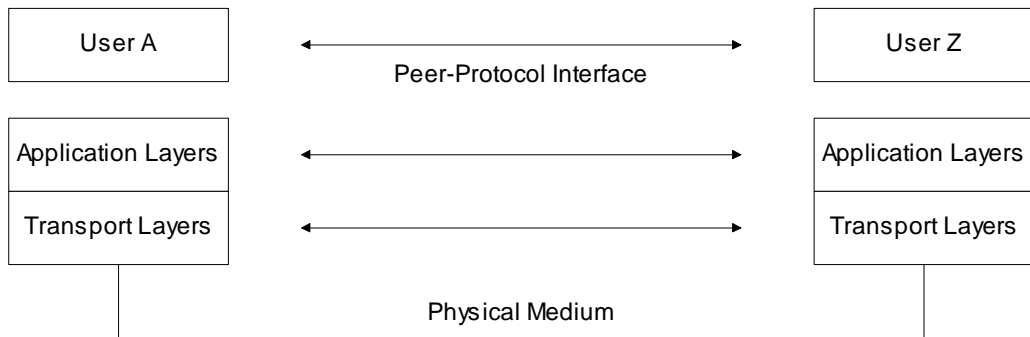
- Communication architecture
  - Modeling of communication systems, comprising
    - Functional components
    - Operations interfaces between them
- Communication protocols
  - Operational procedures
    - Intra- and inter-modules
- Communication standards
  - Agreement between manufacturers on protocols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

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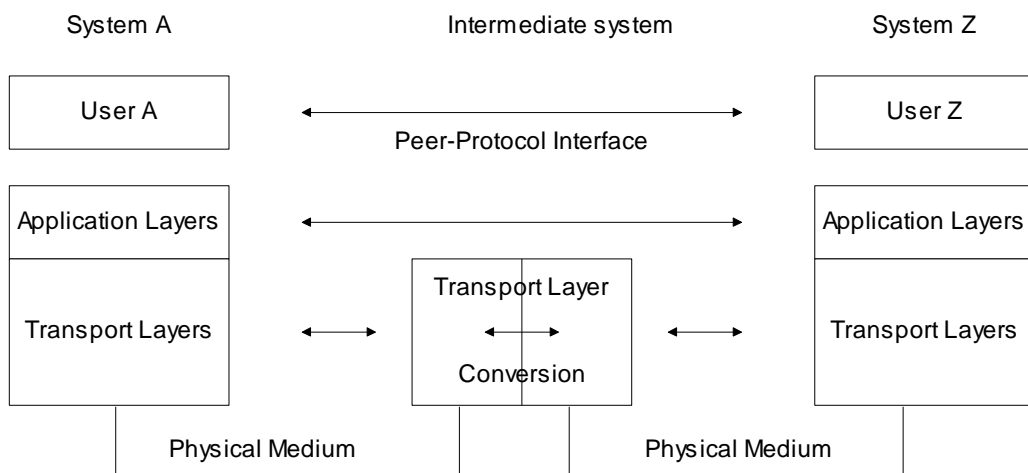
## Notes

- Examples: (Students to call out)

# Communication Architecture



(a) Direct Communication between End Systems



(b) Communication between End Systems via an Intermediate System

**Figure 1.10 Basic Communication Architecture**

## Notes

- Inter-layer interface: user and service provider
- Peer-layer protocol interface
- Analogy of hearing-impaired student
- Role of intermediate systems
- Gateway: Router with protocol conversion as gateway to an autonomous network or subnet

