

# Chapter 1: Networking Fundamentals

## **Our goal:**

- Get and feel the terminology
- More depth, detail later in course
- Approach:
  - ✓ Use Internet as example

## **Overview:**

- What's Network?
- What's Networking?
- Advantages and Disadvantages (costs) of Networking
- Network Characteristics
  - ✓ Circuit and Packet Switching
  - ✓ Connection-Oriented vs. Connectionless
- Types and Sizes of Networks
  - ✓ PAN, LAN, WLAN, and WAN
- Network Performance

# Networking Fundamentals

- **What is a network?**

A network is a collection of computers or other hardware devices that are connected together, either physically or logically, using special hardware and software, to allow them exchange information and cooperate.

- **What is a networking?**

A networking is the process involved in designing, implementing, upgrading, managing and otherwise working with networks and network technologies.

# The Advantages (Benefits) of Networking

- **Connectivity and Communication:** Networks connect computers and the users of those computers. Users can communicate with each other using technologies like electronic mail.
- **Data Sharing:** Network users can share the same data whether it is in database, group software development, and much more.
- **Hardware Sharing:** Example of giving each 10 employees in a department an extensive color printer, one printer can be placed on the network for everyone to share.
- **Internet Access:** The Internet is itself an enormous network, accessing the Internet, you are using a network.

## Benefits Cont'd ...

- **Data Security and Management:** A network administrators manage the company's critical data. Data can be centralized on shared servers. This makes it easy for everyone to find the data, makes it possible for the administrators to ensure that the data is regularly backed up, and also allows for the implementation of security measures to control who can read or change various pieces of critical information.
- **Performance Enhancement and Balancing:** A network can be used to enhance the overall performance of some applications by distributing the computation tasks to various computers on the network.
- **Entertainment:** Networks facilitate many types of games and entertainment. The Internet itself offers many sources of entertainment.

# The Disadvantages (Costs) of Networking

- **Network Hardware, Software and Setup Costs:** Setting up a network requires an investment in hardware and software, as well as funds for planning, designing and implementing the network.
- **Hardware and Software Management and Administration Costs:** In all but the smallest of implementations, ongoing maintenance and management of the network requires the care and attention of an IT professional.
- **Undesirable Sharing:** One significant “sharing problem” in this regard has to do with viruses, which are easily spread over networks and the Internet. Mitigating these effects costs more time, money and administrative effort.
- **Data Security Concerns:** A poorly-secured network puts critical data at risk, exposing it to the potential problems associated with hackers, unauthorized access and even sabotage.

# A Networking Protocol

- A **networking protocol** defines a set of rules, algorithms, messages and other mechanisms that enable software and hardware in networked devices to communicate effectively.
- A protocol usually describes a means for communication between corresponding entities at the same OSI Reference Model layer in two or more devices.

# Circuit-Switching and Packet-Switching Networks

- There are two approaches to determine the path between devices over which information will flow.
  - Either a path can be set up between the devices in advance, or the data can be sent as individual data elements over a variable path.

