ECE 405: Computer Networks

- Lecture 1 – Introduction

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OUTLINE:

➤ Administrative Restrictions.

➤ Define Computer Network.

➤ Technical Applications of Networks.

➤ Typical Communication Directions.

➤ How is it Work?

➤ Network Topology.

➤ Classification of Networks.

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Administrative Restrictions

➢ **No mid-term exams.**
➢ **Roughly equal weight for quizzes.**
- **30% Quizzes (expect a quiz every lecture).**
- **5% project or presentation.**
- **5% Homework or MCQ exams.**
- **60% Final exam.**

You MUST demonstrate competence in both projects and quizzes to pass the course.

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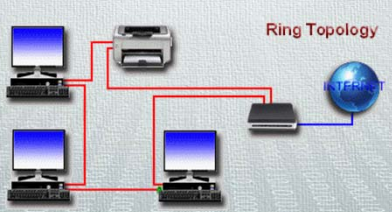
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Define Computer Networks

❖ **Computer network is a connection of autonomous computers and network devices for:**
- **Resource sharing (data/devices) in an efficient manner**
- **Communication amongst them.**
❖ **The computers can be geographically located anywhere.**

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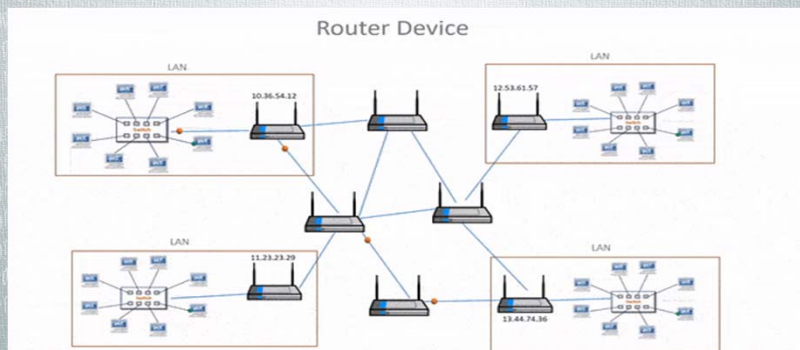
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Define Computer Network

❖ **Computer network is an "interconnected collection of autonomous computers connected by a single technology"**
interconnected = **able to exchange information for a set of nodes connected by media links"**
  • **node = any device capable of sending &/or receiving data to &/or from other nodes in the network.**
❖ **"a connected collection of hardware and software that permits information exchange and resource sharing"**
  • **information = data, text, audio, video, images, …**
  • **resources = printers, memory, link bandwidth, ...**

Ring Topology

INTERNET

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Define Computer Networks

❖ **What is the Internet?**
  • **"network of networks"**
  • **"collection   of   networks interconnected by routers"**
  • **"a communication medium used by millions"**

❖ **The Internet is defined as the set of networks connected by routers that are configured to pass traffic among any computers attached to any network in the set.**

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Technical Applications of Networks

Resource Sharing
- Hardware (computing resources, disks, printers)
- Software (application software)

Information Sharing
- Easy accessibility from anywhere (files, databases)
- Search Capability (WWW)

Communication
- Email
- Message broadcast

Remote computing

Distributed processing (GRID Computing)

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Typical Communication Directions

❖ **Compare simplex and duplex communication with example.**
- **Simplex—communication is unidirectional (eg. keyboard, monitor).**
- **Half-duplex—Can transmit and receive, but not simultaneously (eg. walkie-talkie)**
- **Full-duplex—Can transmit and receive simultaneously (eg. telephone network).**

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How is it work?