# OSI Reference Model

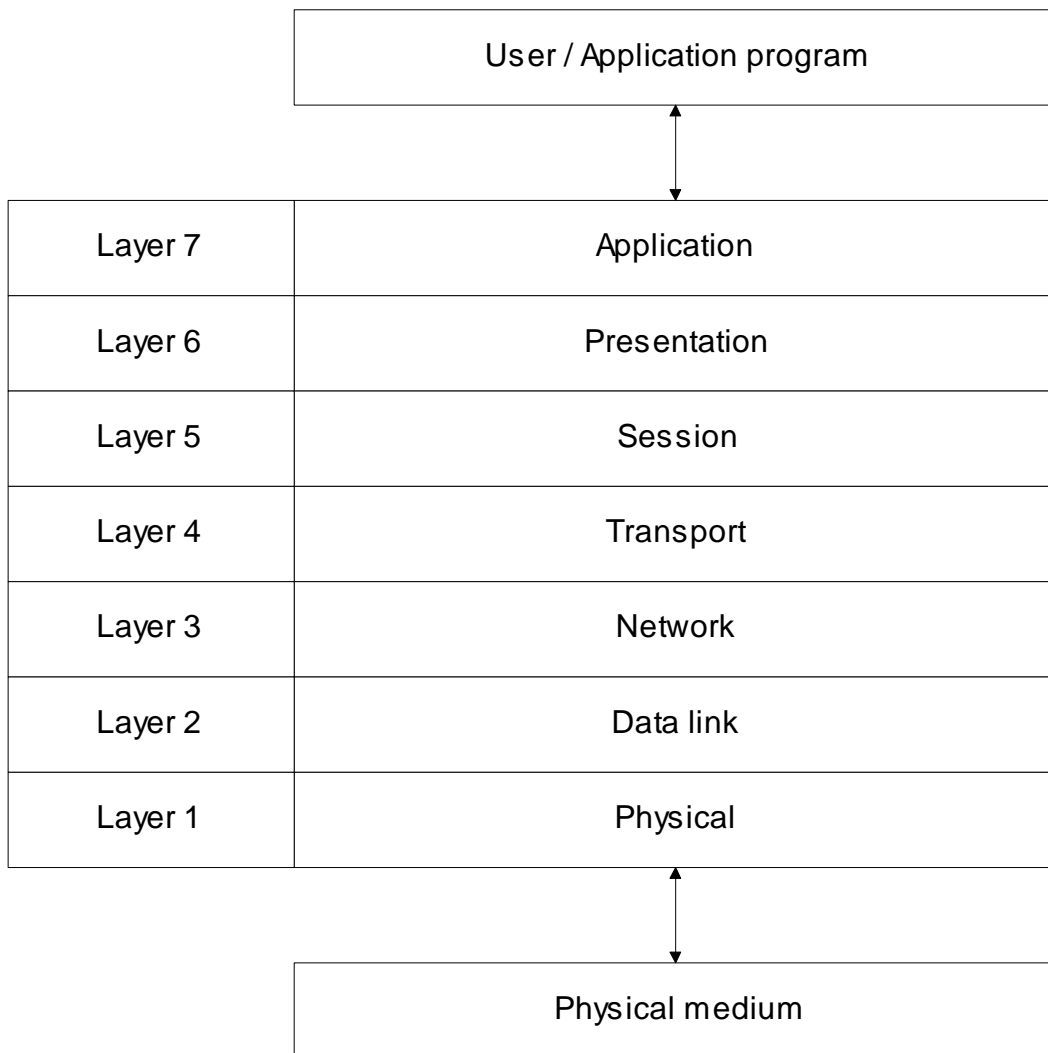


Figure 1.11 OSI Protocol Layers

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## Notes

- Importance of the knowledge of layer structure in NM



# 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

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## Notes

- Importance of services offered by different layers and the protocol conversion at different layers in NM

# PDU Communication Model

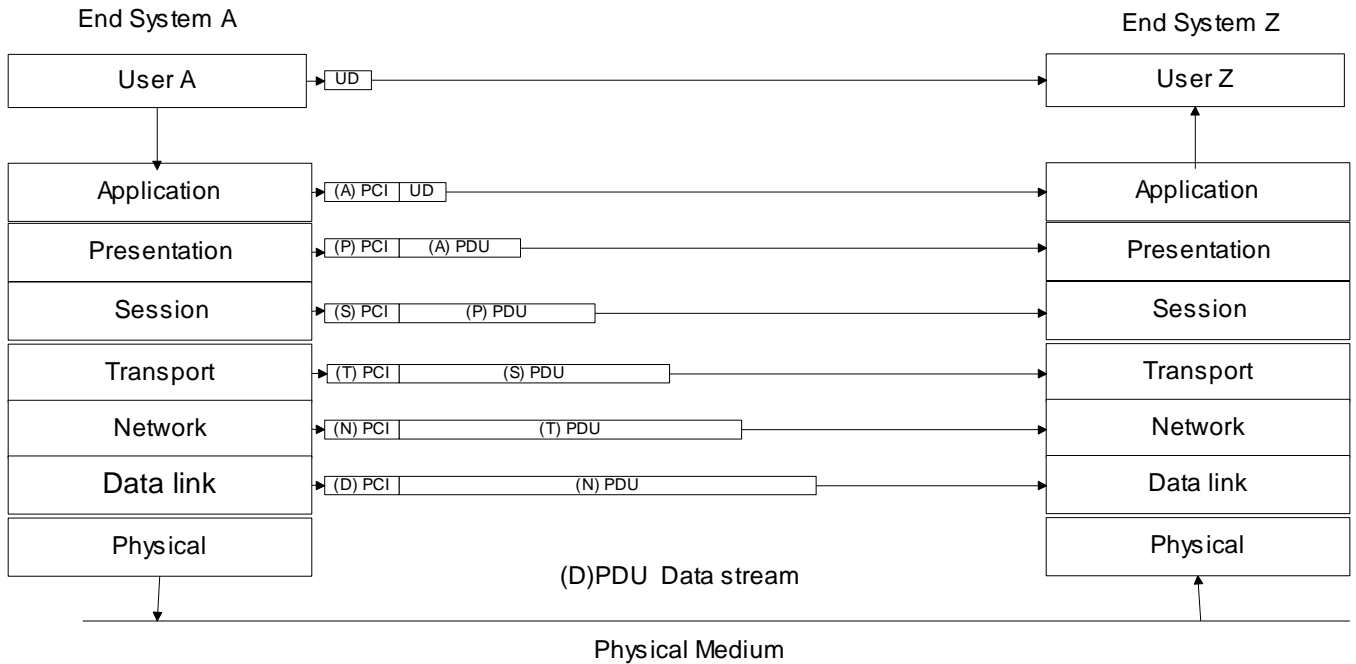
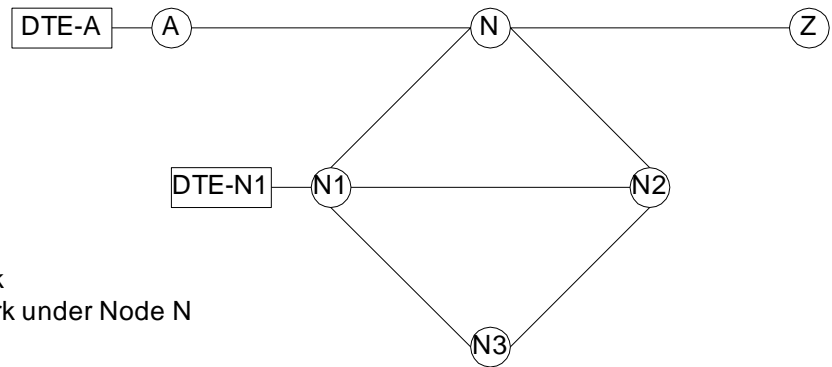


