CS 303

COMPUTER NETWORKS

B.Tech. III (CSE) Semester – V
COMPUTER NETWORKS (CORE - 10)
CS303

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand computer network models and services offered at different layers of network protocol stack.
CO2	apply knowledge of data communication, data transmission techniques using various transmission media to deliver error free data and communicate with multiple nodes.
CO3	analyse various routing methods to identify effective routing protocols.
CO4	evaluate network performance by means of transport and flow control protocols, Congestion Control protocols and Quality of services.
CO5	create a computer network application using modern network tools and simulation softwares.

- **INTRODUCTION** **(06 Hours)**

  Overview of Computer Networks and Data Communication, Computer Networking Protocols and Standards, Types of Computer Networks, Network Topology, Protocol Hierarchies and Design Issues, Interfaces and Services, Networking Devices, OSI and TCP/IP Reference Models.

- **PHYSICAL LAYER** **(06 Hours)**

  Physical Layer Design Issues, Data Transmission Techniques, Multiplexing, Transmission Media, Asynchronous Communication, Wireless Transmission, ISDN, ATM, Cellular Radio, Switching Techniques and Issues.

- **LOGICAL LINK CONTROL LAYER** **(06 Hours)**

  LLC Design Issues, Framing, Error and Flow Control, Framing Techniques, Error Control Methods, Flow Control Methods, PPP and HDLC.

- **MEDIUM ACCESS CONTROL LAYER** **(06 Hours)**

  MAC Layer Design Issues, Channel Allocation Methods, Multiple Access Protocols - ALOHA, CSMA, CSMA/CD Protocols, Collision Free Protocols, Limited Contention Protocols, LAN Architectures, IEEE -802 Standards, Ethernet(CSMA/CD), Token Bus, Token Ring, DQDB, FDDI, Bridges and Recent Developments.

- **NETWORK LAYER** **(06 Hours**

  Network Layer Design Issues, Routing Algorithms and Protocols, Congestion Control Algorithms and QoS, Internetworking, Addressing, N/W Layer Protocols and Recent Developments.

- **TRANSPORT LAYER** **(06 Hours**

  Transport Layer Design Issues, Transport Services, Sockets, Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Transport Layer Protocols, Real Time Transport Protocol (RTP), Stream Control Transmission Protocol (SCTP), Congestion Control, QoS and Recent Developments, Virtualization, Network Functions Virtualization(NFV), Software Defined Networks.

- **APPLICATION LAYER** **(06 Hours**

  Client Server Model, Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP) and Recent Developments.

Tutorials will be based on the coverage of the above topics separately **(14 Hours**

Practicals will be based on the coverage of the above topics separately **(28 Hours**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours= 84 Hours

5. Books Recommended:

1. William Stalling, "Data and Computer Communication", 10/E, Pearson India, 2017.
2. B. Forouzan, "Data Communication and Networking", 5/E, McGraw Hill, 2017.
3. Douglas E. Comer, "Internetworking with TCP/IP Volume – I", 6/E Pearson India, 2015.
4. Andrew S. Tanenbaum, "Computer Network", 5/E, Pearson India, 2013.
5. W. Richard Stevens, "TCP/IP Illustrated Volume - I", 2/E, Addison Wesley, 2011.

Practical / Assignments / Tutorials

Practical Assignments shall be based on the theory topics and shall consist of implementation of small routines/tools/programs/utilities using C / C++ / NetSim / Qualnet/NS2.

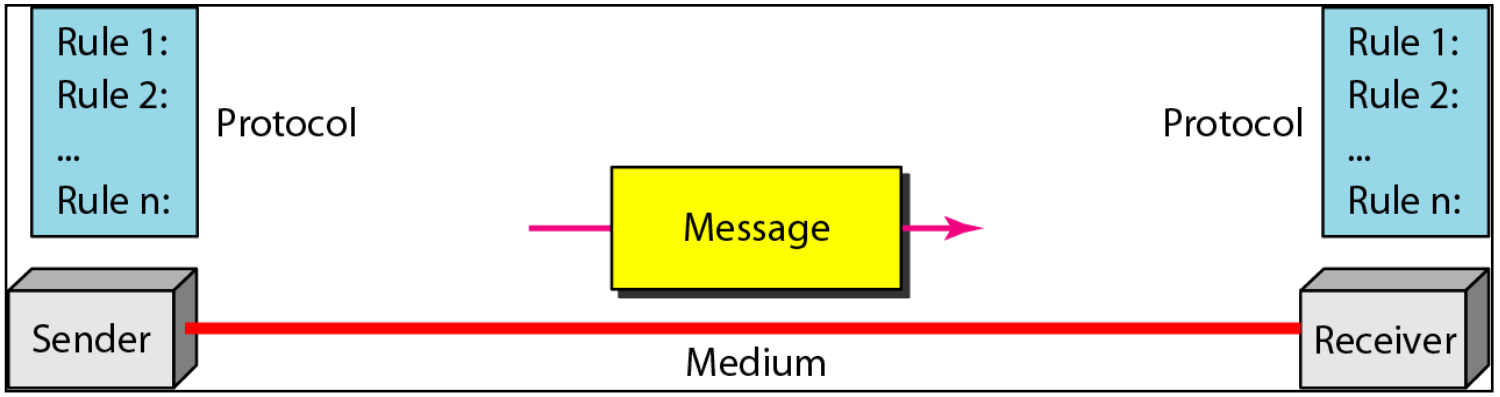
Tutorial / assignments shall be specifically based on the implementation of some standards/ Quiz /Presentations.

Introduction

The term telecommunication means communication at a distance. The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data. Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Components
Data Representation
Data Flow

