

2CS304

Digital Communications

Semester-III

Department of Computer Science and Engineering
Institute of Technology,
Nirma University

Faculty involved

- Prof Sharada Valiveti
- Prof Chandan Trivedi
- Prof Parita Oza
- Prof Umesh Bodhke

Course Code & Name	2CS304-Digital Communications
Credit Details	2-1-0- 3 [L-T-P-C]
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Course Blog/Website/LMS	https://lms.nirmauni.ac.in/course/view.php?id=1028
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Outline - Lecture-1

- ▶ **Why Digital Communications?**
- ▶ **What to study?**
 - Syllabus & Course Outcomes
- ▶ **How we study?**
 - Teaching and Examination Scheme
- ▶ **Tutorial Class, Books, Resources**
- ▶ **Necessity of Communication and Networks**
- ▶ **Applications and Components of Communication**
- ▶ **Transmission modes and Topologies**

Introduction to Digital Communications

- Communication is the need of the day
- Digital Communication – information is encoded digitally as discrete signals and electronically transferred to the recipients
- Impact of communication on our daily lives
 - Using the internet and mobile phones for interpersonal communication
 - Businesses, banking, transportation systems, TV and radio broadcasts etc.
- This course orients the students about various aspects of data encoding for digital communication and introduces the entire networking system to explore further in upcoming semesters

Course Outcomes (COs):

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

1. explain data/signal transmission over communication media
2. analyze various spread spectrum, multiplexing and modulation techniques
3. apply the concepts of data communication to solve various problems

SYLLABUS

Unit I

Introduction to Data Communication: Components of network, its types and topology, protocol. Network models: OSI reference model, TCP/IP protocol suite, Applications of data communications Data Communications and Networking for Today's Enterprise

7

Unit II

Data and Signal: Types of Analog and digital signals and its characteristics, transmission of digital signal, data rate limits, signals in time and frequency domain, transmission impairment, performance measurement of network

4

Unit III

Digital Transmission: Digital to Digital and Analog to Digital conversions, Transmission modes, Digital to Analog and Analog to Analog conversions

6

Unit IV

Multiplexing and Spread Spectrum Techniques: Switching techniques, types of switching, structure of a switch, types of switches, telephone and cable network for data communication, dial up modem, DSL lines, Cable TV

5

Unit V

Types of Errors: Detection versus correction, coding, block coding, cyclic codes, checksum, forward error correction

4

Unit VI

Transmission Media: Guided media and unguided media: radio frequency allocation, frequency reuse, propagation of radio waves, micro waves and infrared, satellite communication, cellular telephony

4

Suggested Readings

1. Behrouz Forouzan, Introduction to Data Communication and Networking, Tata McGraw Hill
2. William Stallings, Data and Computer Communication, PHI
3. Schweber W.L, Data Communication, Tata McGraw Hill
4. Andrew S Tanenbaum, Computer Networks, PHI
5. B.P. Lathi, Zhi Ding, Modern Digital and Analog Communication, Oxford University Press

Lesson Planning

Topics	Hour(s)	CO Mapping	Applications
Unit I Introduction to Data Communication: <ul style="list-style-type: none"> Components of network, its types and topology, protocol. Network models: OSI reference model, TCP/IP protocol suite, Applications 	[7] 2 4 1	CO 1	Network design, Network programming
Unit II Data and Signal: <ul style="list-style-type: none"> Types of Analog and digital signals and its characteristics Transmission of digital signal, data rate limits, signals in time and frequency domain Transmission impairment, performance measurement of network 	[4] 1 2 1	CO1, CO3	Network Design and troubleshooting, Noise Removal
Unit III Digital Transmission: <ul style="list-style-type: none"> Digital Transmission: Digital to digital and Analog to digital conversion, Transmission modes Analog transmission: Digital to analog and analog to analog conversion 	[6] 3 3	CO2	Digital Data Transmission, Radio and TV Broadcasting

Unit IV Multiplexing and Spread Spreading Techniques: <ul style="list-style-type: none">• Pseudo-Noise Sequence & DS Spread Spectrum• FH Spread Spectrum• Multiple Access Techniques	[5] 	CO2 	Privacy of data, Anti-jamming
Unit V Error Detection and Correction : <ul style="list-style-type: none">• Detection versus correction, coding, block coding• Cyclic codes, checksum, forward error correction.	[4] 	CO1,3 	Error Detection & Correction in Transmission
Unit VI Transmission Media: <ul style="list-style-type: none">• Guided media• Unguided media	[4] 	CO1 	Home and College Network

Component wise Continuous Evaluation & Semester End Examination weight-age

Component	Continuous Evaluation			SEE
Component weightage	0.6			0.4
	Quizzes(3) 30%	Assignments (2) 30%	Comprehensive Evaluation - 40%	

Tutorials details:

The tutorials are planned as per the mentioned schedule and list is updated on LMS

Course Assessment Schemes

- **Continuous Evaluation (100 marks)**
 - Quizzes (30 marks)
 - Assignments (30 marks)
 - Comprehensive Evaluation (40 marks)
- **Semester End Examination (100 marks)**

Online Class Engagement Strategies

1. Involve the students during session (instead of lecturing them) and learn to call students by names. This will help in ensuring that students stay connected.
2. Asking questionnaire during the sessions which might help you to understand and stay connected with the concepts.
3. Cooperative learning during doubt solving sessions
4. Discussion forums for asynchronous gap-filling and thread management
5. Adapt dynamically to the feedback and shift to high-order thinking skills
6. Extensive use of LMS for the course, as the students need to keep track of himself/herself, pending submissions for all courses and grades attained

Course Material

<https://lms.nirmauni.ac.in/course/view.php?id=1028>

- Course Policy
- PPTs, Notes, other Material
- Tutorials
- Question bank
- Web-links, Blogs, Video Lectures, Journals Animations /Simulations, Software's
- Advanced topics
- Industries/Organizations

Have a great semester ahead!!!

Unit-1

Introduction

Chandan Trivedi

Contents

- Introduction to Data Communications
- Components
- Topologies
- Networks
- Network Types
- Internet History

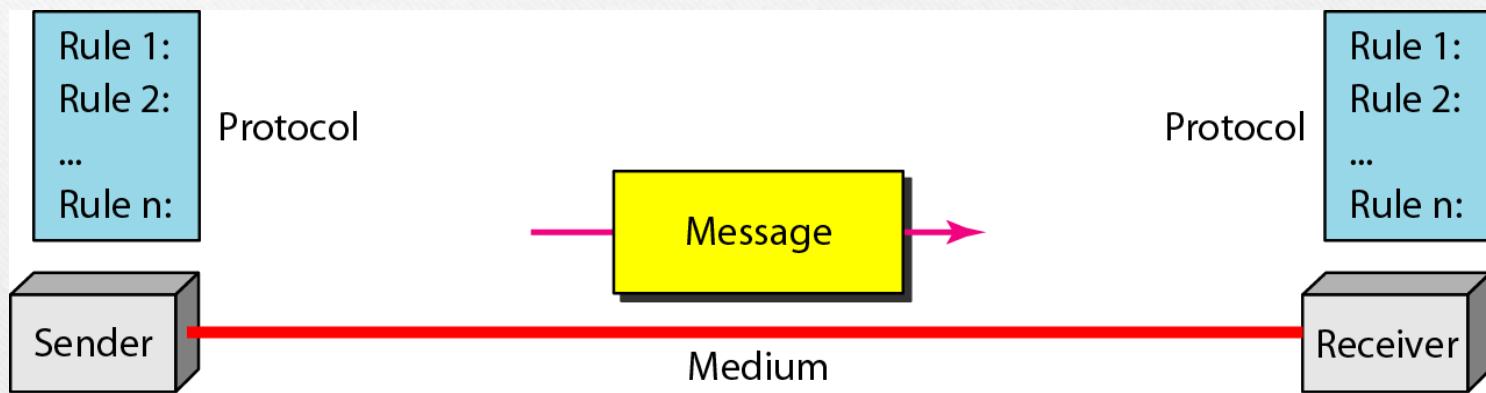
Data Communications

- Communications
 - Communicate means to share information
 - Locally (Face to face) or remotely (telecommunication)
- Data
 - Information presented in whatever form is agreed upon by parties creating and using the data
- Data Communications
 - Exchange of data between two devices via some form of transmission medium
 - Communicating devices must be part of communication system made up of a combination of hardware (physical equipment) and software (programs)

