PATUAKHALI SCIENCE AND TECHNOLOGY UNIVERSITY

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Q1-1.
Identify the five components of a data communications system.

A data communications system typically consists of five key components:

Message: This is the information or data that is being transmitted from one point to another. It could be text, numbers, images, videos, or any other form of digital data.

Sender/Transmitter: This component is responsible for encoding the message into a format suitable for transmission over the communication channel. It initiates the transmission process and may also perform tasks like error checking and correction.

Receiver: The receiver component is responsible for receiving the transmitted data from the communication channel. It decodes the received signal back into its original format so that the message can be understood. The receiver may also perform error checking and correction to ensure the integrity of the data.

Communication Channel: This is the physical or logical pathway through which the data is transmitted from the sender to the receiver. It could be a wired medium such as copper cables, fiber optics, or wireless mediums such as radio waves, microwaves, or infrared.

Protocol: Protocols define the rules and conventions that govern how data is transmitted and received in a data communications system. They specify parameters such as the format of the data, error detection and correction techniques, data compression methods, and the sequence of steps involved in the communication process. Protocols ensure that devices from different manufacturers can communicate with each other effectively. Examples of protocols include TCP/IP (Transmission Control Protocol/Internet Protocol) for internet communication, and HTTP (Hypertext Transfer Protocol) for web browsing.

Q1-2.
What are the three criteria necessary for an effective and efficient network?

For an effective and efficient network, three key criteria are essential:

1. **Reliability:** Reliability refers to the ability of the network to consistently provide uninterrupted service and deliver data accurately to its intended destination. A reliable network minimizes downtime and ensures that data packets are transmitted and received without errors or loss. To achieve reliability, network components such as routers, switches, cables, and communication links should be robust and redundant, with failover mechanisms in place to handle failures gracefully.

2. **Performance**: Performance relates to the speed, throughput, and responsiveness of the network. It encompasses factors such as data transfer rates, latency, and bandwidth availability. A network with high performance can efficiently handle the transmission of data, support multiple users or applications simultaneously, and deliver a satisfactory user experience. To optimize performance, network administrators may implement techniques such as Quality of Service (QoS) prioritization, traffic shaping, and bandwidth management.

3. **Scalability**: Scalability refers to the network's ability to accommodate growth in terms of users, devices, and data traffic without compromising performance or functionality. A scalable network can easily expand or adapt to meet changing demands and accommodate increased workload or traffic volume. Scalability can be achieved through the use of modular hardware and software components, flexible architecture designs, and

efficient resource allocation strategies. Additionally, future-proofing the network by considering potential expansion requirements during the initial design phase can help ensure long-term scalability.

Q1-3.
What are the advantages of a multipoint connection over a point-to-point connection?

Multipoint connections offer several advantages over point-to-point connections, particularly in networking contexts:

1. **Cost Efficiency**: Multipoint connections typically require fewer physical resources (such as cables, routers, and switches) compared to point-to-point connections. This leads to lower infrastructure costs, making multipoint connections more cost-effective, especially when connecting multiple devices or locations.
2. **Simplicity of Setup and Maintenance**: Setting up and maintaining multipoint connections is often simpler than managing multiple individual point-to-point connections. With multipoint connections, a single network infrastructure can serve multiple endpoints, reducing complexity in configuration and troubleshooting tasks.
3. **Resource Sharing**: In a multipoint connection, network resources can be shared among multiple endpoints. This allows for efficient utilization of bandwidth, especially in scenarios where data traffic patterns fluctuate or peak at different times across various endpoints. Resource sharing can improve overall network performance and optimize resource allocation.
4. **Scalability:** Multipoint connections are inherently scalable, as they can accommodate the addition of new endpoints without requiring significant changes to the network infrastructure. This scalability makes multipoint connections suitable for expanding networks or accommodating growth in the number of connected devices or users over time.