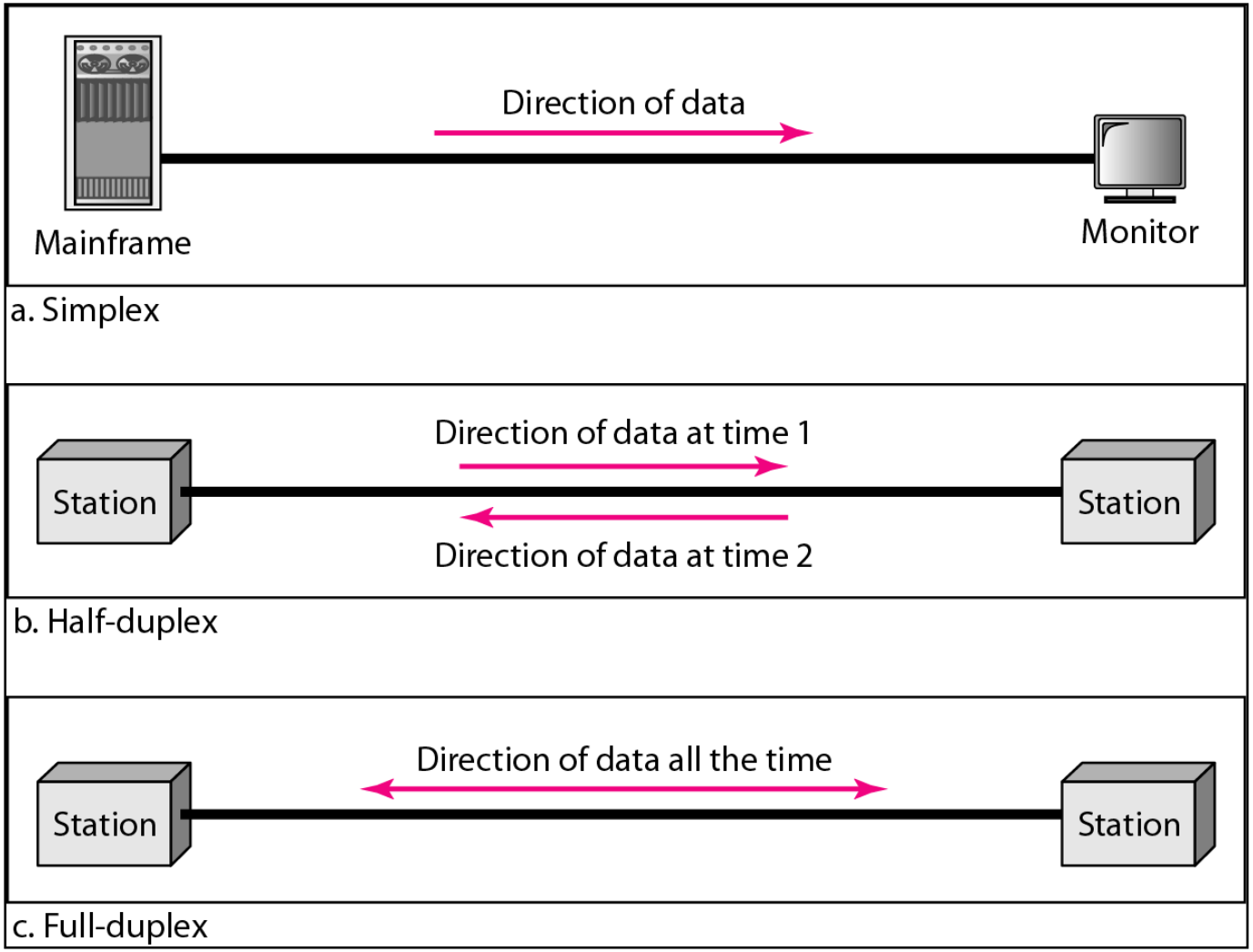
Figure 1.1 *Five components of data communication*



Data Representation

- *Text*
- *Numbers*
- *Images*
- *Audio*
- *Video*

Figure 1.3 *Data flow (simplex, half-duplex, and full-duplex)*



1-2 NETWORKS

A network is a set of devices (often referred to as nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.

Distributed Processing
Network Criteria
Physical Structures - Type of Connection, Physical Topology
Network Models
Categories of Networks
Interconnection of Networks: Internetwork

Network Criteria

- Performance
- Reliability
- Security

Figure 1.3 Physical Structure (*Types of connections: point-to-point and multipoint)*