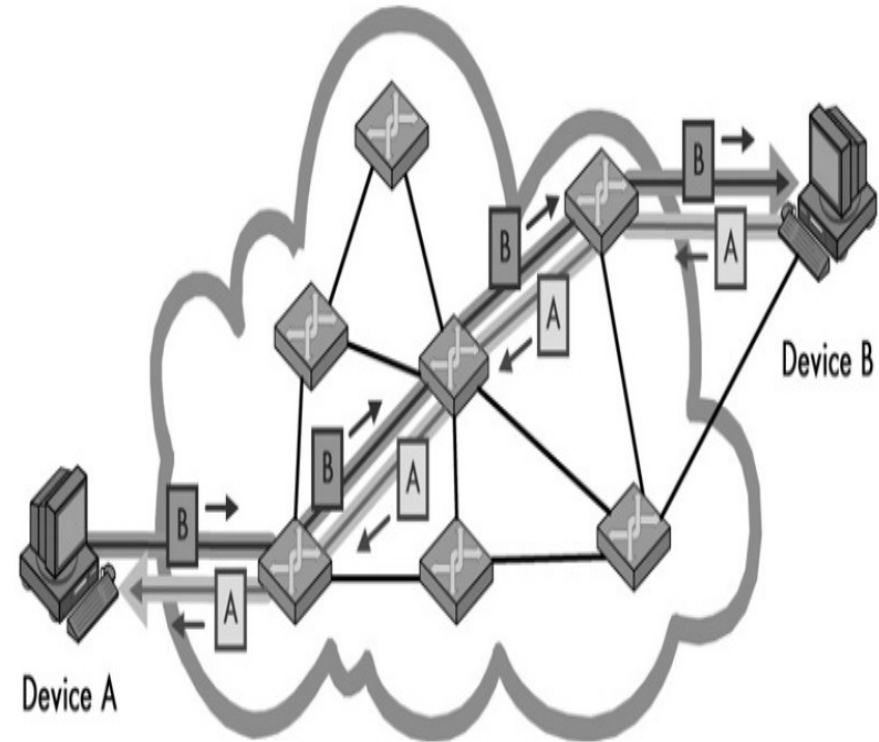
# Circuit Switching

- In this networking method, a connection called a circuit is set up between two devices, which is used for the whole communication.
- The circuit may either be a fixed one that is always present, or it may be a circuit that is created on an as-needed basis.
- Even if many potential paths through intermediate devices may exist between the two devices communicating, only one will be used for any given dialog.



# Circuit Switching Cont'd

- In a circuit-switched network, before communication can occur between two devices, a circuit is established between them.
- Once set up, all communication between these devices takes place over this circuit, even though there are other possible ways that data could conceivably be passed over the network of devices between them.

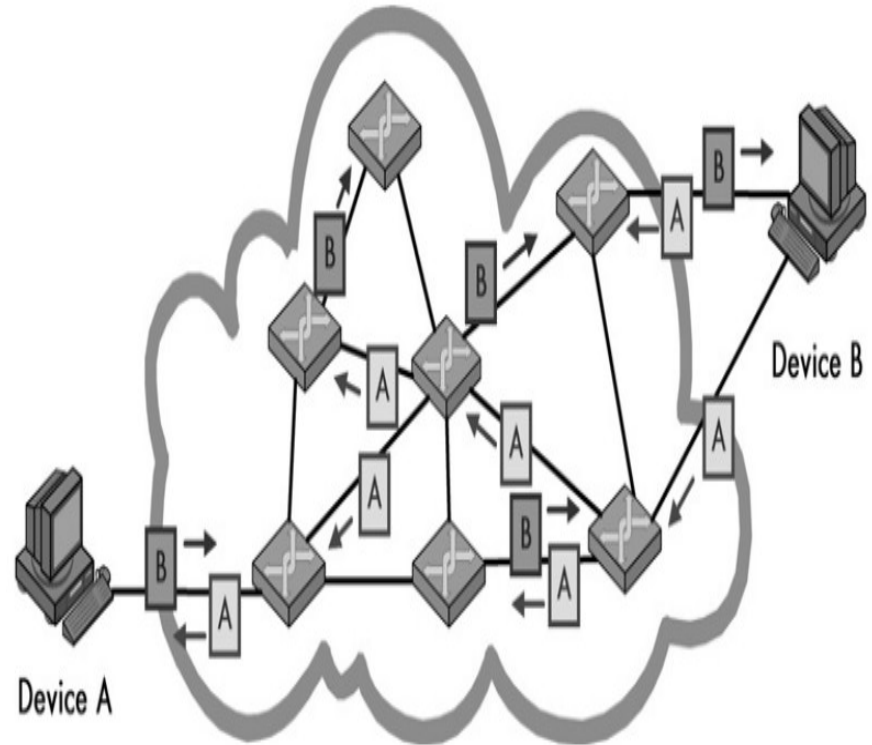


# Packet Switching

- In this network type, no specific path is used for data transfer. Instead, the data is chopped up into small pieces called packets and sent over the network.
- The packets can be routed, combined or fragmented, as required to get them to their eventual destination.
- On the receiving end, the process is reversed—the data is read from the packets and re-assembled into the form of the original data.

# Packet Switching Cont'd

- In a packet-switched network, no circuit is set up prior to sending data between devices.