5. **Collaboration and Communication**: Multipoint connections facilitate collaboration and communication among multiple users or devices simultaneously. They enable group discussions, video conferencing, file sharing, and other collaborative activities without the need for separate point-to-point connections between each pair of participants.
6. **Flexibility**: Multipoint connections offer greater flexibility in network design and topology. They support various network architectures, such as star, mesh, and hybrid topologies, allowing network administrators to choose the configuration that best suits their requirements and objectives.

Overall, multipoint connections provide advantages in terms of cost efficiency, simplicity, resource sharing, scalability, collaboration, and flexibility, making them a preferred choice for many networking scenarios, particularly in environments with multiple endpoints or distributed locations.

Q1-4.
What are the two types of line configuration?

The two types of line configuration in networking are:

1. **Point-to-Point Configuration**: In a point-to-point configuration, there is a direct physical link between two devices or nodes. This setup forms a dedicated communication path between the sender and receiver, with no other devices sharing the link. Point-to-point connections are commonly used in scenarios where communication occurs between two specific endpoints, such as a computer connected to a modem via a telephone line or a router connected to a remote server via a leased line.
2. **Multipoint Configuration**: In a multipoint configuration, multiple devices or nodes are interconnected using a shared communication medium. This setup allows multiple devices to communicate with each other over the same link. Multipoint connections can take various forms, such as bus, ring, star, mesh, or hybrid topologies, depending on the arrangement of devices and the type of communication medium used. Multipoint

configurations are commonly used in local area networks (LANs) and wide area networks (WANs) to facilitate communication among multiple endpoints within a network.

Q1-5.
Categorize the four basic topologies in terms of line configuration.

The four basic topologies can be categorized in terms of line configuration as follows:

1. **Point-to-Point Topology:** In a point-to-point topology, each device or node is directly connected to one other device or node through a dedicated communication link. Therefore, point-to-point topology corresponds to the point-to-point line configuration. Examples of point-to-point connections include a simple serial link between two computers or a direct connection between a computer and a printer.
2. **Bus Topology**: In a bus topology, all devices are connected to a single communication line, known as the bus or backbone. Therefore, a bus topology corresponds to the multipoint line configuration, where multiple devices share the same communication medium. Devices communicate by sending data onto the bus, and all devices on the network receive the data. However, only the intended recipient processes the data.
3. **Star Topology**: In a star topology, each device is connected directly to a central hub or switch through a separate point-to-point connection. Therefore, each connection in a star topology represents a point-to-point configuration. The central hub or switch serves as a central point for communication, managing and directing data traffic between devices. Examples of star topologies include Ethernet LANs using a central Ethernet switch or a wireless access point in a Wi-Fi network.
4. **Ring Topology**: In a ring topology, each device is connected to two other devices, forming a closed loop or ring structure. Although the physical layout of a ring topology resembles a multipoint connection, the logical flow of data is still point-to-point. Data circulates around the ring from

one device to the next until it reaches its destination. Each connection between adjacent devices can be considered a point-to-point link. Examples of ring topologies include Token Ring networks, where devices pass a token sequentially around the ring to gain access to the network.

In summary, point-to-point topology corresponds directly to the point-to-point line configuration, while bus, star, and ring topologies can be categorized under the multipoint line configuration, as multiple devices share the same communication medium.

Q1-6.
What is the difference between half-duplex and full-duplex transmission modes?

Difference between half-duplex and full-duplex transmission modes:

- **Half-Duplex**: In half-duplex transmission mode, data can be transmitted and received, but not simultaneously. The communication channel is shared between the sender and receiver, allowing communication in both directions, but only one direction at a time. Devices take turns transmitting and receiving data. For example, walkie-talkies and Ethernet hubs use half-duplex communication.
- **Full-Duplex**: In full-duplex transmission mode, data can be transmitted and received simultaneously. Each device has separate communication channels for transmitting and receiving data, enabling concurrent two-way communication. Full-duplex communication is common in modern networking technologies such as Ethernet switches and wireless networks.