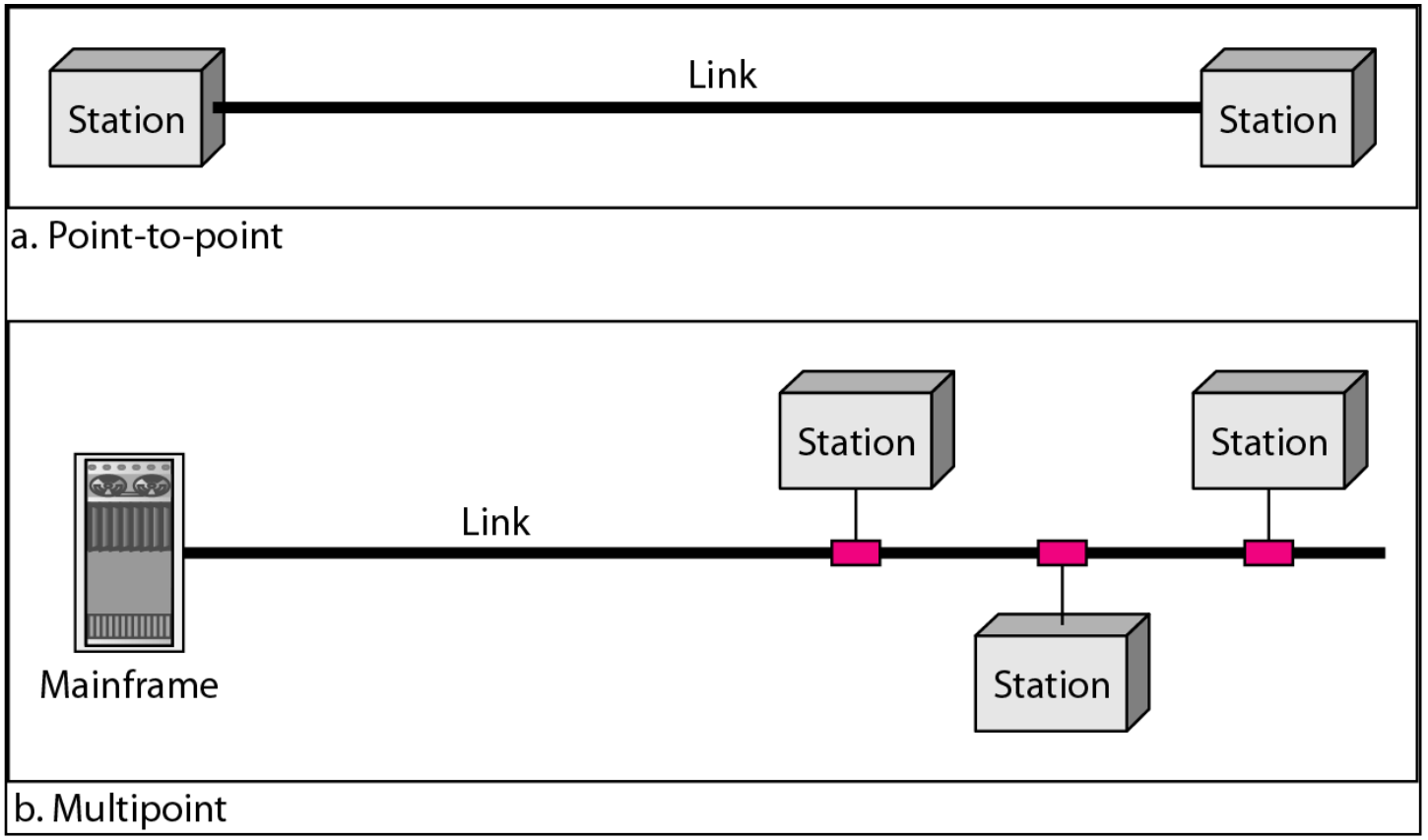


Figure 1.4 Physical Structure (*Categories of topology)*

Physical topology refers to the way network is laid out physically where

- Two or more devices connect to a link
- Two or more links form a topology

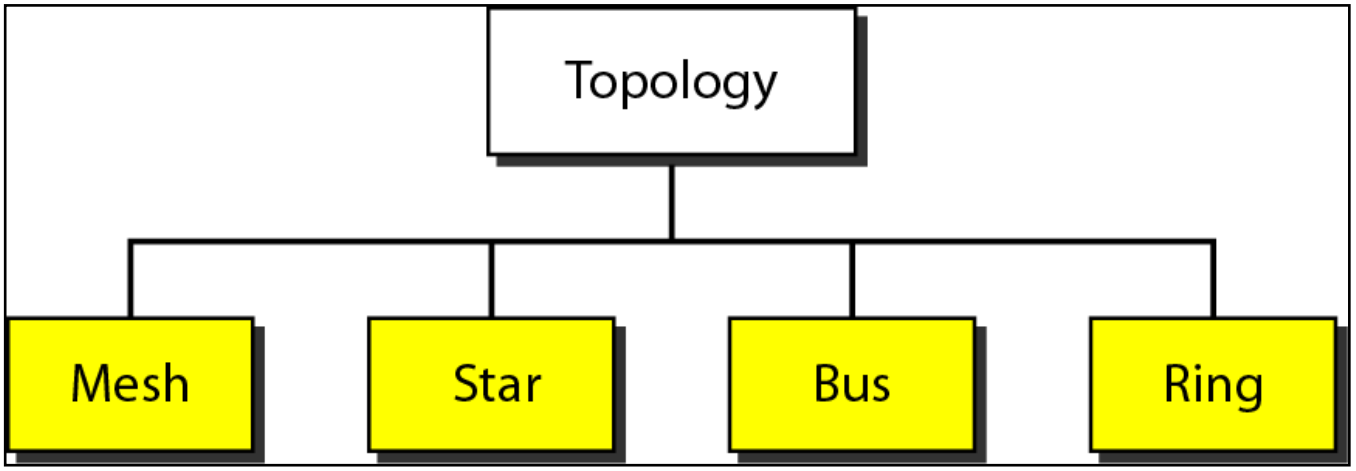