# Connection-Oriented and Connectionless Protocols

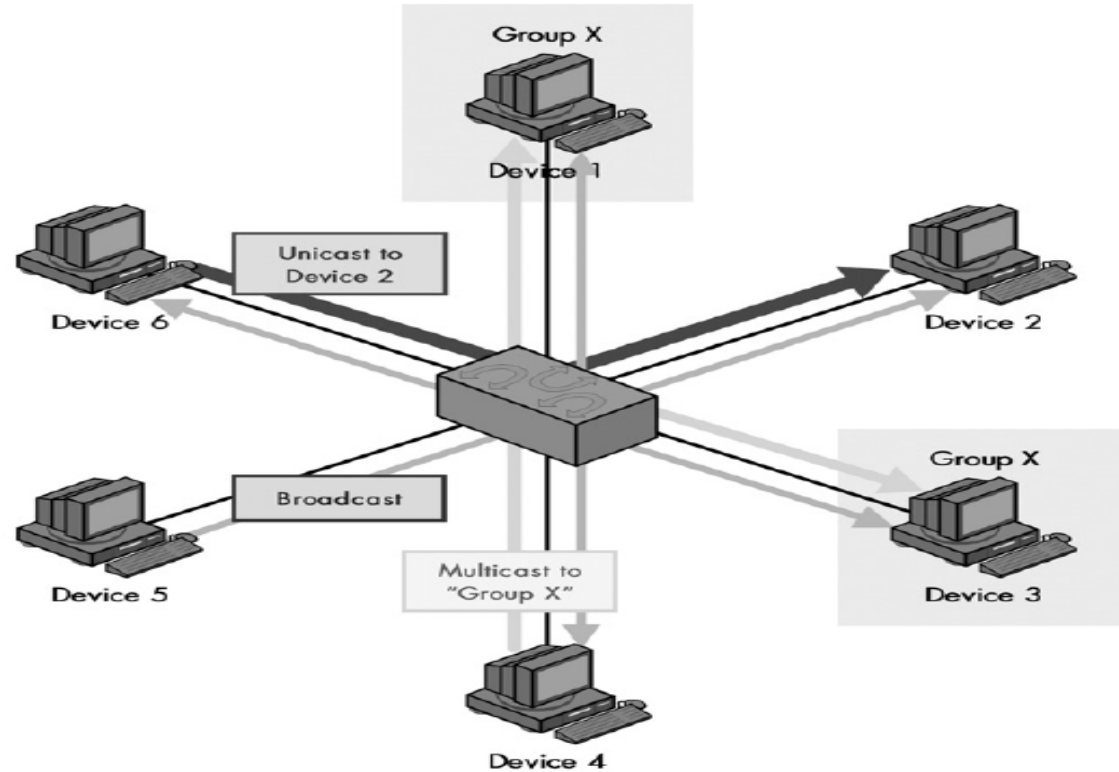
Protocols are divided into two categories based on their use of connections:

- **Connection-Oriented Protocols:** These protocols require that a logical connection be established between two devices before transferring data. This is done by following a specific set of rules that specify how a connection should be initiated, negotiated, managed and eventually terminated.
- **Connectionless Protocols:** These protocols do not establish a connection between devices. As soon as a device has data to send to another, it just sends it.

# Transmission Methods: Unicast, Broadcast and Multicast Messages

- **Unicast Messages:** These are messages that are sent from one device to another device; they are not intended for others.
- **Broadcast Messages:** These messages are sent to every device on a network.
- **Multicast Messages:** they are sent to a group of stations that meet a particular set of criteria.