Q1-7.
Name the four basic network topologies, and cite an advantage of

each type.

Four basic network topologies and their advantages:

- **Bus Topology**: Advantage - Easy to set up and cost-effective. Requires less cabling than other topologies.
- **Star Topology**: Advantage - Centralized management and easy troubleshooting. Failure of one device does not affect others.
- **Ring Topology**: Advantage - Equal access to resources for all devices. No collisions in data transmission.
- **Mesh Topology:** Advantage - High fault tolerance and redundancy. Multiple paths available for data transmission.

Q1-8.
For n devices in a network, what is the number of cablelinks required for a mesh, ring, bus, and star topology?

Number of cable links required for different network topologies with n devices:

- **Mesh Topology:** n(n-1)/2
- **Ring Topology**: *n*
- **Bus Topology**: n-1
- **Star Topology**: n

Q1-9.
What are some of the factors that determine whether a communications system is a LAN or WAN?

Several factors determine whether a communication system is classified as a LAN (Local Area Network) or WAN (Wide Area Network). These factors include:

1. **Geographical Coverage**: LANs typically cover smaller geographical areas, such as a single building, office, campus, or a cluster of nearby buildings. In contrast, WANs cover larger geographical areas, such as cities, regions, countries, or even continents. The size of the coverage area is a fundamental determinant in distinguishing between LANs and WANs.

2. **Ownership and Control**: LANs are often owned, controlled, and managed by a single organization, such as a business, educational institution, or government agency. The organization has full authority over the network infrastructure, including hardware, software, and security policies. In contrast, WANs may involve multiple organizations, service providers, or telecommunications companies collaborating to provide connectivity over vast geographical distances. WANs may also be privately owned by a single organization but extend beyond its premises.

3. **Technologies Used**: LANs typically utilize high-speed, low-latency technologies for data communication within a confined area. Common LAN technologies include Ethernet, Wi-Fi (802.11), and token ring. LANs may also employ technologies such as Ethernet switches, hubs, and routers to facilitate communication between devices. WANs, on the other hand, require technologies capable of transmitting data over long distances, often spanning multiple networks and geographical regions. WAN technologies include leased lines, fiber optics, satellite links, MPLS (Multiprotocol Label Switching), and SONET/SDH (Synchronous Optical Networking/Synchronous Digital Hierarchy).

4. **Data Transmission Speed**: LANs typically offer higher data transmission speeds compared to WANs. LANs commonly support gigabit or even multi-gigabit data rates, enabling fast communication between devices within the local network. In contrast, WANs often have lower data transmission speeds due to the longer distances involved and the use of slower transmission media. While WAN speeds have improved significantly with advancements in technology, they may still be slower compared to LAN speeds.

5. **Cost and Complexity**: LANs are generally less expensive and less complex to set up and maintain compared to WANs. LAN infrastructure typically involves fewer network devices, shorter cable runs, and simpler configurations. In contrast, WAN deployment requires careful planning,

coordination, and investment in specialized equipment and services to ensure reliable connectivity over long distances. WANs may incur higher costs due to expenses associated with leased lines, equipment procurement, and ongoing maintenance.

By considering these factors, organizations can determine whether their communication system is best classified as a LAN or WAN and design their network infrastructure accordingly to meet their specific requirements and objectives.

Q1-10.
What is an internet? What is the Internet?

- **Internet (capital "I")**: Refers to the global network that connects millions of networks worldwide, allowing communication and data exchange between computers and devices across different geographical locations. The Internet is a proper noun and denotes the specific global network infrastructure.
- **internet (lowercase "i")**: Refers to any interconnected network of networks. It can be used to describe smaller-scale networks that are interconnected, such as a corporate intranet or a university network.

Q1-11.
Why are protocols needed?

Protocols are needed to facilitate communication and data exchange between devices in a network by defining standardized rules and procedures. Some reasons why protocols are needed include:

- **Interoperability:** Protocols ensure that devices from different manufacturers can communicate with each other effectively by adhering to a common set of rules and conventions.