Figure 1.13 PDU Communication Model between End Systems

## Notes

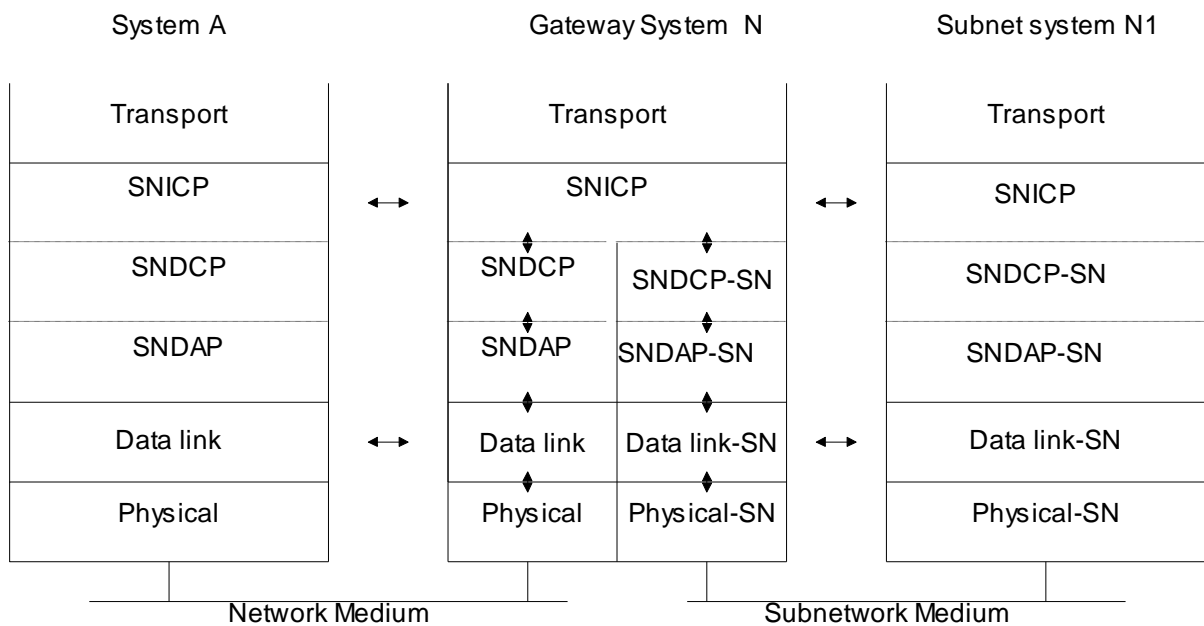
- What is the relevance of PDU model in NM?

# Gateway



A-N-Z Standard Network  
N-N1-N2-N3 Subnetwork under Node N

(a) Network configuration



(b) Protocol Communication

Figure 1.16 Gateway Communication to Private Subnetwork

## Notes

- cc:mail from a station in Novel IPX network to an Internet station with SMTP email

# OSI and Internet

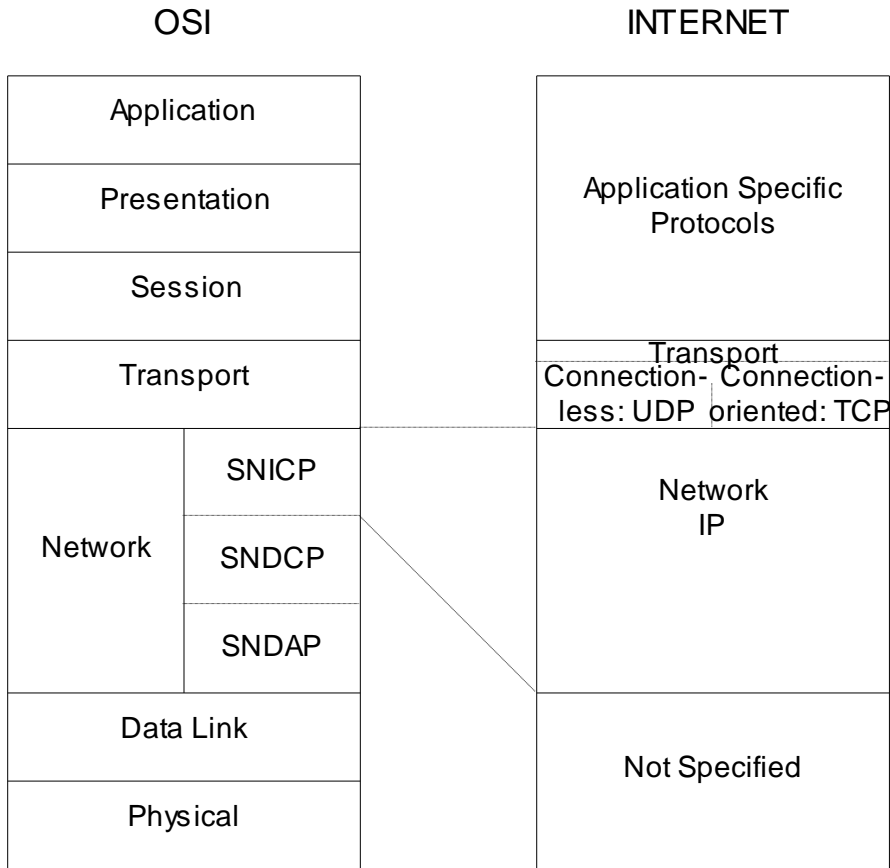


Figure 1.17 Comparison of OSI and Internet Protocol Layer Models

## Notes

- Simplicity of Internet; specifies only layers 3 and 4
- Integrated application layers over Internet
- Commonality of layers 1 and 2 - IEEE standard