Data Communications

- Effectiveness depends on
 - Delivery
 - System must deliver data to the correct destination
 - Accuracy
 - System must deliver data accurately
 - Timeliness
 - System must deliver data in timely manner
 - Jitter
 - Variation in packet arrival time

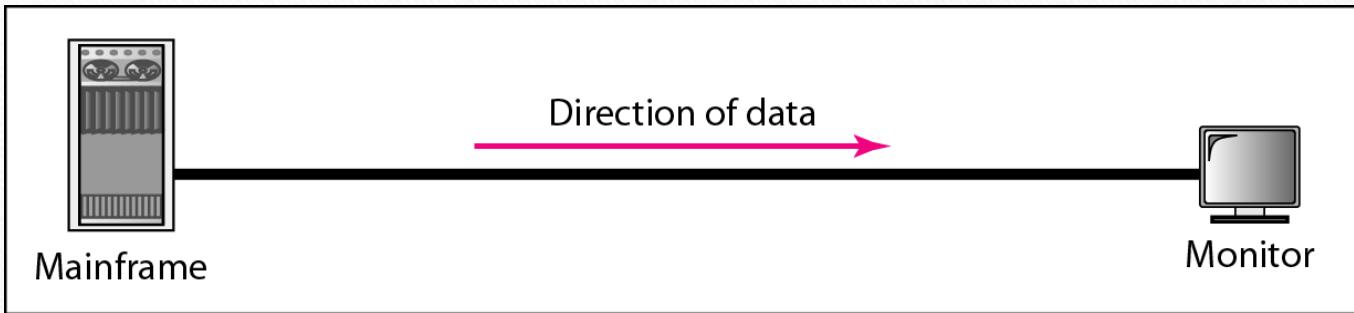
Data Communications



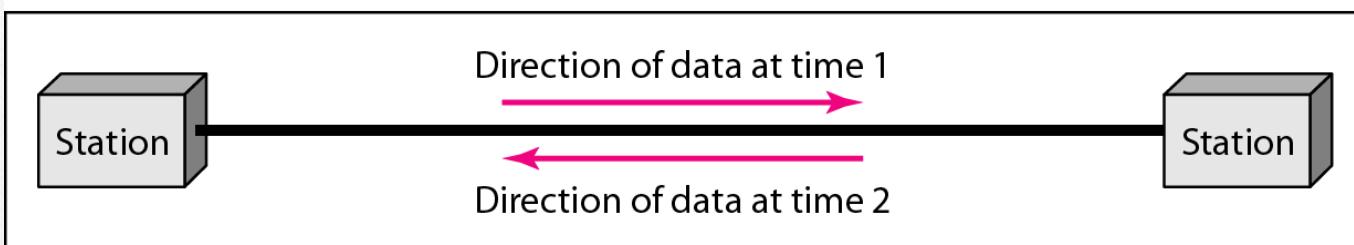
Five components of data communication

Data Communications

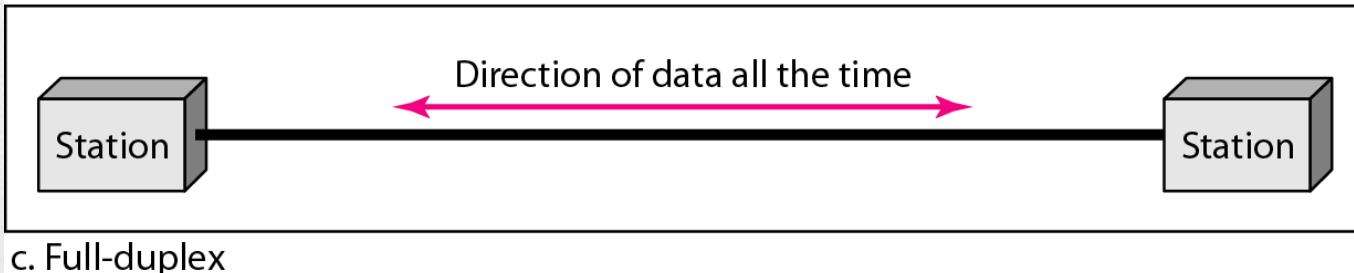
- Data Representation (Bit Pattern)
 - Text – Unicode (32 bits), ASCII
 - Numbers – digits converted to binary
 - Images – matrix of pixels (picture elements)
 - Each pixel is represented by bits to show colour of pixel
 - Audio – recording or broadcasting sound or music
 - Continuous and not discrete
 - Video – recording or broadcasting a picture or a movie
 - Can be continuous or discrete



a. Simplex



b. Half-duplex



c. Full-duplex

Data Flow

Networks

- Interconnection of a set of devices capable of communication
 - Device can be a host or a connecting device, connected using wired or wireless medium

Need of networks

- **Resource sharing**
 - Hardware: printers, disks, terminals, etc.
 - Data.
- **Robustness**
 - Fault tolerance
- **Load balancing**
 - Processing and data can be distributed over the network
- **Location independence**
 - Users can access their files, etc. from anywhere in the network

Networks: Network Criteria

- Performance
 - **Metrics include** - Transit time, response time, number of users, type of transmission medium, capabilities of the connected hardware, efficiency of software, **throughput** and **delay**
- Reliability
 - Frequency of failure, time taken for a link to recover from a failure, network's robustness in catastrophe
- Security
 - Protecting data from unauthorized access, protecting data from damage and development, implementing policies and procedures for recovery from breaches and data losses

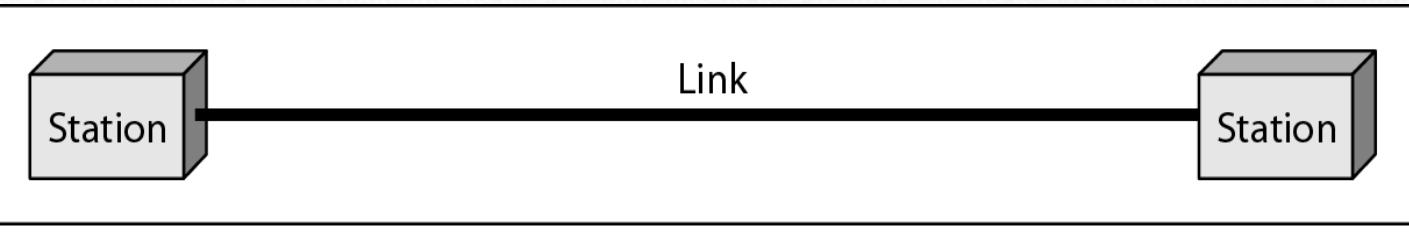
Applications

- Marketing and sales
- Financial services
- Manufacturing
- Electronic data interchange (EDI)
- Electronic mail
- Video on demand
- Voice over IP
- Teleconferencing