- **Error Detection and Correction**: Protocols include mechanisms for detecting and correcting errors that may occur during data transmission, ensuring data integrity and reliability.
- **Addressing and Routing**: Protocols define how devices are addressed and how data is routed from the source to the destination across a network.
- **Data Formatting**: Protocols specify the format and structure of data packets, including how data is encoded, encapsulated, and interpreted by receiving devices.

Q1-12.
In a LAN with a link-layer switch (Figure 1.8b), host 1 wants to send a message to host 3. Because communication is through the link-layer switch, does the switch need to have an address? Explain.

In a LAN with a link-layer switch, the switch does not need to have an address like hosts. Because it operates at the data link layer, forwards frames based on MAC addresses, and performs transparent switching without modifying the frames.

Q1-13.
How many point-to-point WANs are needed to connect n LANs if each LAN should be able to directly communicate with any other LAN?

The number of point-to-point WAN connections needed to connect n LANs in a full mesh topology is n(n-1)/2.

Q1-14.
When a resident uses a dial-up or DLS service to connect to the Internet, what is the role of the telephone company?

The telephone company serves as the infrastructure provider and facilitator of connectivity for subscribers using dial-up or DSL services to access the Internet.

Q 15

If there is a single path between the source host and the destination host, do we need a router between the two hosts?

No, if there is a single path between the source host and the destination host within the same network segment, a router is not strictly necessary for communication between them.

P1-1.

What is the maximum number of characters or symbols that can be represented by Unicode?

By considering, last update in January 2022 Unicode supports over 143,000 characters, covering various scripts, symbols and emoji.

P1-2.

A color image uses 16 bits to represent a pixel. What is the maximum number of different colors that can be represented?

Maximum number of colors = 2^(number of bits per color component)

The maximum number of different colors that can be represented in a color image using 16 bits per pixel is 65,536.

P1-3.

Assume six devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?

Total number of cables: 6*(6-1)/2 = 15

Number of ports per device = (6-1)*2 = 10

P1-4.
For each of the following four networks, discuss the consequences if a connection fails.

a. Five devices arranged in a mesh topology
b. Five devices arranged in a star topology (not counting the hub)
c. Five devices arranged in a bus topology
d. Five devices arranged in a ring topology

a. Mesh Topology: Communication between the specific pair of devices with the failed connection may be affected, but other connections remain unaffected due to multiple paths.

b. Star Topology: Communication between the device with the failed connection and all other devices is disrupted, but other devices remain unaffected.

c. Bus Topology: Communication for devices downstream of the failure is disrupted, while devices upstream may still function.

d. Ring Topology: Communication for all devices downstream of the failed connection is disrupted, isolating them until the issue is resolved.

P1-5.
In the ring topology in Figure 1.7, what happens if one of the stations is unplugged?

If one station is unplugged in a ring topology, communication is disrupted for all stations downstream of the unplugged station, isolating them from the network until the issue is resolved.

P1-6.
In the bus topology in Figure 1.6, what happens if one of the stations is unplugged?

If one station is unplugged in a bus topology, only that station and devices downstream lose connectivity, while the rest of the network remains unaffected

P1-7.
When a party makes a local telephone call to another party, is this a point-to-point or multipoint connection? Explain your answer.

This connection is point-to-point. Because, communication occurs between two specific endpoints (the caller and the receiver).

P1-8.
Compare the telephone network and the Internet. What are the similarities? What are the differences?

Similarities:

1. Both facilitate global communication.
2. Support various communication services.
3. Rely on specific protocols for communication.

Differences:

1. Telephone network primarily for voice, Internet for diverse communication.
2. Telephone: circuit-switched; Internet: packet-switched.
3. Telephone: hierarchical infrastructure; Internet: decentralized.
4. Telephone: traditional billing; Internet: diverse pricing models.
5. Telephone: evolved from analog; Internet: rapid evolution.