# Application Protocols

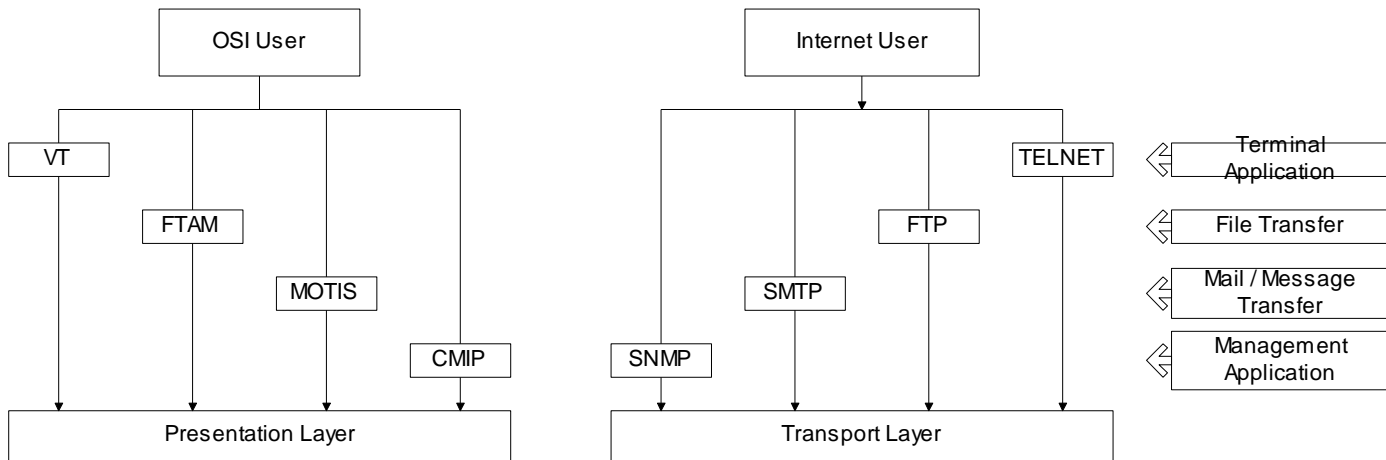


Figure 1.18 Application Specific Protocols in ISO and Internet Models

## Notes

<b>Internet user</b>	<b>OSI user</b>
Telnet	Virtual Terminal
File Transfer Protocol	File Transfer Access & Mgmt
Simple Mail Transfer Protocol	Message-oriented Text Interchange Standard
Simple Network Management Protocol	Common Management Information Protocol