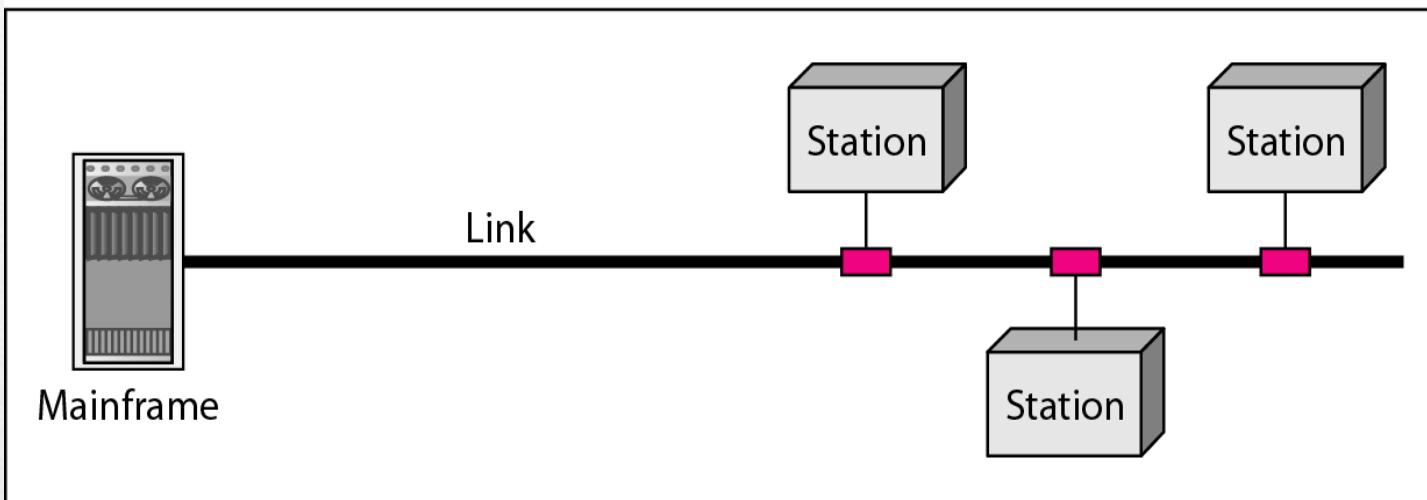
Networks: Physical Structures

- A network is two or more devices connected through **links**
- Two types of connections
 - Point-to-point connection
 - Dedicated link between two devices; entire capacity is reserved for the two devices
 - Multipoint connection
 - More than two specific devices share same link
 - Channel capacity is shared either temporally or spatially

Networks: Physical Structures



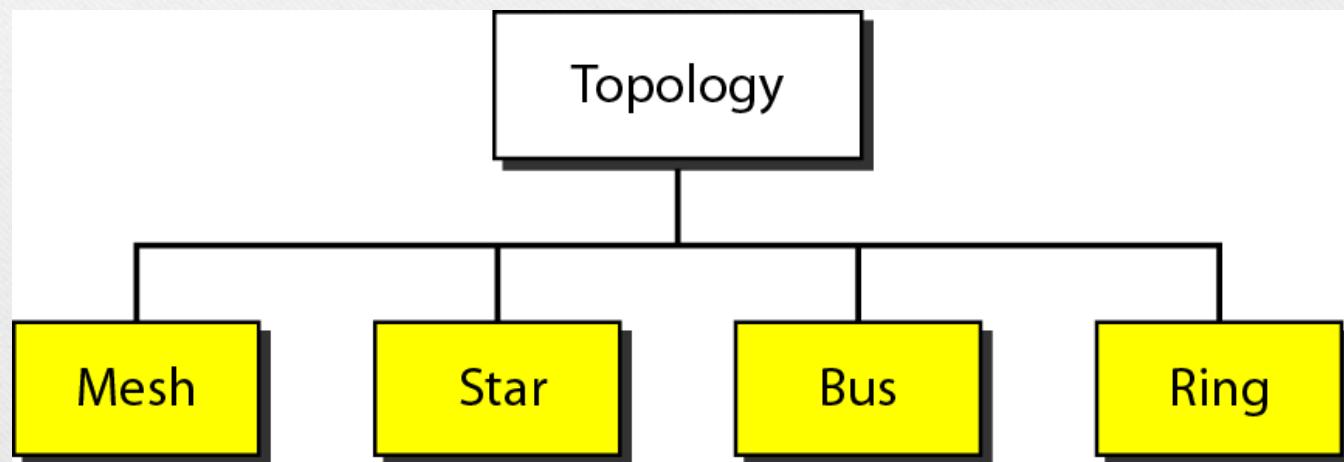
a. Point-to-point



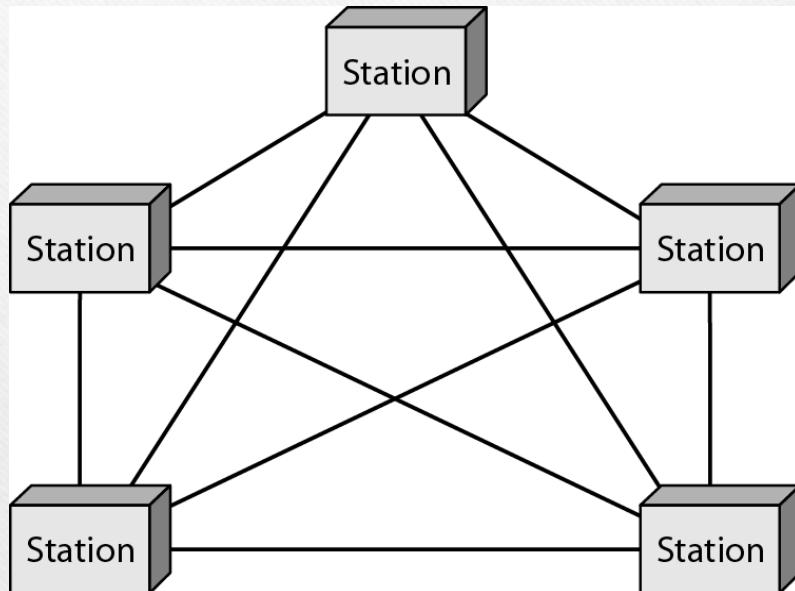
b. Multipoint

Networks: Physical Topology

- Way in which network is laid physically
- Geometric representation of the relationship of all links and linking devices (nodes) to one another