❖ Networks use digital transmission (as opposed to (older) analogue systems)
  • All information represented by *bits* (only values are 0 and 1), more resistant to noise.
  • In addition, extra bits (not part of the information to be transmitted) can be added in order to reduce noise effects, e.g. automatically correct bit errors
  • It may require analogue-to-digital &/or digital-to-analogue conversions (e.g. if input/output information is in analogue form).
❖ Components of a network:
  • message: information to be communicated.
  • sender: device that sends the message.
  • receiver: device that receives the message.
  • medium: physical path from sender to receiver.
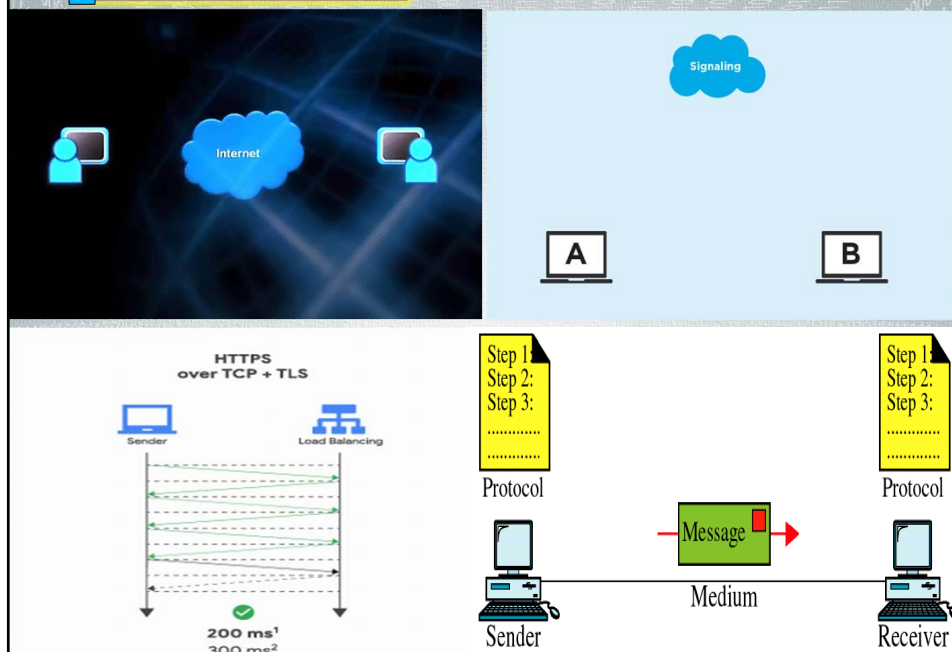 • protocol: set of rules that govern data communications.

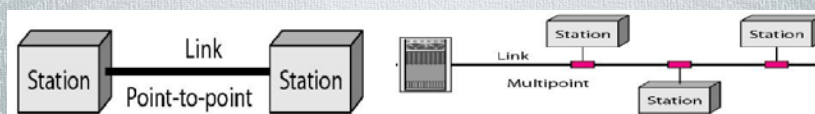ECE 405: Computer Networks   Dr. Bilal Rabah   9

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How is it work?

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Network Topology

❖ **The network <u>topology</u> defines the way in which computers, printers, and other devices are connected. A network topology describes the layout of the wire and devices as well as the paths used by data transmissions.**

❖ **There are two types of line configuration:**
• **A point-to-point connection: provides a dedicated link between two nodes.**
• **A multipoint: more than two nodes share a single link, i.e., bandwidth is shared.**

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Network Topology

❖**The topologies in which a network can be organized as:**

• **<u>Mesh</u>—Each device has a dedicated point-to-point link to every other device. It is robust and secure. Installation is difficult and expensive. The total number of links is $n(n-1)$ for n nodes. OR $(n(n-1)/2)$, WHY?**
  Where is the mesh is used?
• **<u>Star</u>−Each device has a dedicated point-to-point link to the hub. All communication goes via the hub. It is less expensive and robust. If hub fails, then the network is non-functional.**

Bus Topology   Ring Topology   Star Topology
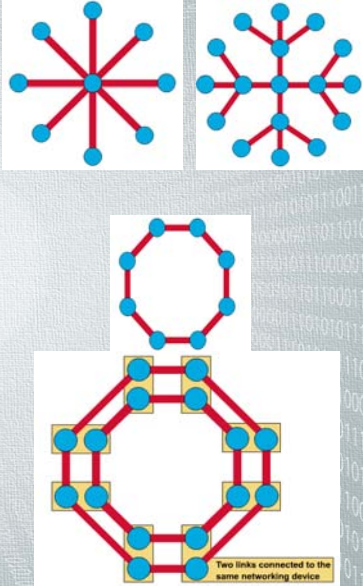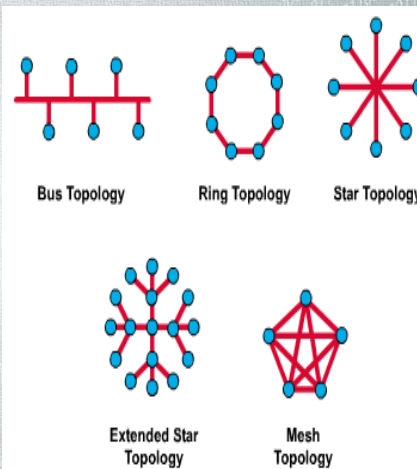
Extended Star Topology   Mesh Topology