Figure 1.5 *A fully connected mesh topology (five devices)*

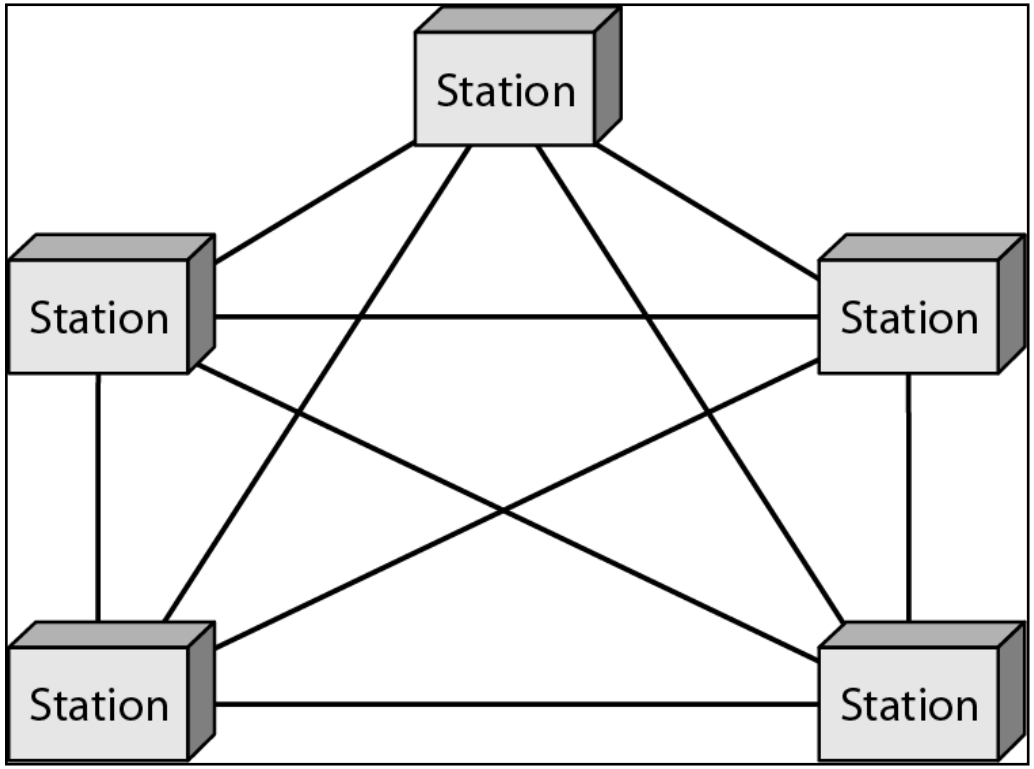


Figure 1.6 *A star topology connecting four stations*

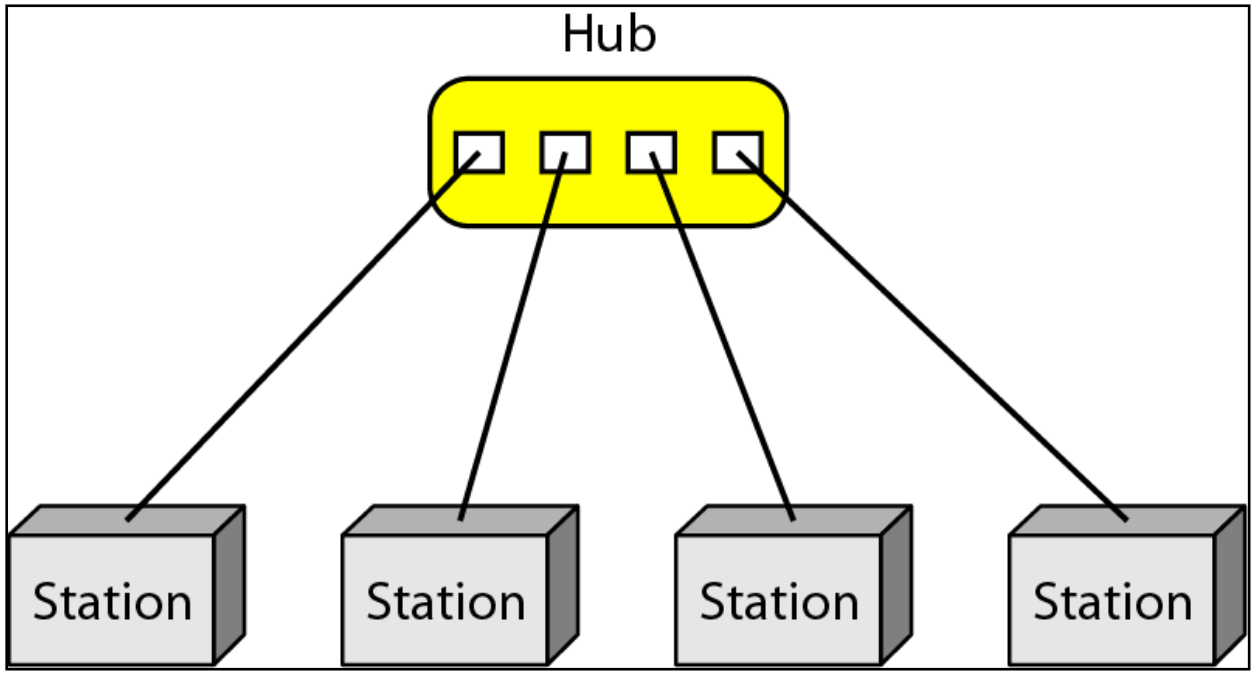


Figure 1.7 *A bus topology connecting three stations*

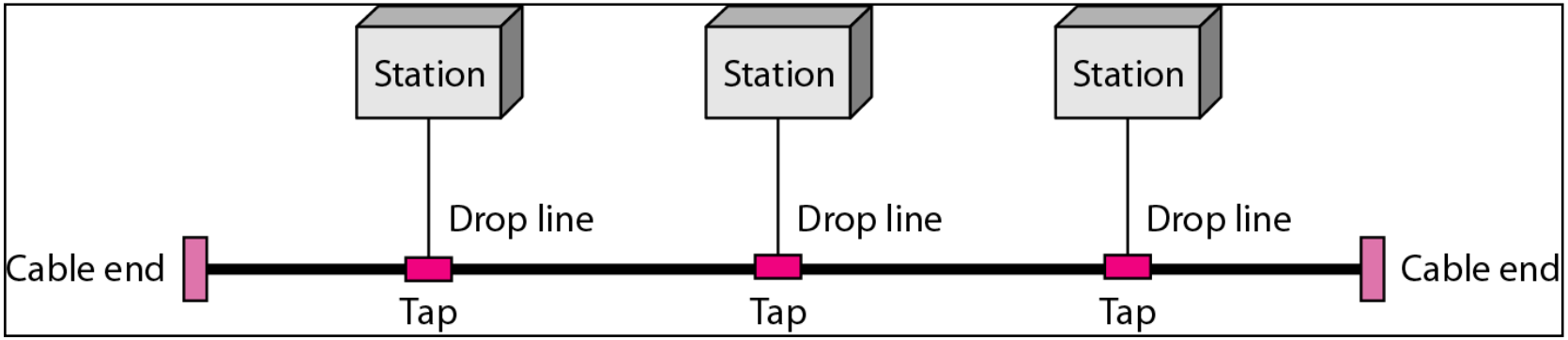