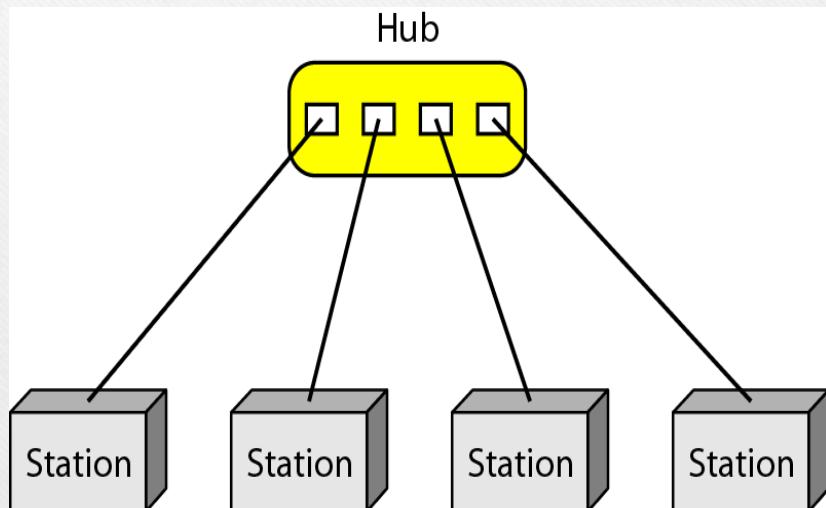


Networks: Physical Topology: Mesh



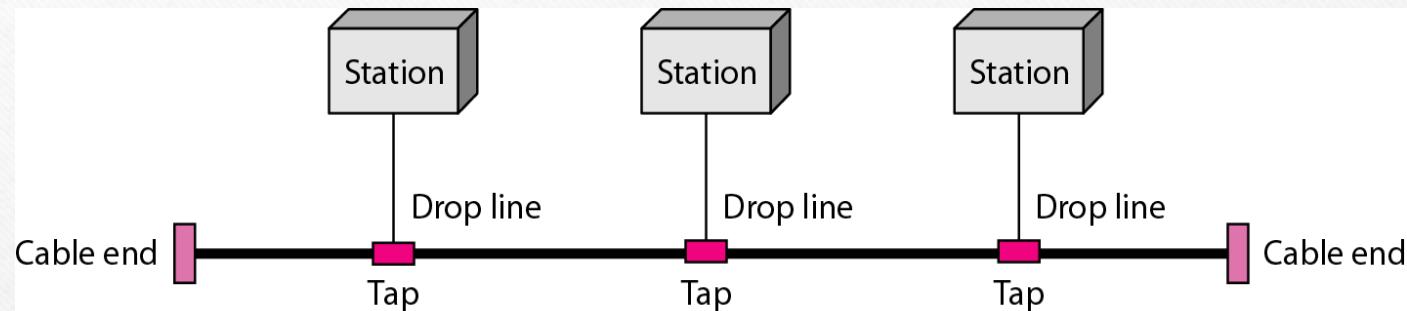
- Dedicated link
- No. of physical links (n nodes):
 - $n(n-1) - \text{if simplex mode}$
 - $n(n-1)/2 - \text{if full-duplex mode}$
- Eg. Each telephone regional office is connected to every other regional office

Networks: Physical Topology: Star



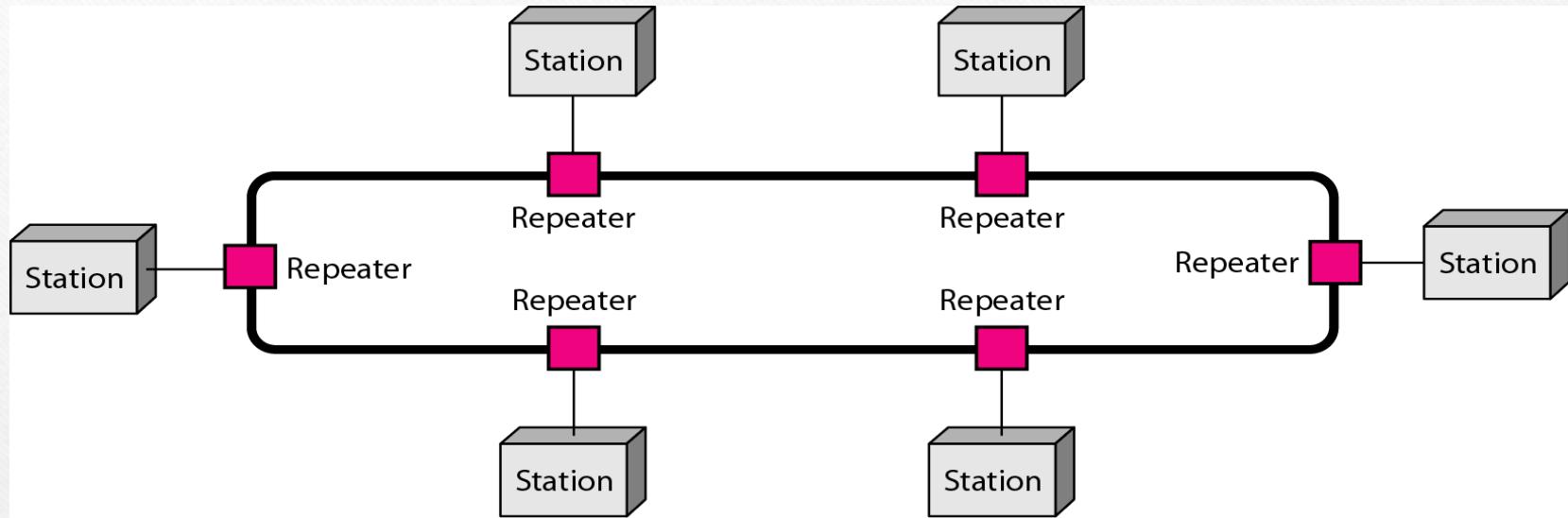
- Each device has dedicated link with the central controller (hub)
- Does not allow direct traffic between devices
 - Controller relays the traffic
- Eg. LANs