# Transmission Methods All in One



# Message Addressing Methods

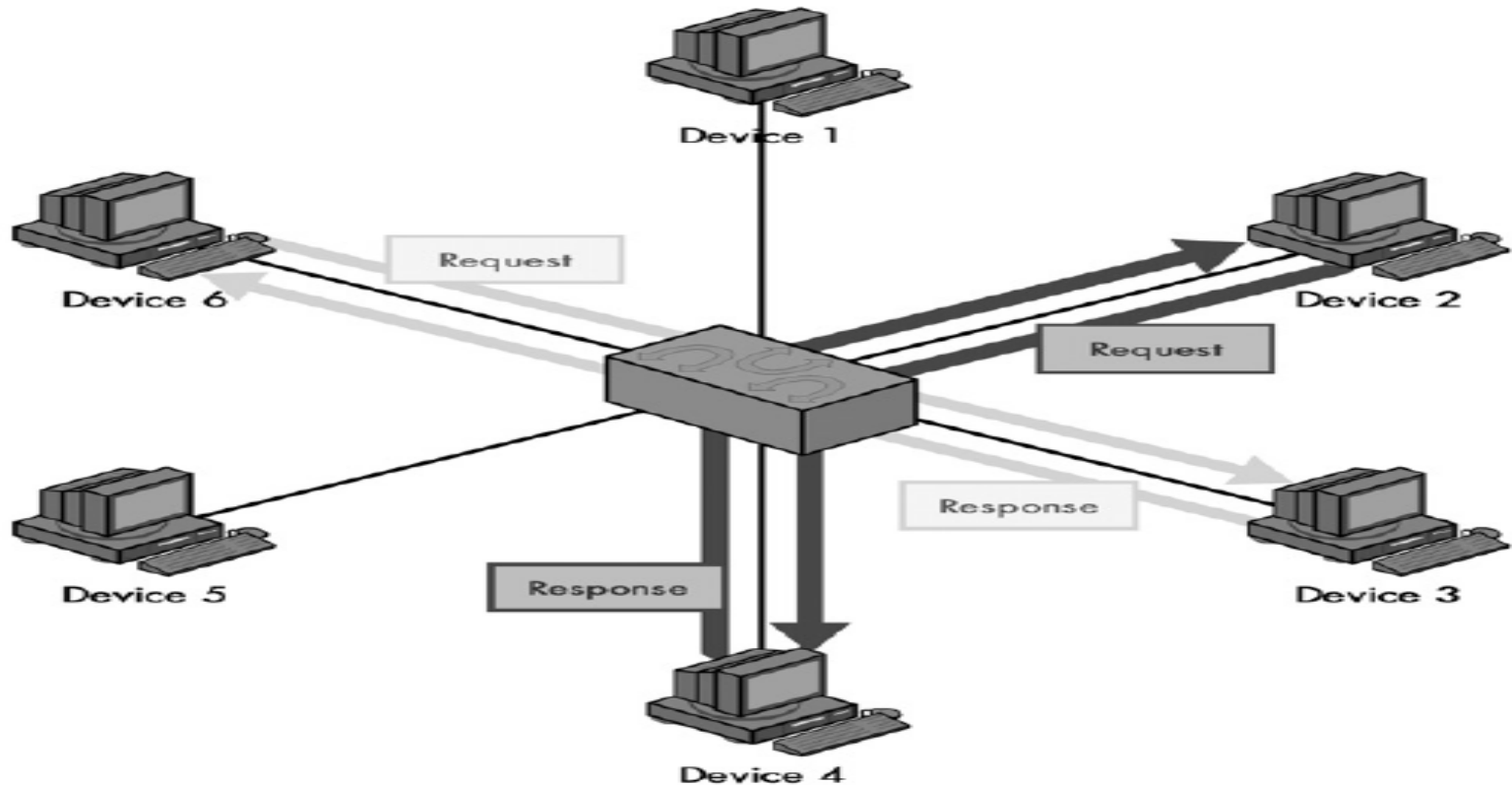
- **Unicast Addressing:** Unicast delivery requires that a message be addressed to a specific recipient.
- **Broadcast Addressing:** Broadcasts are normally implemented via a special address that is reserved for that function.
- **Multicast Addressing:** Multicasts are the most complex type of message because they require a means of identifying a set of specific devices to receive a message.