Figure 1.8 *A ring topology connecting six stations*

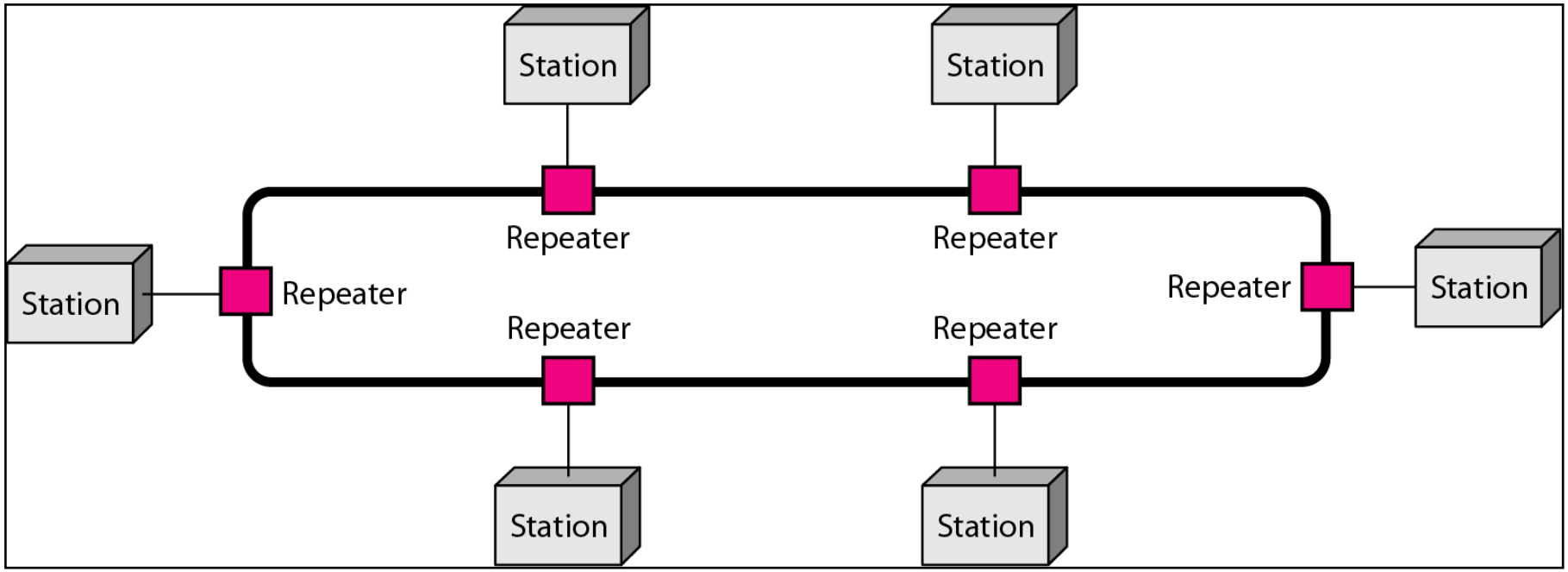
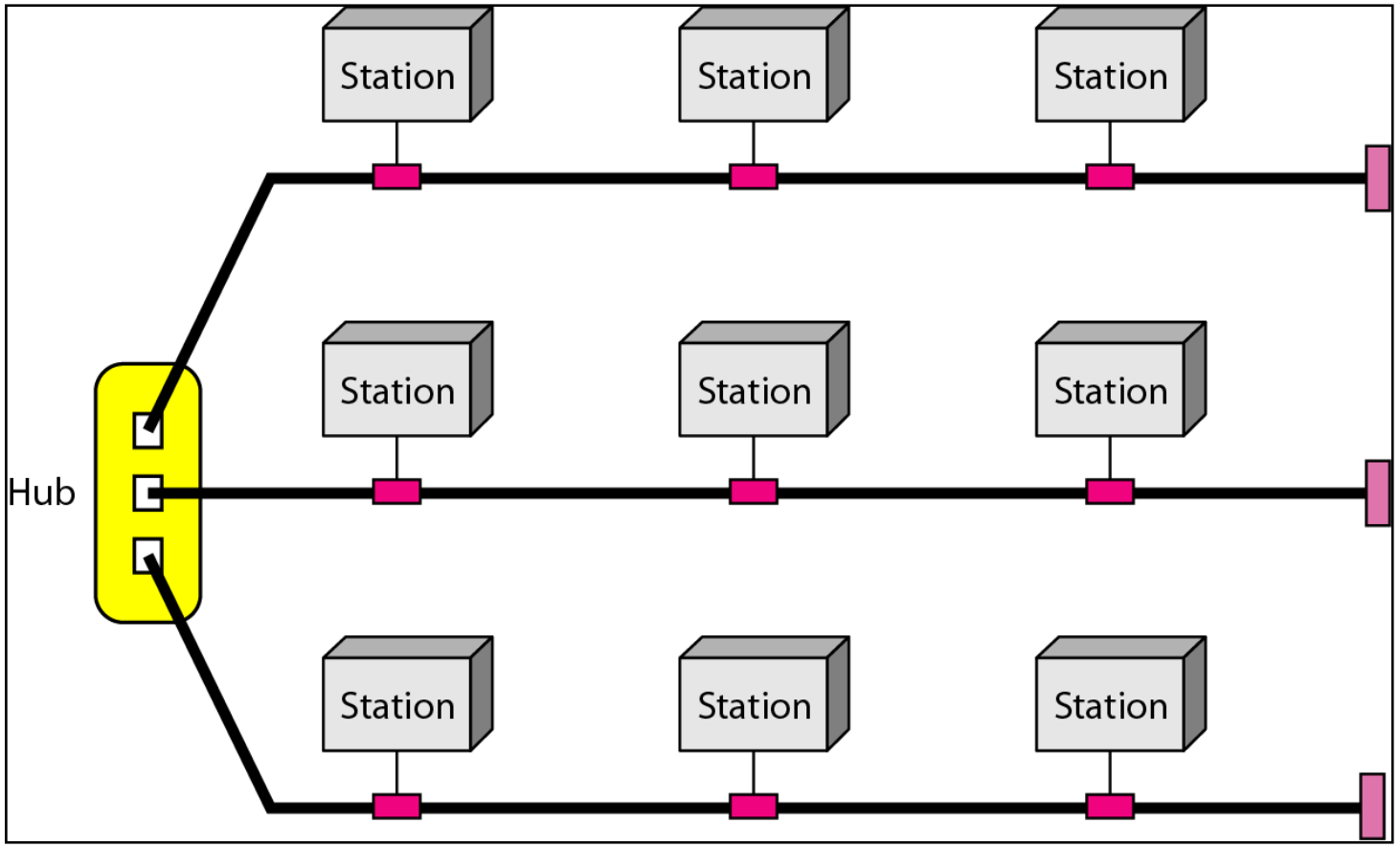


Figure 1.9 *A hybrid topology: a star backbone with three bus networks*



Network Models

- Standards are needed so that multiple hetrogeneous networks can communicate with one another.