Networks: Physical Topology: Bus



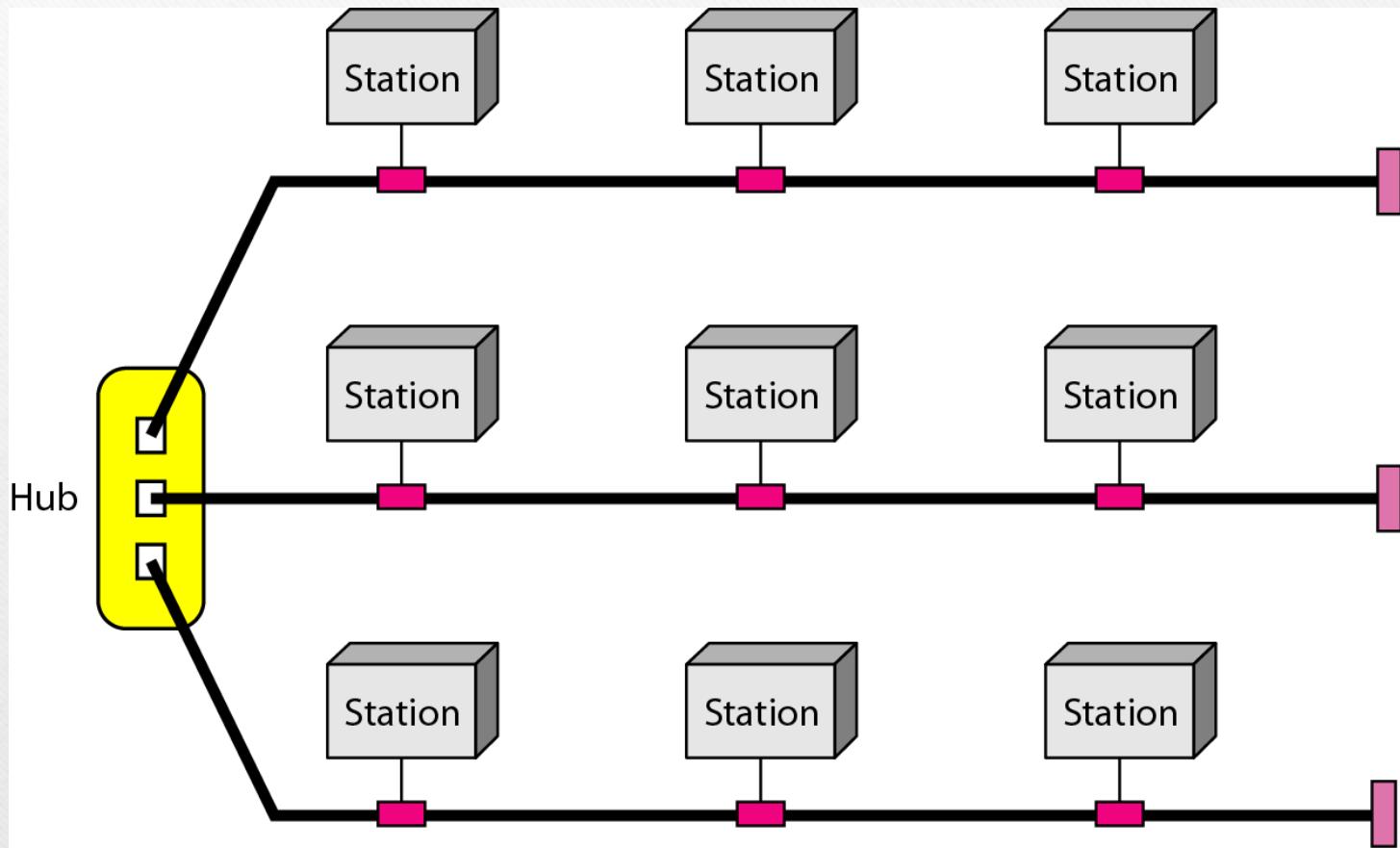
- Multipoint topology
- One long cable acts as a backbone to link all devices
- Nodes connected by drop lines and taps
 - Drop line is connected between main line and node
 - Tap is a connector that splices or punctures into main cable to create contact with the metallic core
- Difficult to reconnect and manage faulty installation

Networks: Physical Topology: Ring



- Each device has a dedicated point-to-point connection with only two devices on either side of it
- When a device receives a signal intended for another device, its repeater regenerates bits and passes them along

Networks: Physical Topology: 3 topologies in Hybrid network

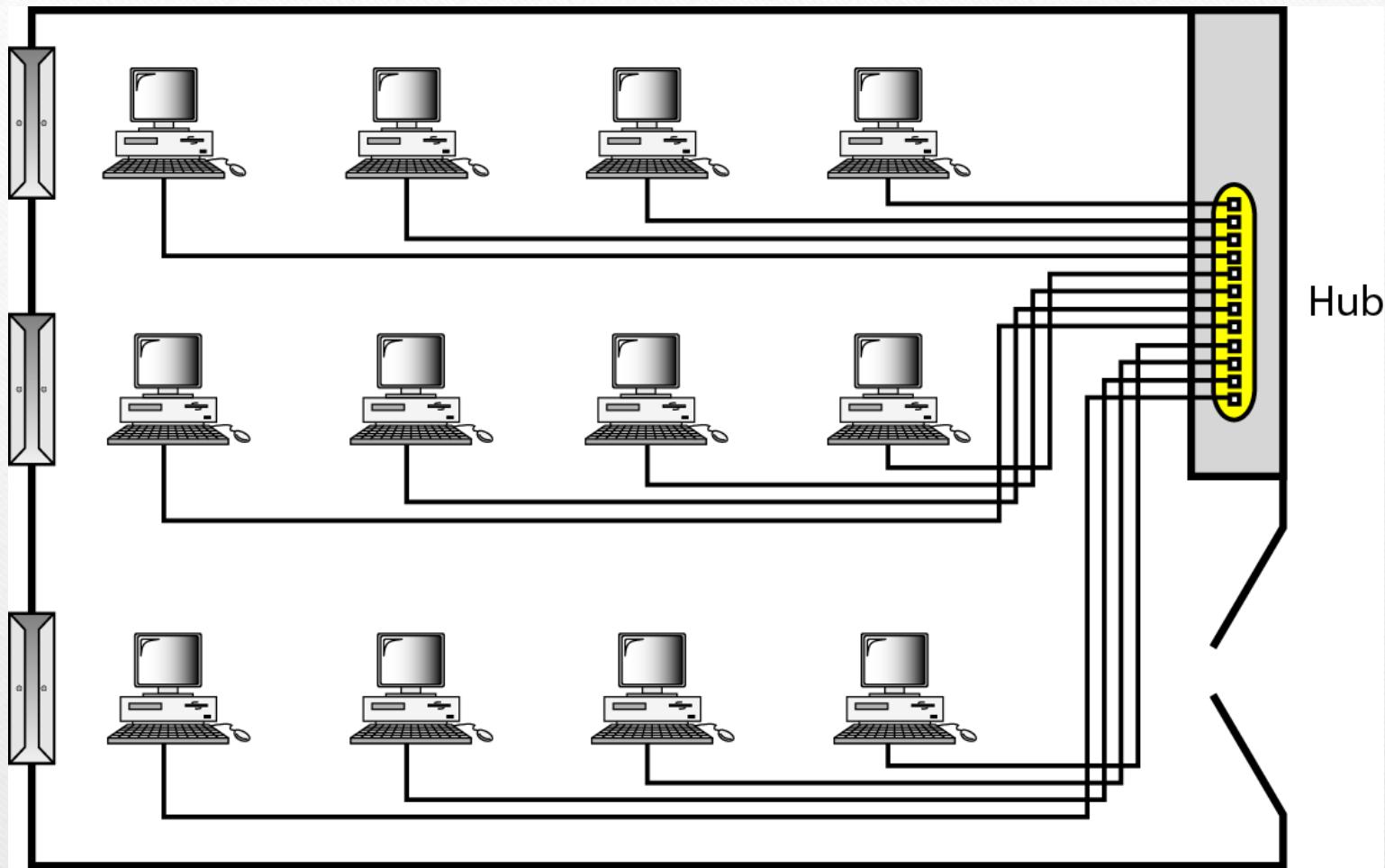


Network Types

- Criteria to define type of network
 - Size
 - Geographical coverage
 - Ownership