# Network Structural Models

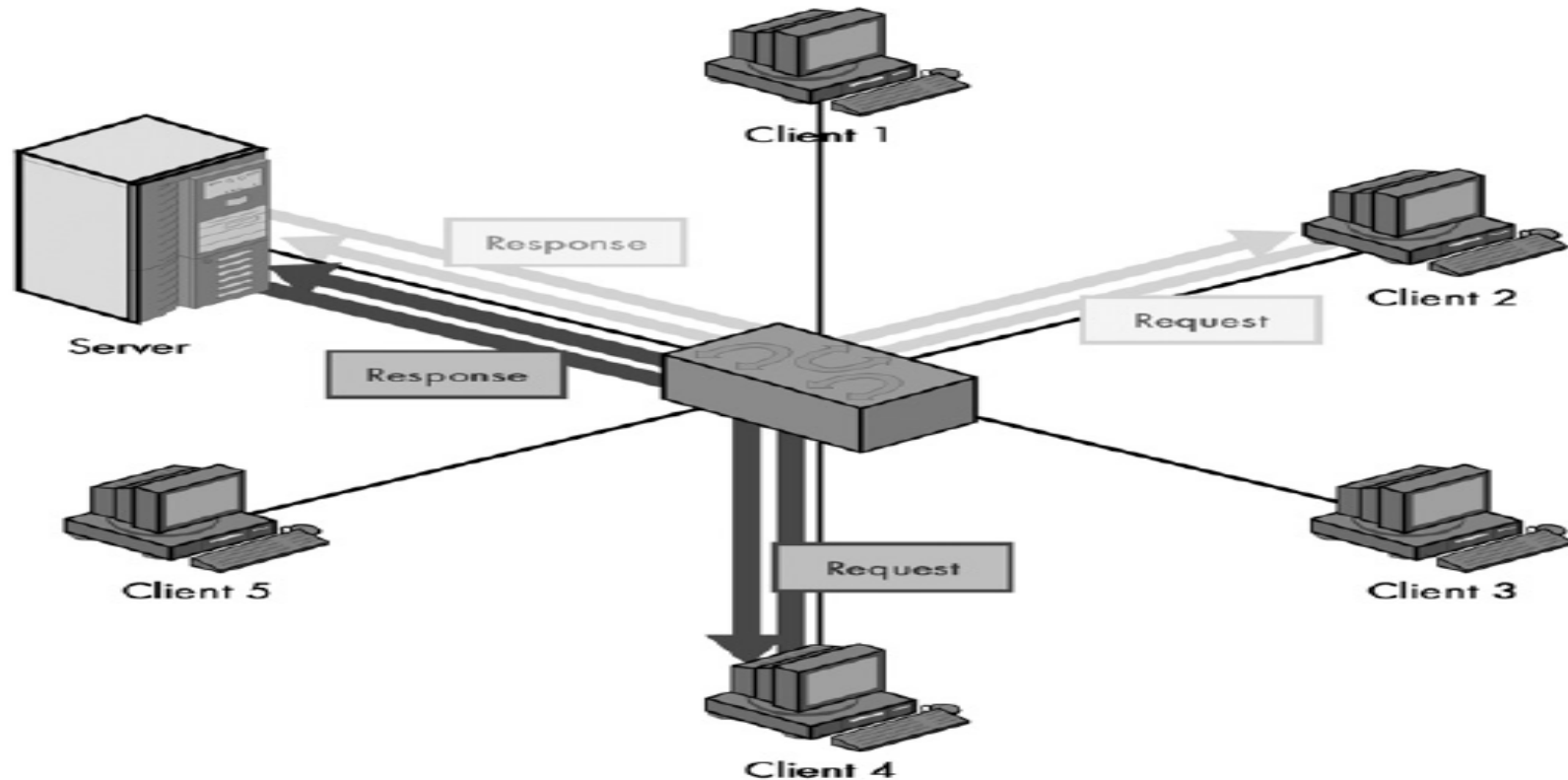
- **Peer-to-Peer Networking**
  - In a peer-to-peer networking setup, every computer is an equal, a peer in the network.
- **Client/Server Networking**
  - A small number of computers are designated as centralized servers and given the task of providing services to a larger number of user machines called clients.



# Peer-to-Peer Networking



# Client/Server Networking



# Types and Sizes of Networks

- **Local Area Networks (LANs):** Networks that connect together computers that are relatively close to each other—generally, within the same room or building.
- **Wireless Local Area Networks (Wireless LANs or WLANs):** Local area networks that connect devices without wires, using radio frequencies or light.
- **Wide Area Networks (WANs):** Networks that connect together devices or other networks over a greater distance than is practical for local area networking.

# Types and Sizes of Networks Cont'd

- **Campus Area Networks (CANs):** Is one created to span multiple buildings in the same location, such as the campus of a university.
- **Metropolitan Area Networks (MANs):** This refers to a network that spans a particular small region or a city.
- **Personal Area Networks (PANs):** This means a very small LAN with a range of only a few feet, intended mostly to connect together devices used by a single person (or very small group).

# Performance Measurements: Speed, Bandwidth, Throughput and Latency

- **Speed:** It refers to the rated or nominal speed of a particular networking technology. For example, Fast Ethernet has a nominal speed of 100 megabits per second;
- **Bandwidth:** Usually refers to the data-carrying capacity of a network or data transmission medium.
- **Throughput:** is a measure of how much actual data can be sent per unit of time across a network, channel or interface.
- **Latency:** Refers to the timing of data transfers on a communications channel or network.

# Communication Modes

- **Simplex:** A network cable or communications channel can only send information in one direction; it's a “one-way street”.
- **Half-Duplex:** Sending information in both directions between two nodes, but only one direction or the other can be utilized at a time.
- **Full-Duplex:** A connection between two devices is capable of sending data in both directions simultaneously.

**End of Chapter 1**  
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