- OSI (Open System Interconnection) model (7 layers)
- Internet Model (5 layers)

Categories of Network

- LAN – It is usually privately owned and link devices in a single office, building or campus (within few kilometers).
- WAN – It provide long distance transmission of data usually in country, continent. Creates a backbone of internet
- MAN – Network size between LAN and WAN. Normally covers a town or a city

Figure 1.10 *An isolated LAN connecting 12 computers to a hub in closet*

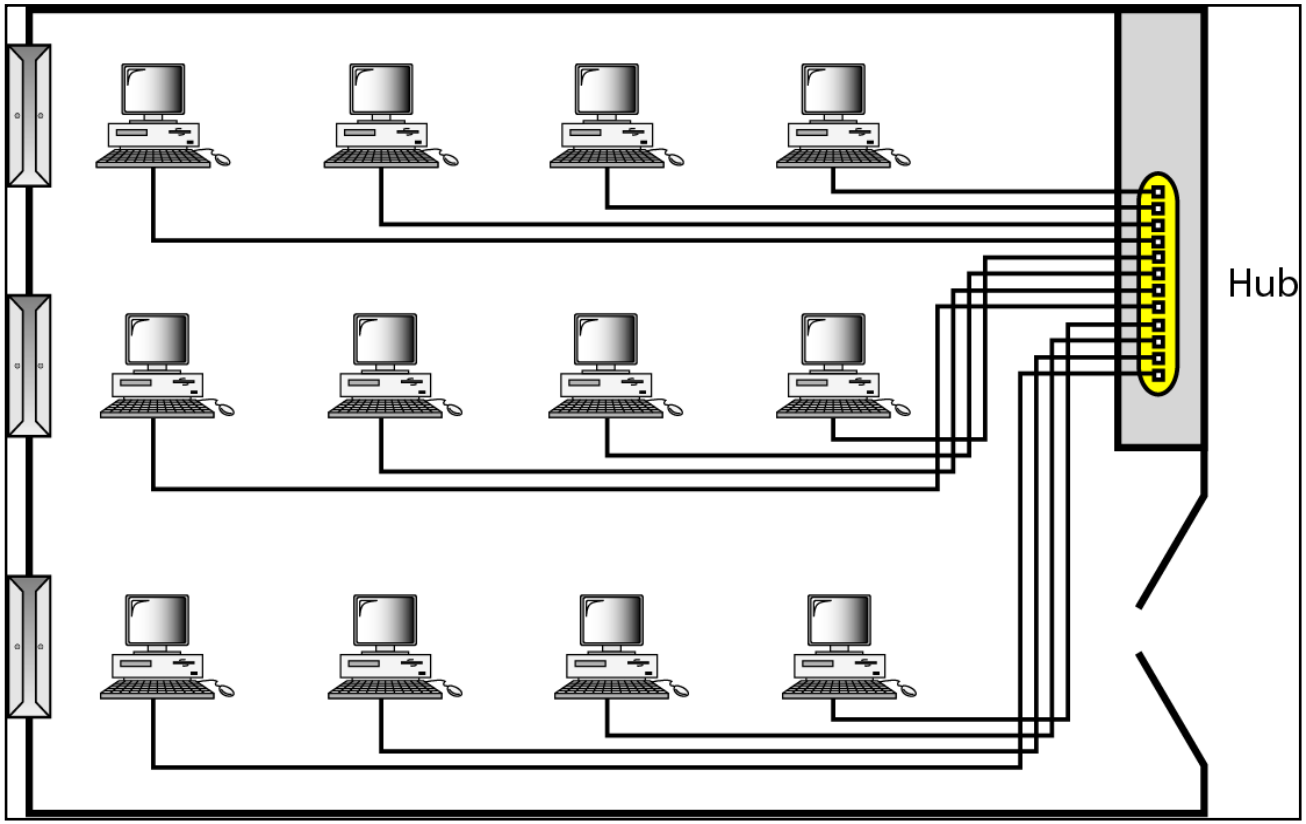


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

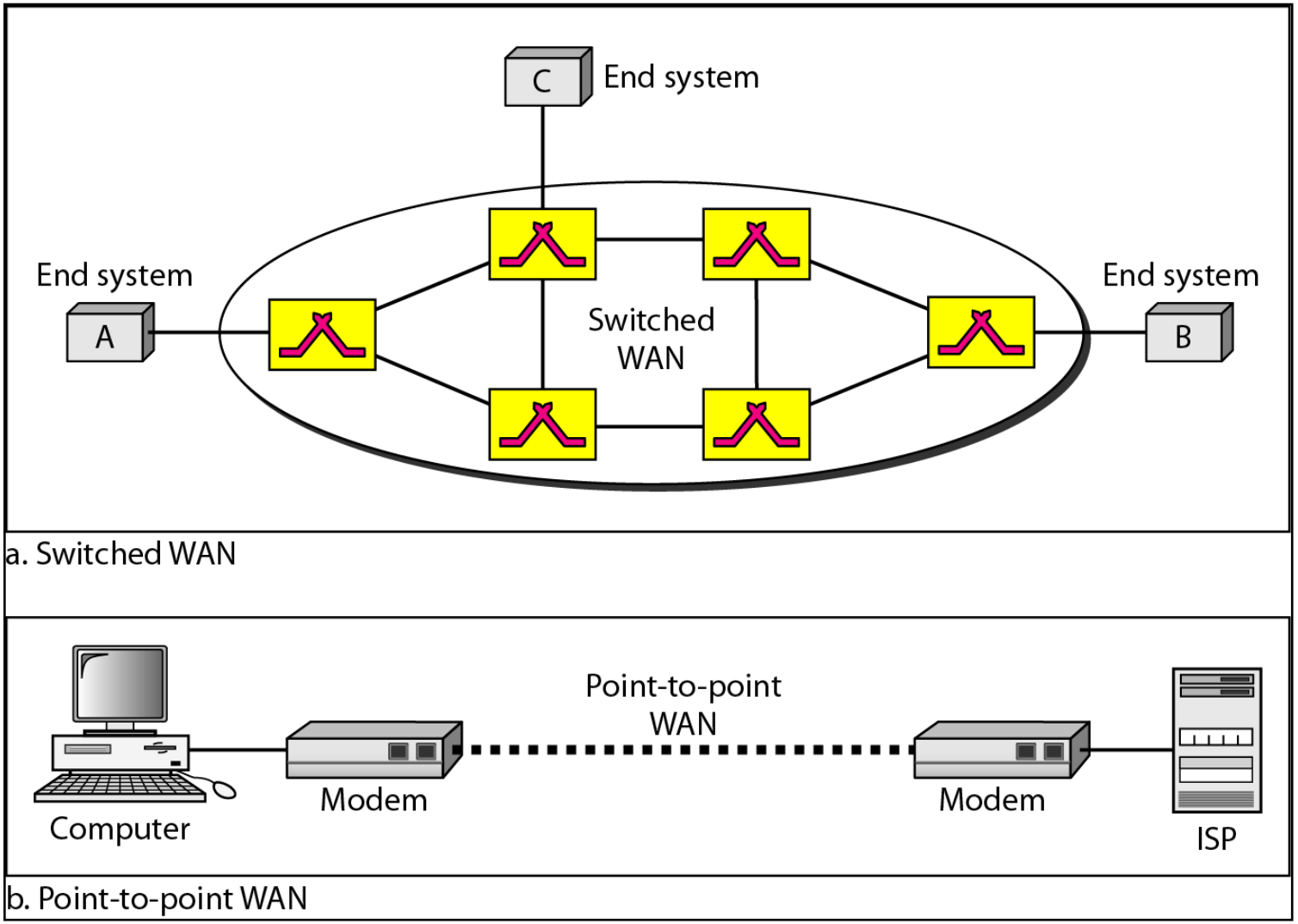
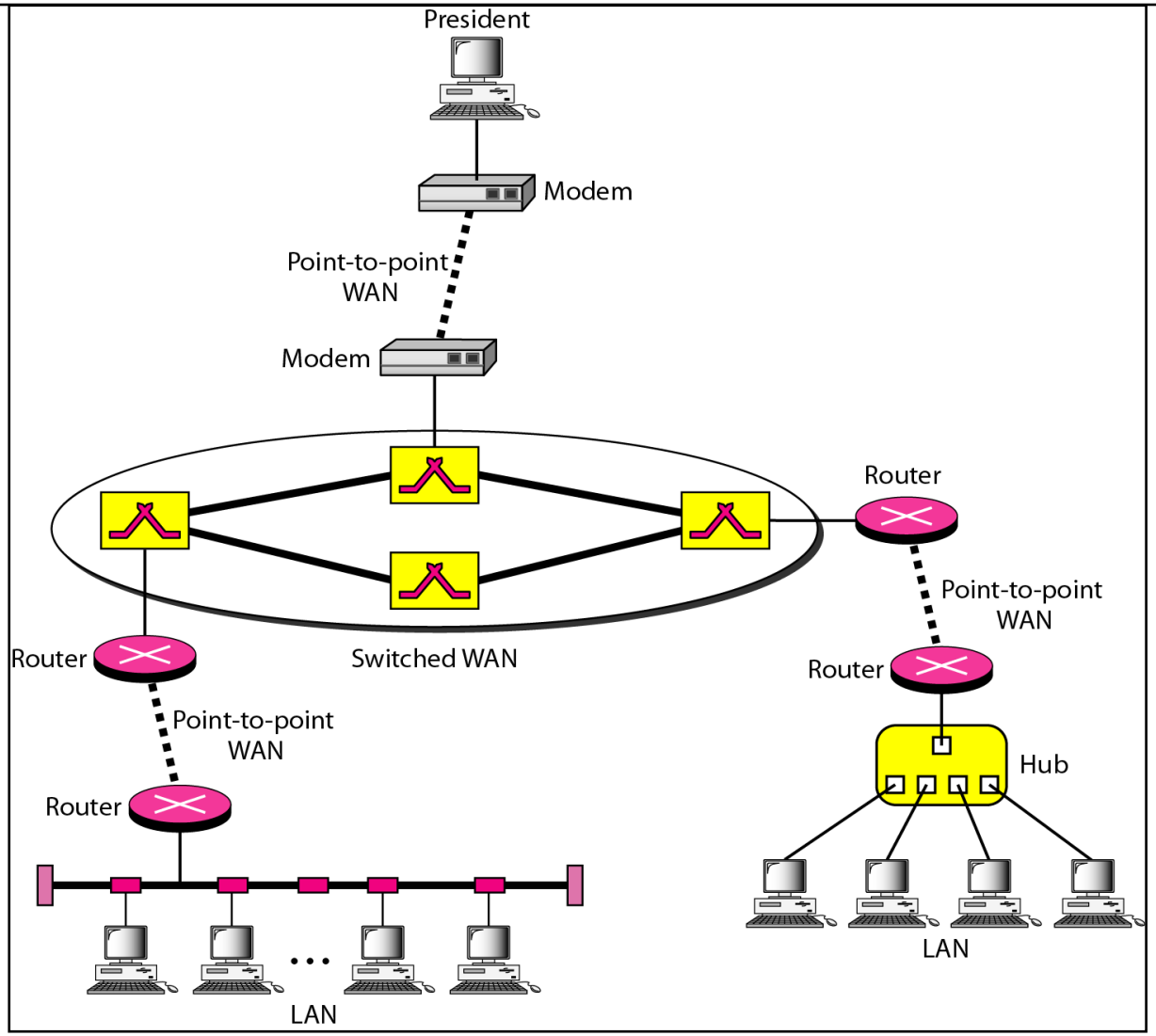