Network Types: LANs

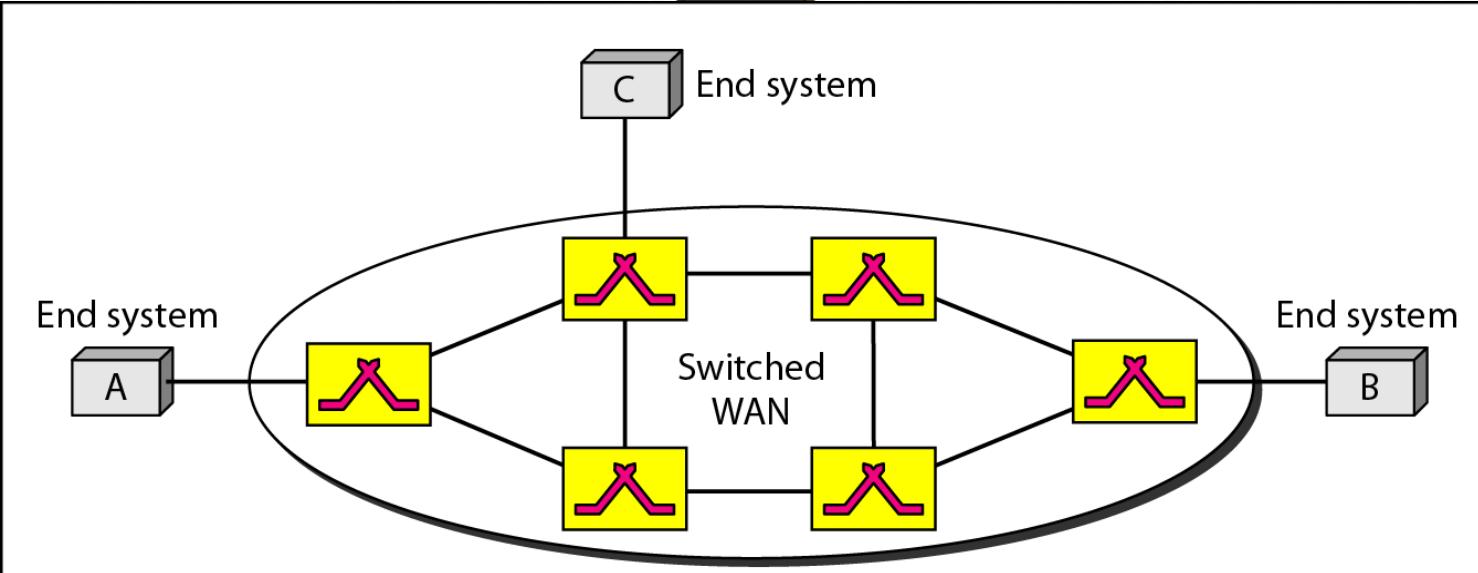
- Usually, privately owned and connects hosts in a single office, building or campus
- Each host has an identifier, an address, that uniquely defines the host in LAN
- Packet sent by a host to another host carries both the source host's and destination host's addresses
- Switch is able to recognize destination address and forwards packets to intended host
- Switch alleviates traffic in the LAN and allows more than one pair to communicate with each other at the same time
- Speeds are normally 100 to 1000 Mbps these days



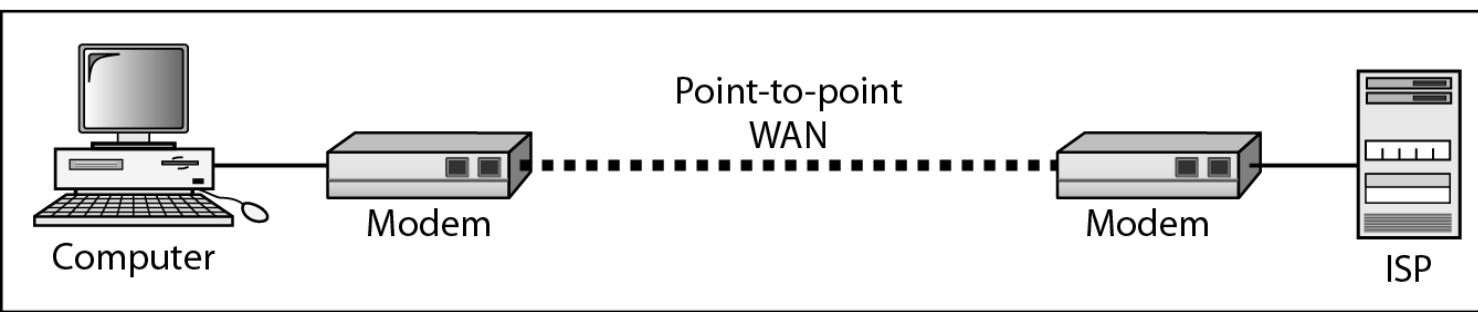
Isolated LAN connecting 12 computers to a hub

Network Types: WANs

- WAN has wider geographical span like spanning a town, state, country or even the world
- Interconnects connecting devices like switches, routers, modems etc.
- Privately owned by an organization usually
- 3 types of WANs
 - Point-to-point WANs
 - Switched WANs
 - Internetwork