# Broadband Network

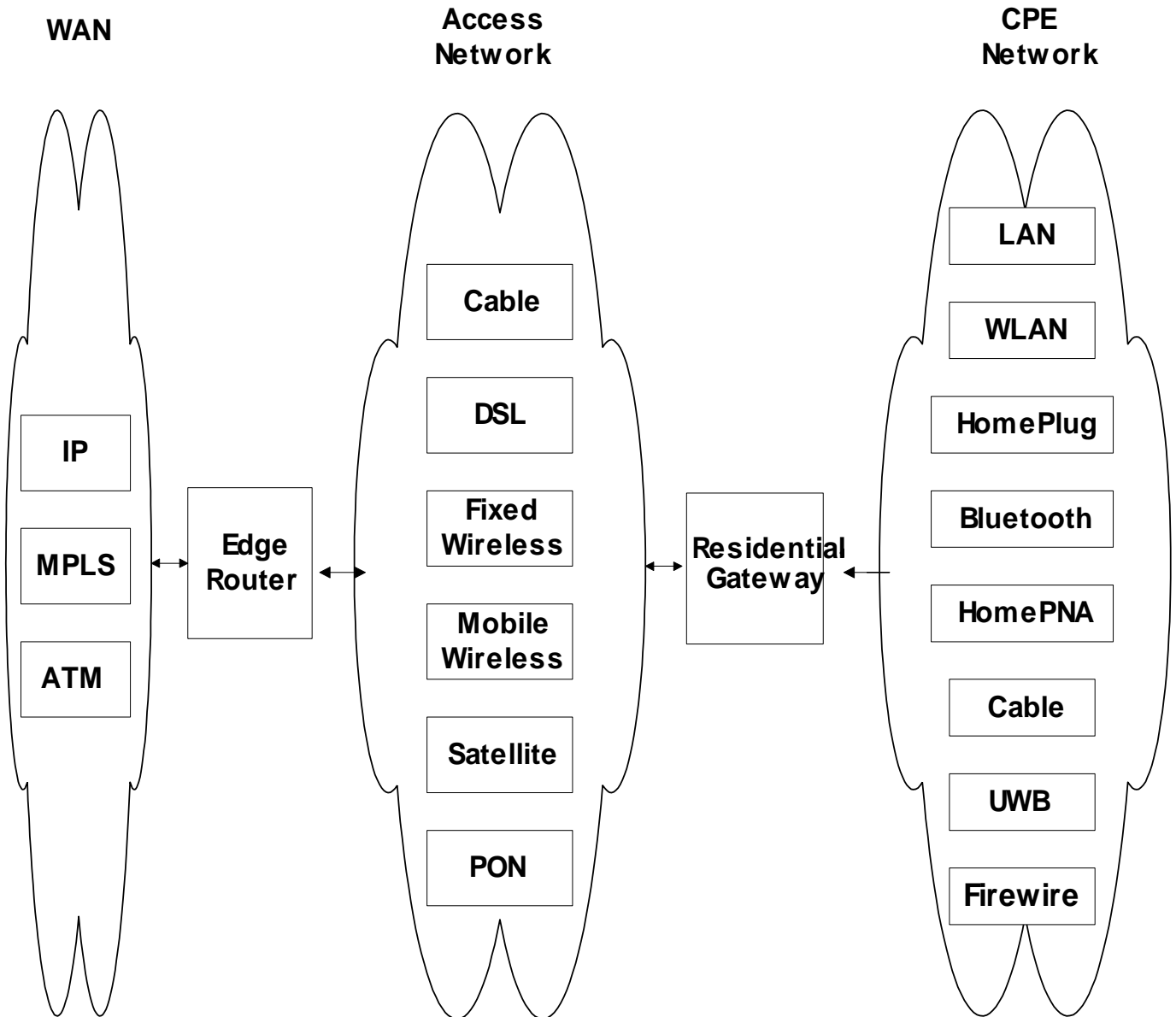


Figure 1.19 Broadband Network Segments and Technologies