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Network Topology

Larger networks use the extended star topology also called tree topology. When used with network devices that filter frames or packets, like bridges, switches, and routers, this topology significantly reduces the traffic on the wires by sending packets only to the wires of the destination host.

❖ Ring—Each device has a dedicated point-to-point connection with the devices on either side of it. A break in the ring can disable the entire network due to unidirectional traffic. A frame travels around the ring, stopping at each node.

Two links connected to the same networking device

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Network Topology

◉ Single ring – All the devices on the network share a single cable

◉ Dual ring – The dual ring topology allows data to be sent in both directions.

❖ Bus—It is multi-point and signal gets weak as it travels through the long cable that acts as backbone. A fault in the bus stops the entire transmission, all the devices on a bus topology are connected by one single cable.
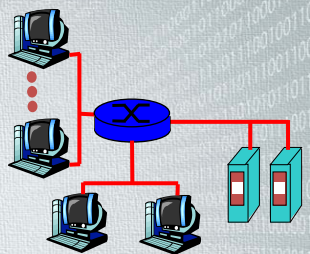
All the topologies above can be representing within the LAN network

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Classification of Networks

❖ **Local Area Network (LAN):**
  - **company/univ local area network (LAN) connects end system to edge router.**
  - **Example of LAN;** *Ethernet*: **shared or dedicated link connects end system and router. Types: 10 Mbs, 100Mbps, Gigabit Ethernet.**
  - **deployment: institutions, home, games, Malls, …**

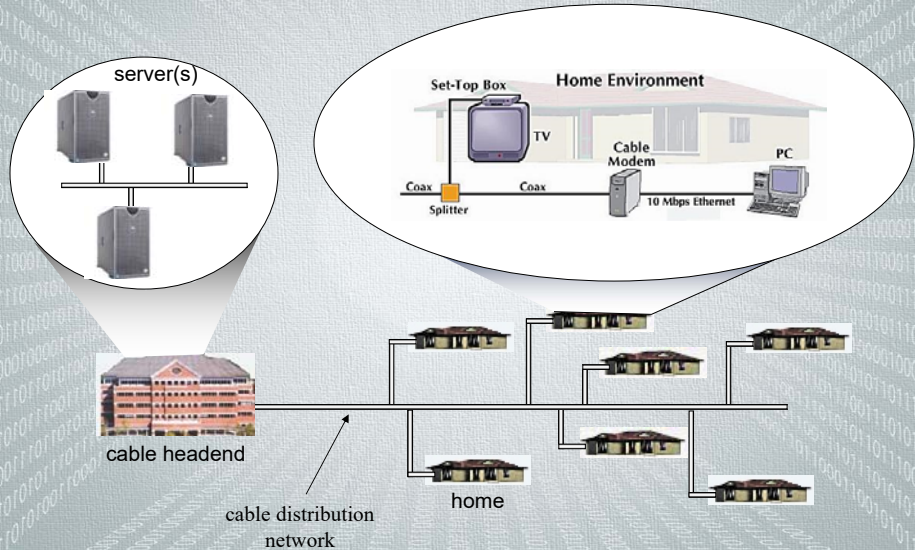❖ **Metropolitan Area Network (MAN): Typically, 500 to 5,000 homes.**

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Classification of Networks

Example of MAN: Cable Network Architecture

server(s)

Set-Top Box   Home Environment

TV

Cable
Modem

PC

Coax   Coax

Splitter   10 Mbps Ethernet

cable headend

home

cable distribution
network

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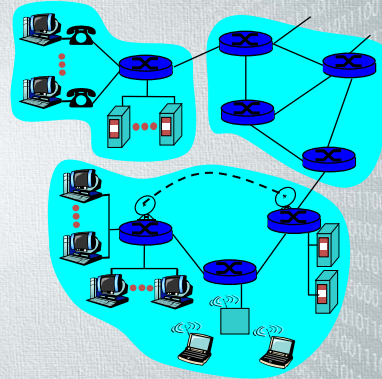
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Classification of Networks