a. Switched WAN

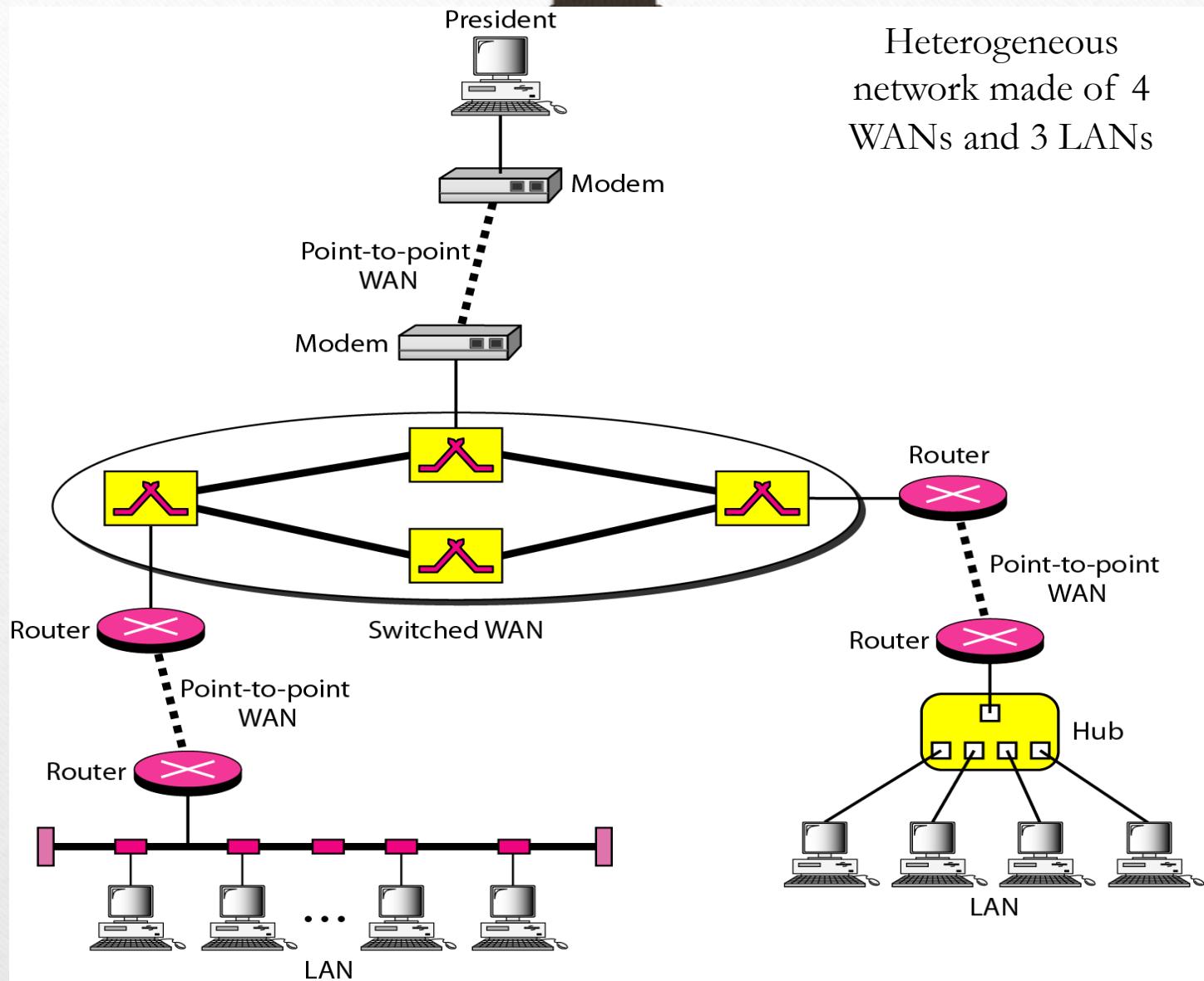


b. Point-to-point WAN

Point – to – point WAN and Switched WAN

Network Types: WANs

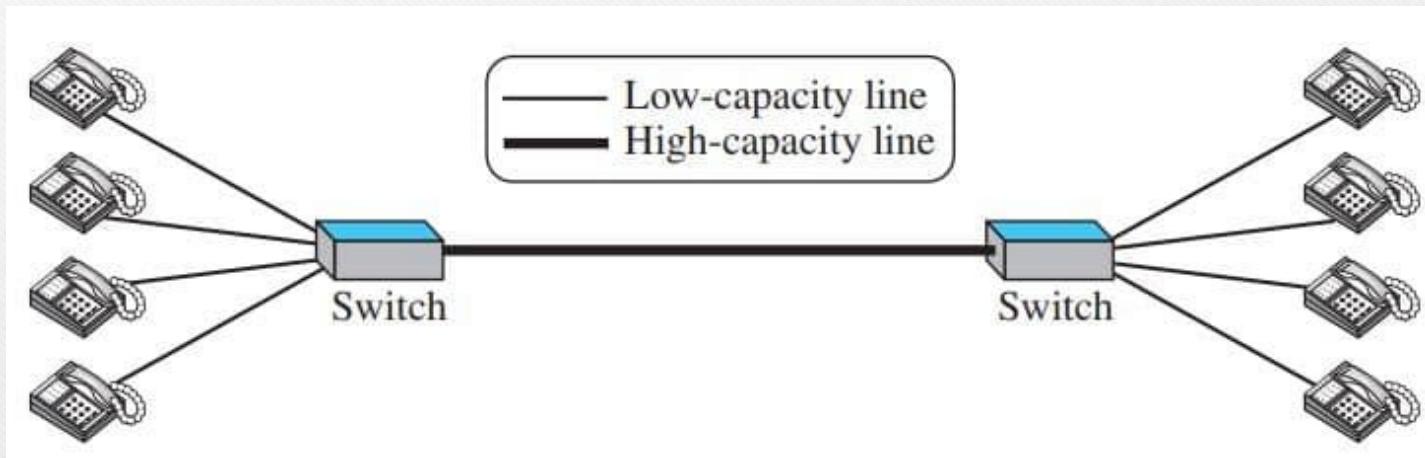
- Rare to see LAN or a WAN in isolation
- Internetwork
 - 2 LANs at different locations
 - Connected through WAN that uses on lease



Network Types: Switching

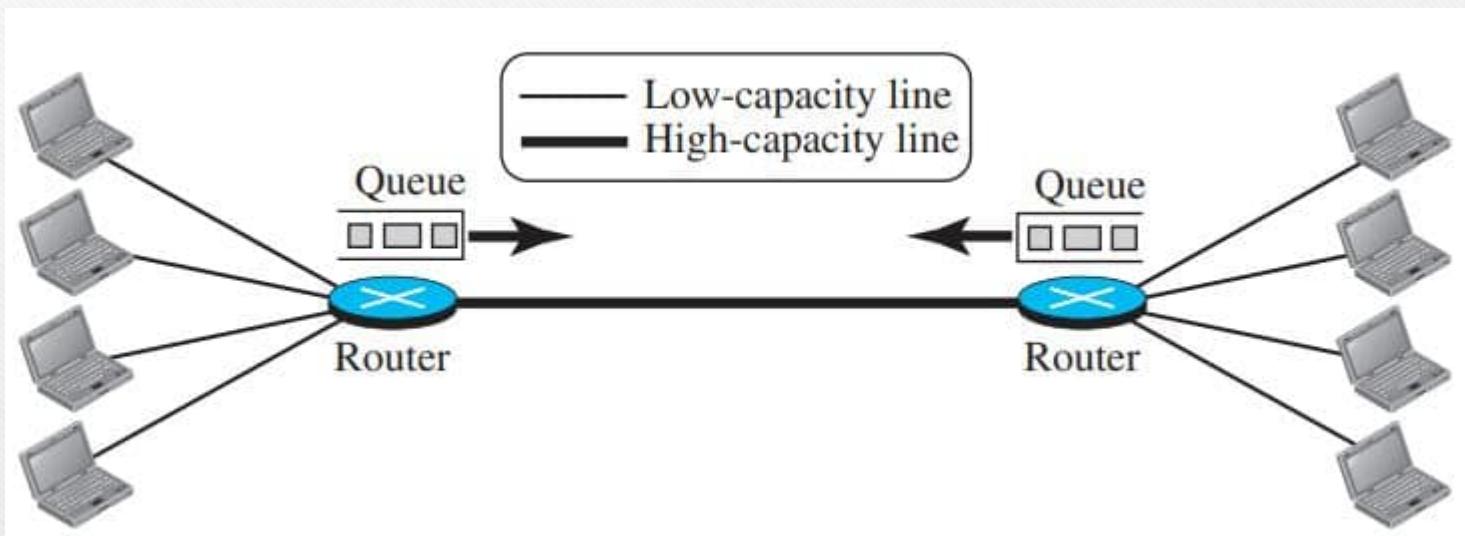
- Switch connects at least 2 links together
- Switch forwards data from one network to another
- Types
 - Circuit switched network
 - Packet switched network

Network Types: Switching: Circuit Switched network



Switch does not have storing capability; it only forwards

Network Types: Switching: Packet Switched network



Router is used for both storing and forwarding as the packet is an independent entity

Internet

- Internet is a collection of networks or network of networks.
- Various networks such as LAN and WAN connected through suitable hardware and software to work in a seamless manner.
- The basic difference between WAN and Internet is that WAN is owned by a single organization while internet is not so.

Historical Background

- One significant development was the ARPANET (Advanced Research Projects Agency Network).
- Starting with four-node experimental network in 1969, it has subsequently grown into a network several thousand computers spanning half of the globe, from Hawaii to Sweden.
- Most of the present-day concepts such as packet switching evolved from the ARPANET project.

The bandwidth was clearly a problem, and in the late 1970s and early 80s another new communication technique known as Local Area Networks (LANs)

- LAN helped computers to communicate at high speed over a small geographical area
- In the later years use of optical fiber and satellite communication allowed high-speed data communications over long distances.