## Notes

# Broadband Access Networks

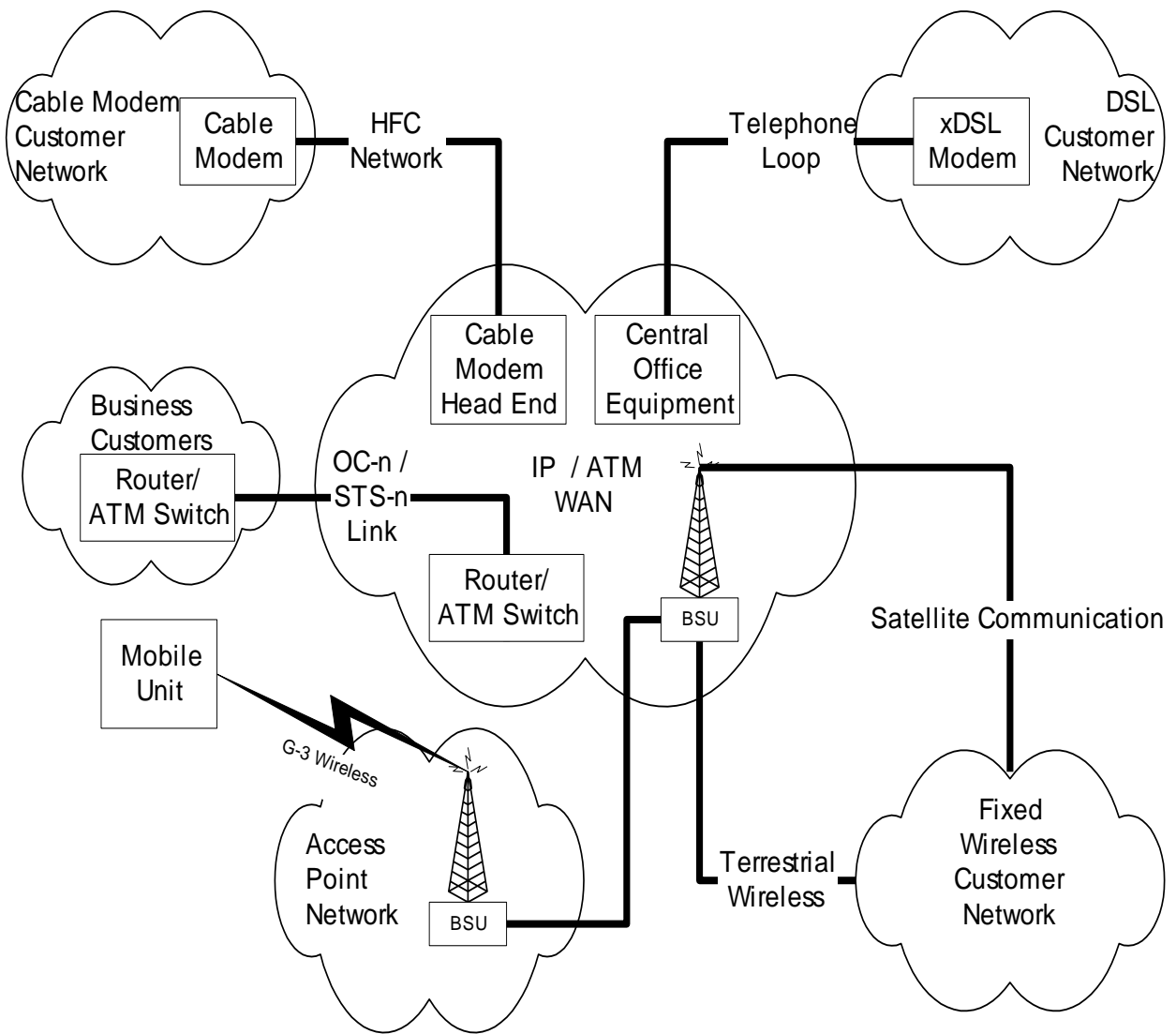
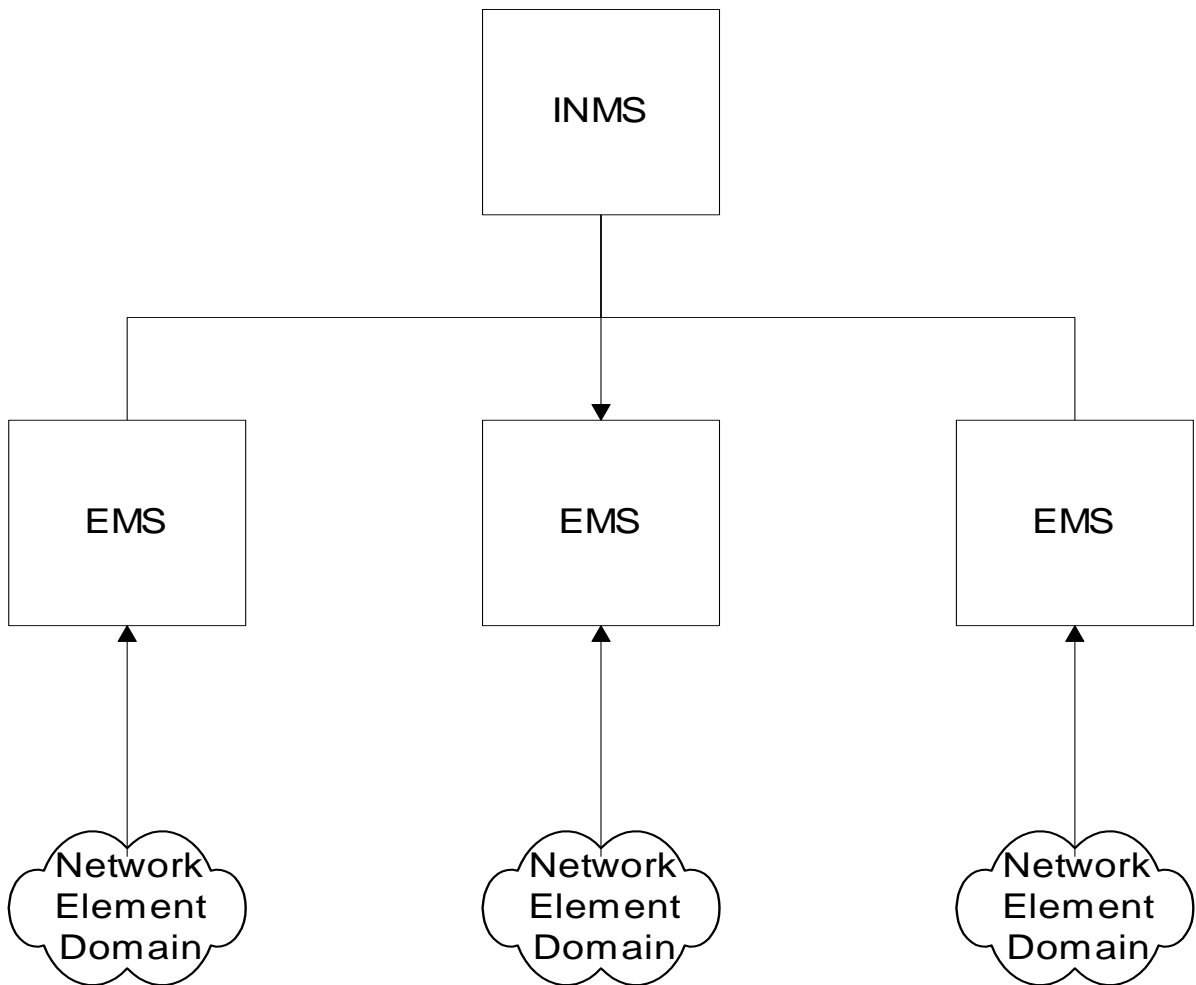