Figure 1.12 *A heterogeneous network made of four WANs and tw LANs*

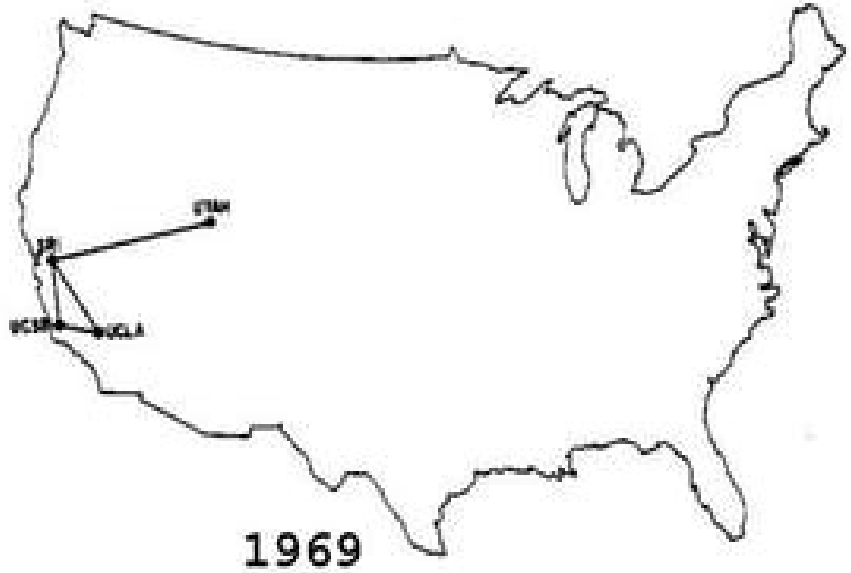


1-3 THE INTERNET

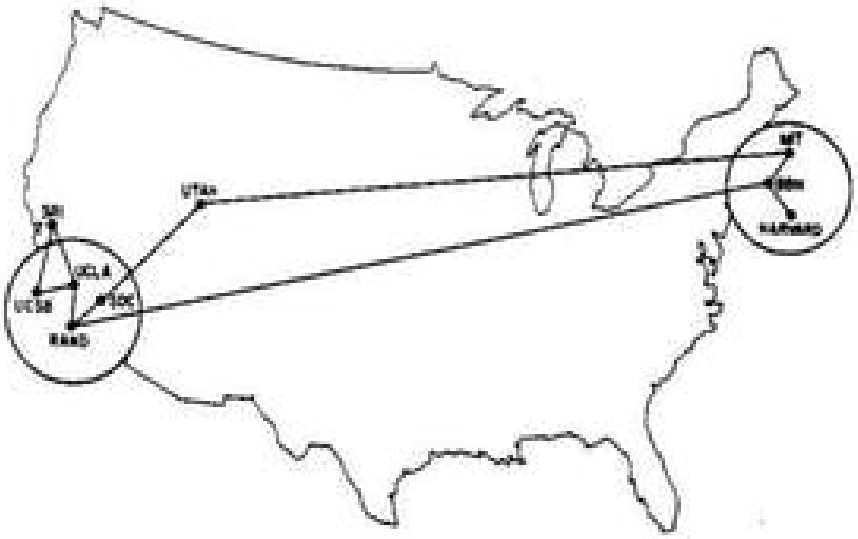
The Internet has revolutionized many aspects of our daily lives. It has affected the way we do business as well as the way we spend our leisure time. The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.

A Brief History
The Internet Today (ISPs)

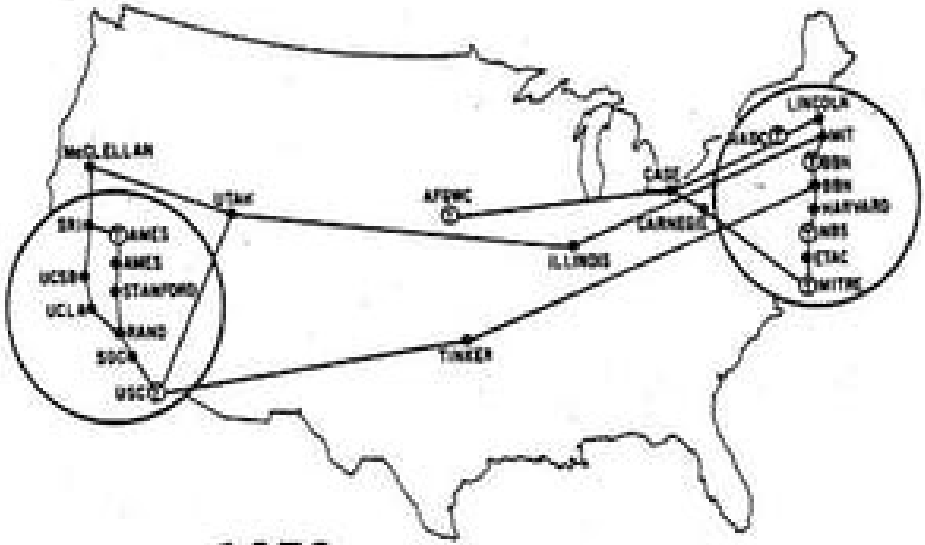
- 1960-Advanced Research Projects Agency (ARPA) in department of Defense (DoD) to connect the comupter to communicate
- 1967-ARPANET, a small network of connected computers via IMP(interface message processor-a specialized computer)
- 1969-ARPANET with 4 nodes from UCLA, UCSB,Stanford Research Institute (SRI) and University of UTAH were connected via IMP.
- 1972-Vint Cerf and Bob Kahn initiated *Internetting Project*
- 1973-Cerf and Kahn's landmark paper outlined the protocol to achieve end to end delivery of packets – *Transmission Control Protocol (TCP)*