❖ **Wide Area Network (WAN):**

- **Spans a large geographic area, e.g., a country or a continent**
- **A WAN consists of several transmission lines and routers**
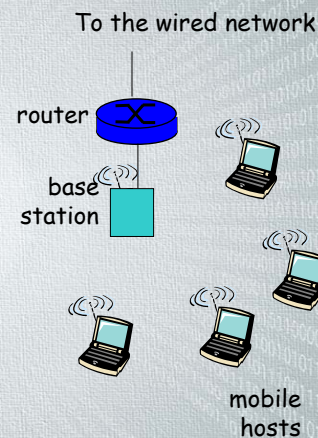- **Internet is an example of a WAN**

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Classification of Networks

❖ **Wireless Networks**

- **shared *wireless* access network connects end system to router**
  - **via base station "access point"**
- **wireless LANs:**
  - **IEEE 802.11b (WiFi)**
- **wider-area wireless access**
  - **provided by telecomm operators**
  - **3G ~ 384 kbps**

To the wired network

router

base station

mobile hosts

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Classification of Networks

❖ **Home networks**

- **Typical home network components:**
- **ADSL or cable modem**
- **router/firewall/NAT**
- **Ethernet**
- **wireless access point**

to/from cable headend

cable modem

router/ firewall

wireless laptops

wireless access point

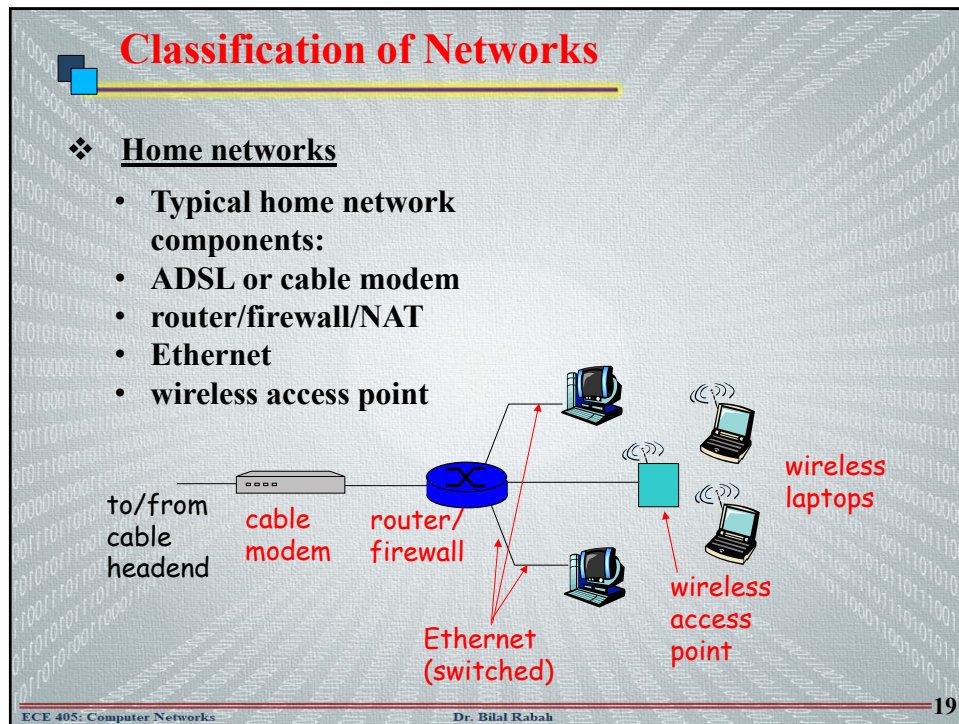Ethernet (switched)

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- Note that, Network topologies are like Delta-Star connections that is used in Electrical circuits, while the applications of these topologies are embedded within the networks such as LAN, WAN, …

References

Andrew S. Tanenbaum, *Computer Network*, Prentice-Hall

Doughlas E. Comer, Computer Networks and Internet

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