Figure 1.20 Broadband Access Networks

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## Notes

# Centrally Managed Network Issues



**Figure 1.21 Case History 2:  
Centrally Managed Network Issues**

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## Notes



# Some Common Network Problems

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

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## Notes

# 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”

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## Notes

# Network Management

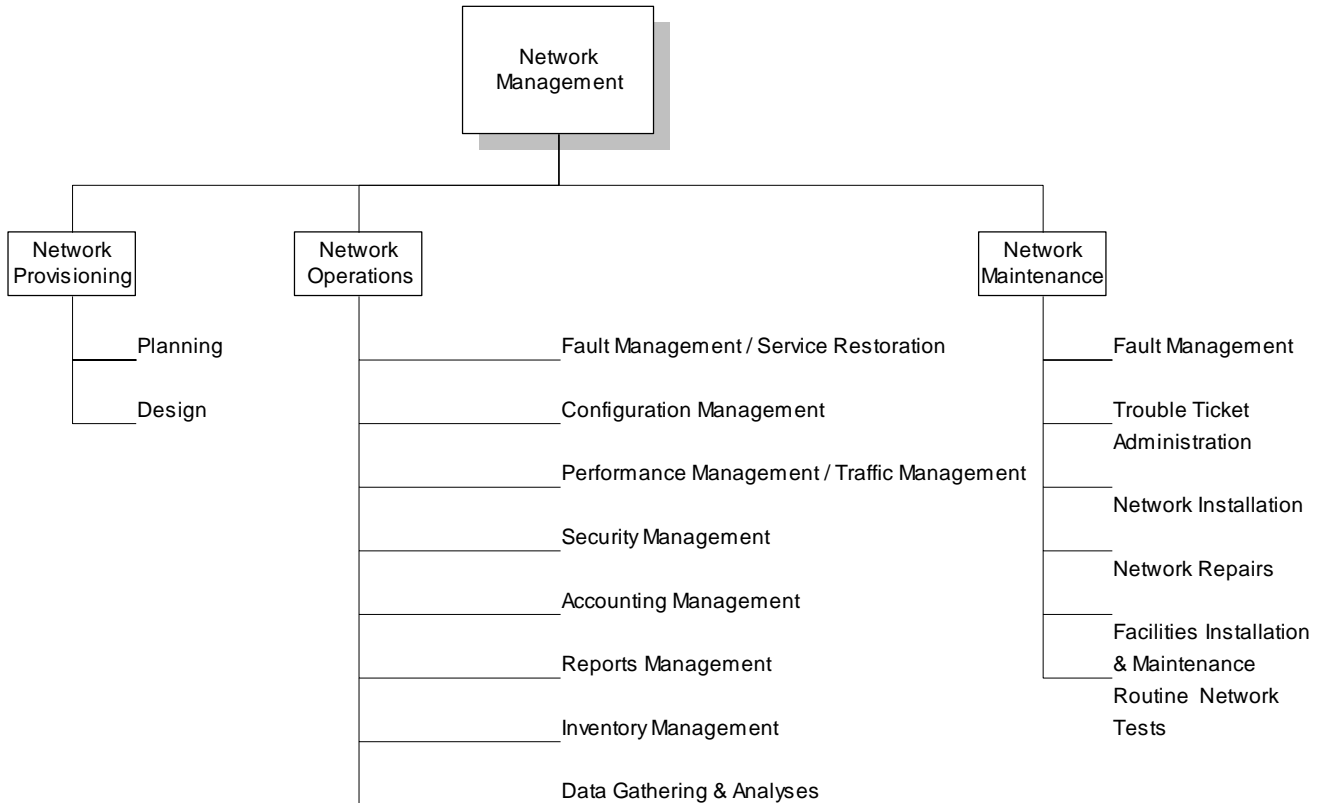


Figure 1.22 Network Management Functional Groupings

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## Notes

- OAMP
  - Operations
  - Administration
  - Maintenance
  - Provisioning

# NM Functional Flow Chart

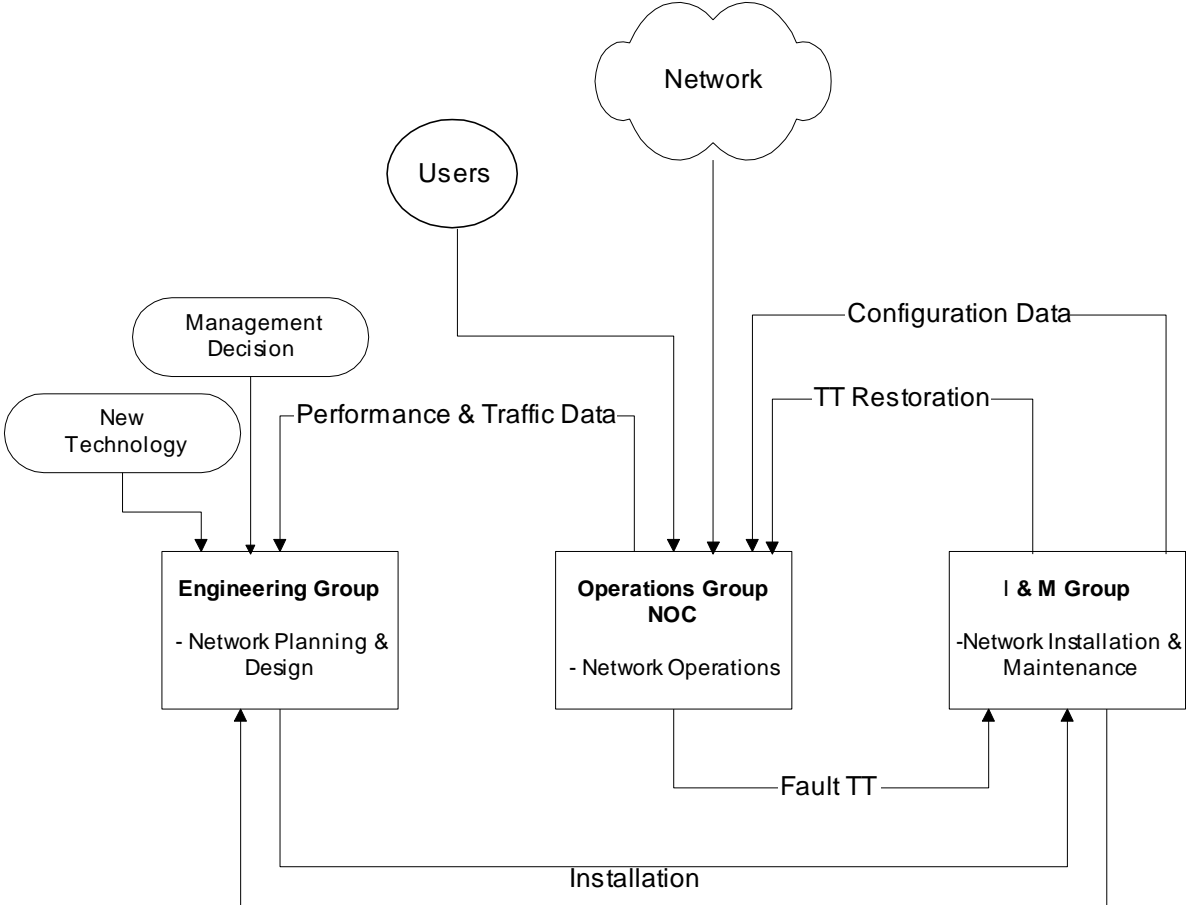
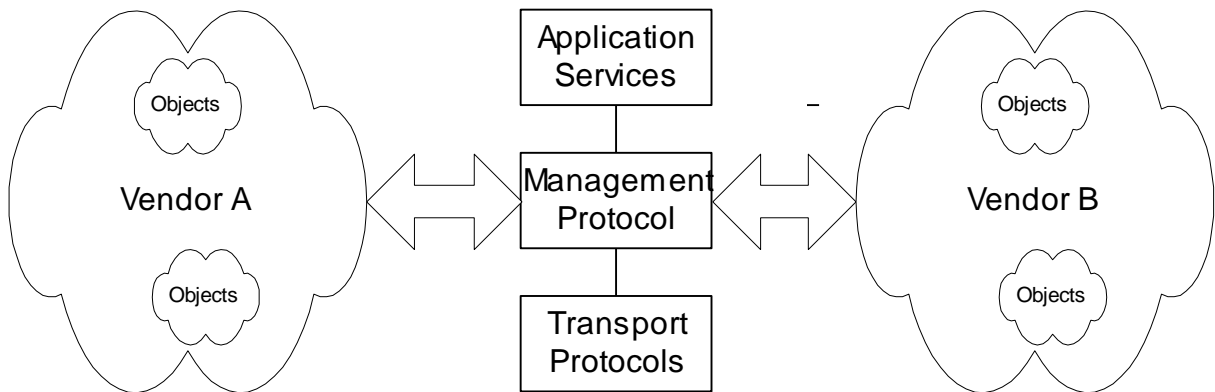