Accessing Internet

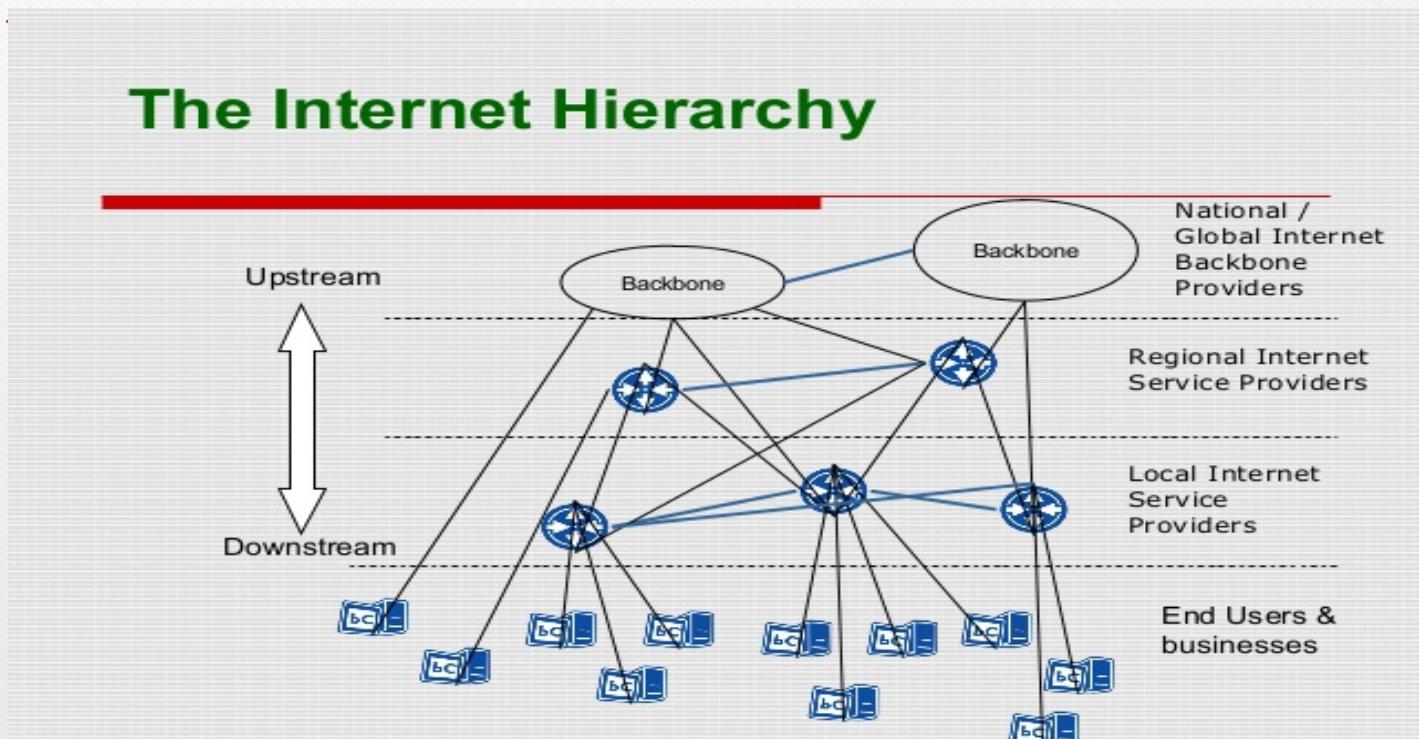
- Using telephone networks
 - Dial-up Services
 - DSL Service
- Using Cable Network
- Using Wireless Networks
- Direct Connection to the Internet

Keywords

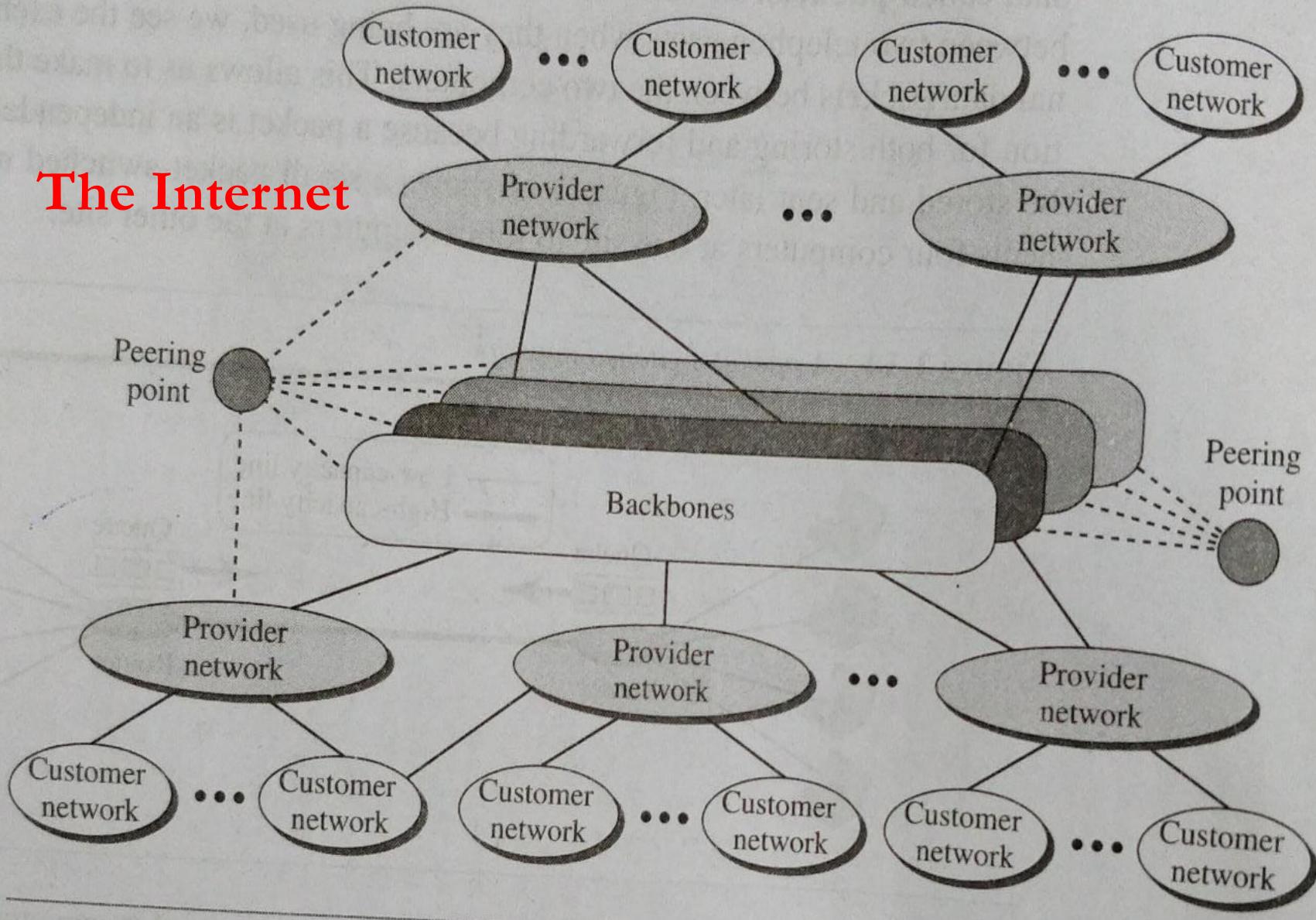
- Network
- internet
- Internet
- Intranet

The Internet Today

- Internet Service Providers(ISP)



The Internet



Questions!!!