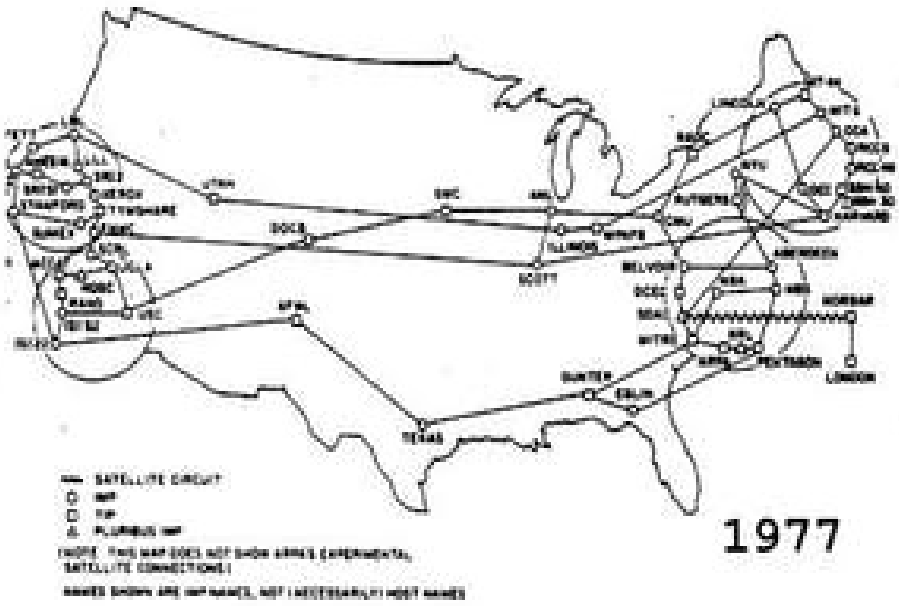
1969



1970

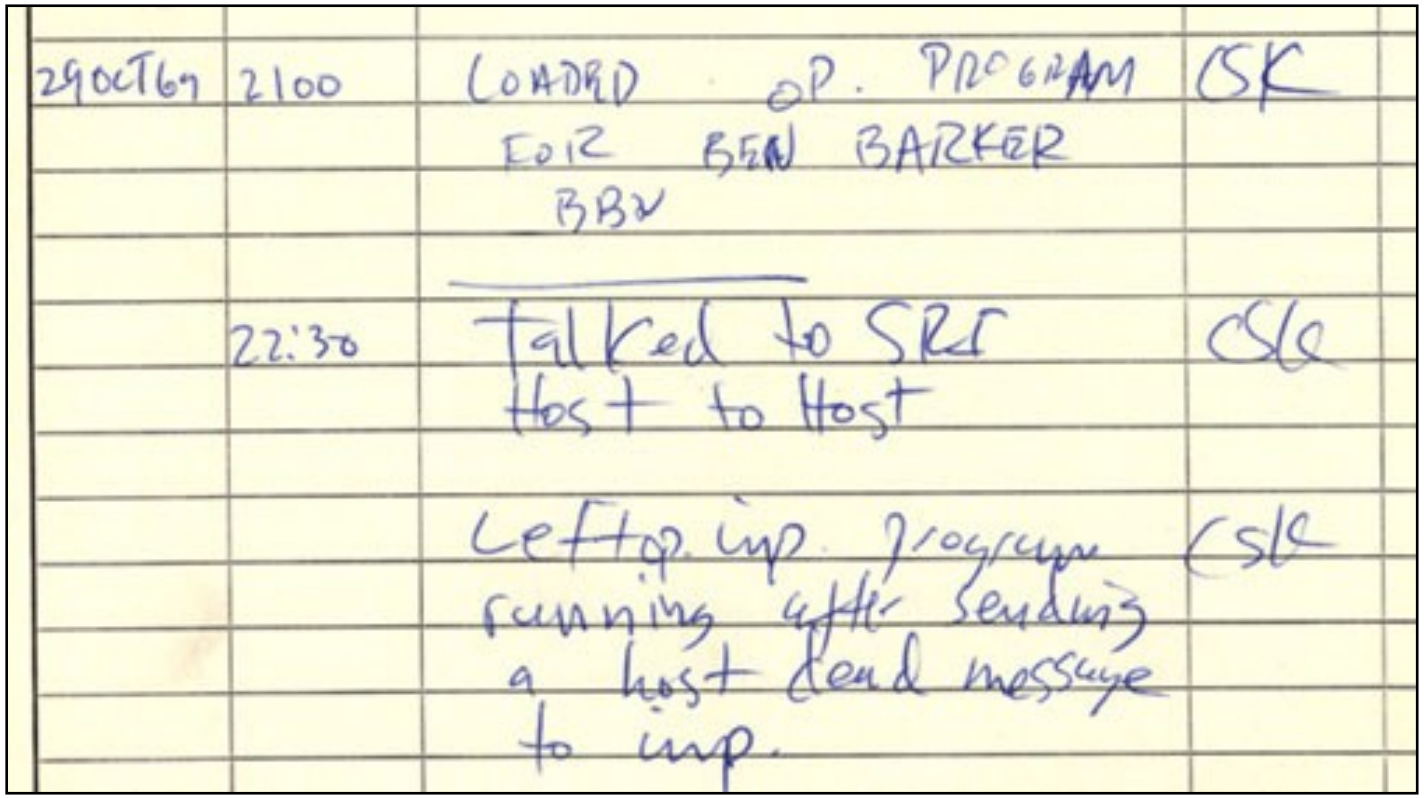


1972



1977

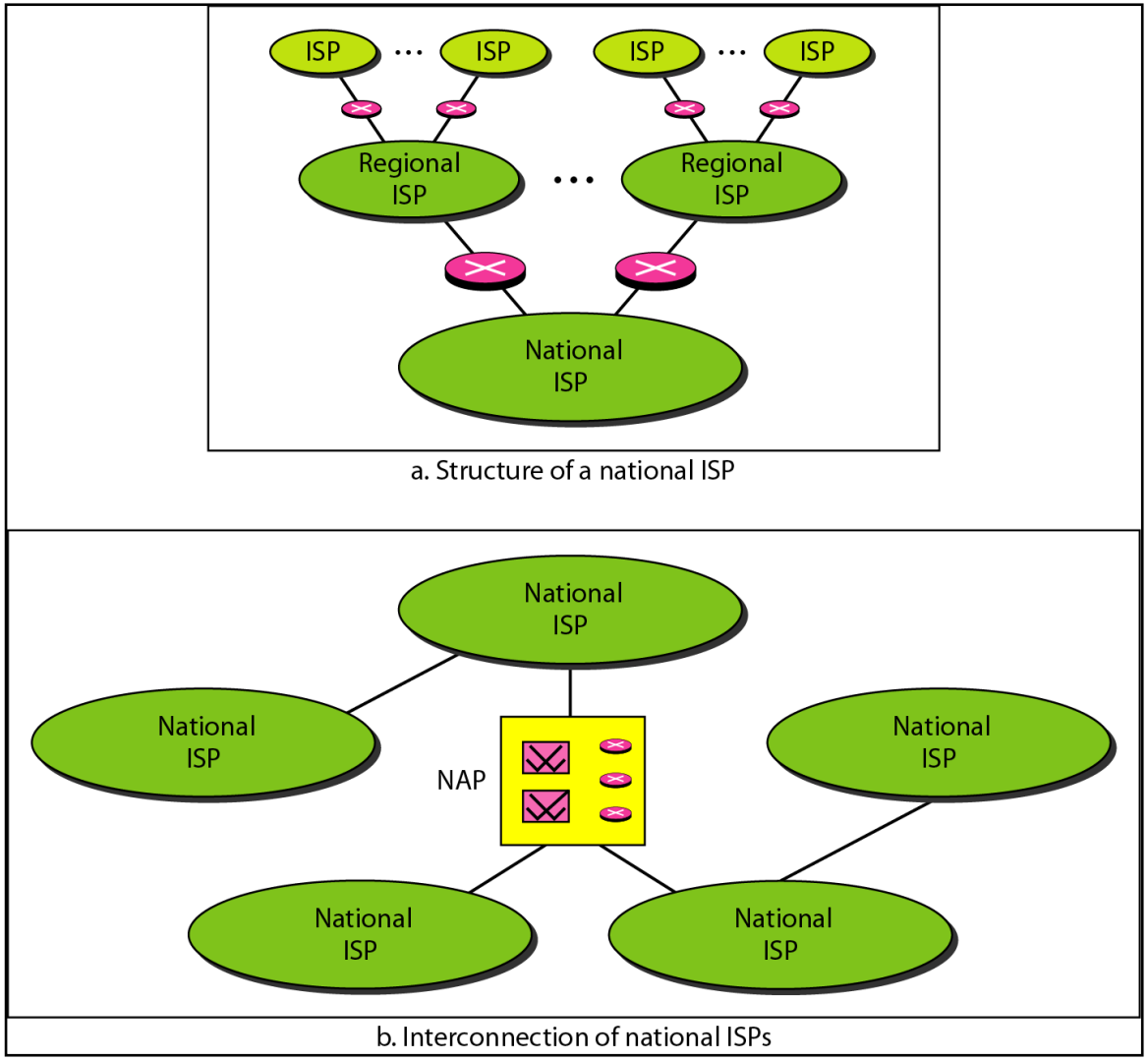
ARPANET interface for Xerox PARC’s PDP-10.



29OCT69	2100	LOADED UP. PROGRAM EOIR BEN BARKER BBN	CSK
	22:30	talked to SRI Host to Host	CSK
		Left up. Imp. program running after sending a host dead message to imp.	CSK

Historical document: First ARPANET IMP log:
the first message ever sent via the ARPANET, 10:30 pm PST on 29 October 1969 (6:30 UTC on 30 October 1969). This IMP Log excerpt, kept at UCLA, describes setting up a message transmission from the UCLA SDS Sigma 7 Host computer to the SRI SDS 940 Host computer.
The initials "CSK" in the log stand for Charles S. Kline. Charley was the first person to ever login to a remote host via the

Figure *1.13* Internet today



Now, we define two widely used terms: protocols and standards.
First, we define protocol, which is synonymous with rule. Then we discuss standards, which are agreed-upon rules.

Protocols
Standards
Standards Organizations
Internet Standards

Protocols and Standards

- Protocols (synonym Rule) decides syntax (representation - header or footer), semantics (meaning of each section of bits) and timing (when and how much data)

- Standards (arrged upon rules) are used to create and maintain open and competitive market. Eg. 802.15

Standard organizations and Internet Standards

- International Organization for Standardization (ISO)
- International Telecommunication Union-Telecommunication Standards Sector (ITU-T)
- American National National Standards Institute (ANSI)
- IEEE
- EIA

- Internet Standards – A throughly tested specification that is added with Internet
- Internet Draft (6 months) and Request for Comment (RFC)