Figure 1.23 Network Management Functional Flow Chart

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## Notes

# Dumbbell Architecture



(b) Services and Protocols

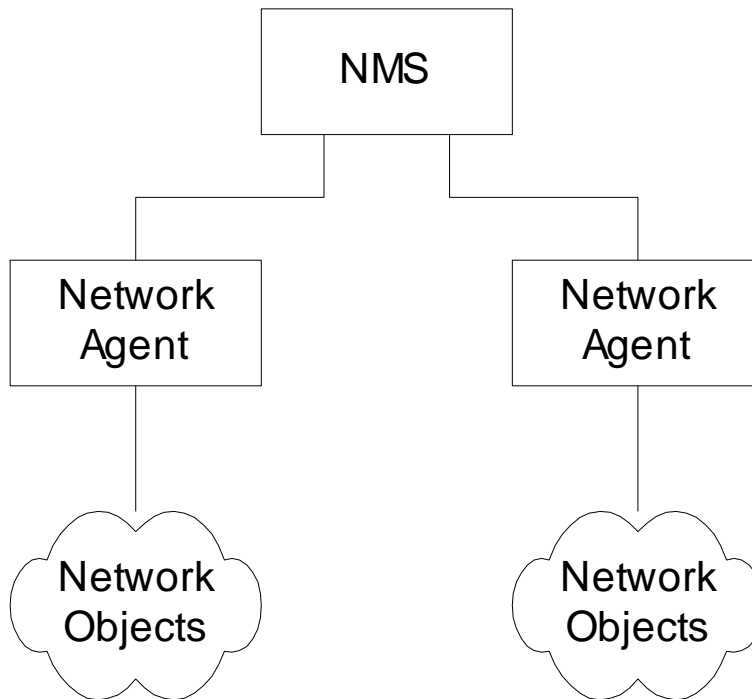
Figure 1.24 Network Management Dumbbell Architecture

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## Notes

- Message exchange between NMSs managing different domains

# NM Components

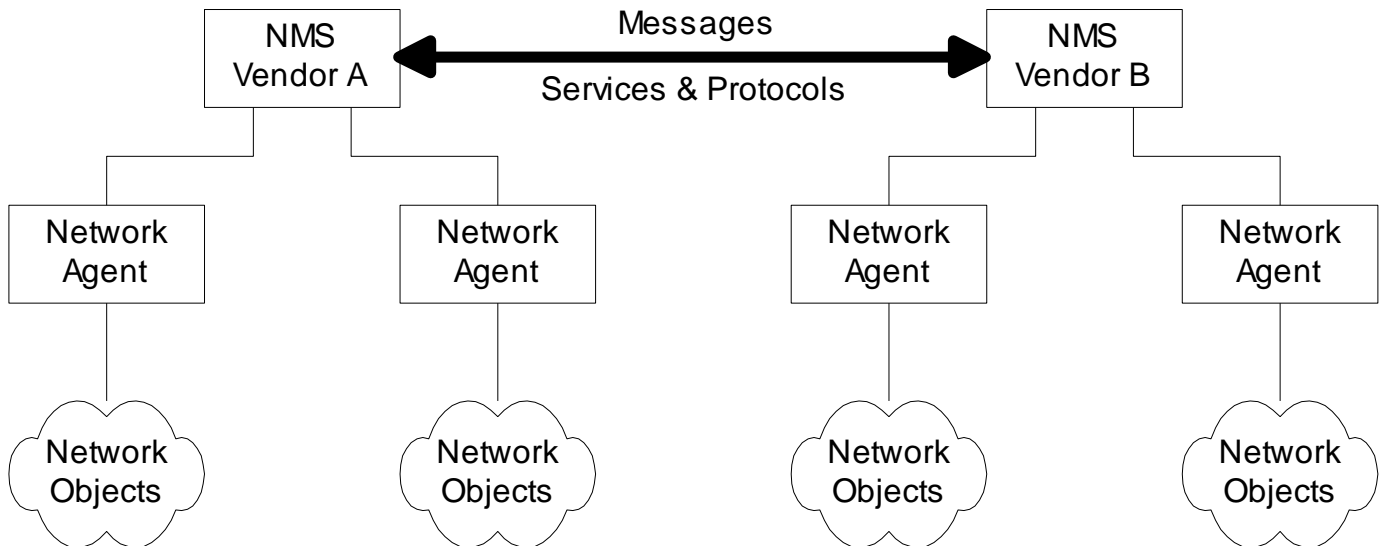


**Figure 1.25 Network Management Components**

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## Notes

# Interoperability



**Figure 1.26 Network Management Interoperability**

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## Notes

- Message exchange between NMSs managing different domains

# 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

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## Notes



# Infrastructure Perspective

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

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## Notes

# Service Perspective

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

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## Notes

# 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

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## Notes