

Networks and Protocols

Tutorial (Week 1)

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1. a) List all layers of the OSI reference model.
- b) Which layers are responsible for the following functions:
 - i) Error detection and control
 - ii) Establishment and terminations between hosts/applications

a)

- Application
- Presentation
- Session
- Transport
- Networks
- Data Link
- Physical

b)

- i) Data link
- ii) Session

2. List down some characteristics of Personal Area Network.

Personal Area Network (PAN)

- Provides transmission of data over short range .
- Requires low power for transmission .
- Appropriate for low cost small networks.
- A part of larger Internet of Things (IoT) ecosystem.

Try to give one example.

3. What is meant by the following terms?

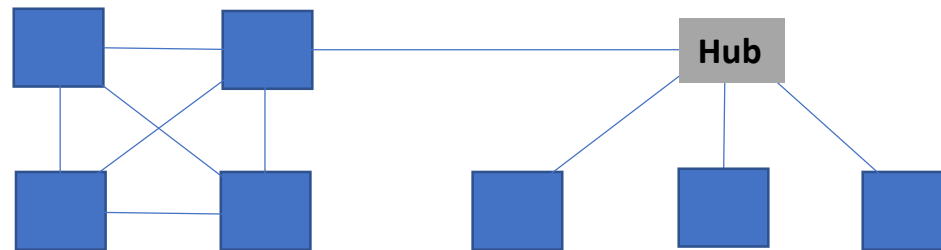
- i) Simplex
- ii) Full Duplex
- iii) Point-to-Multipoint line configuration

i) Simplex is unidirectional i.e. signal flows only in one direction

ii) Full-Duplex is where both stations can transmit and receive simultaneously

iii) Point-to-Multipoint line configuration is one in which more than two specific devices share a single link. The capacity of the link is shared.

4. Construct a Hybrid topology for a network where four computers are connected in a fully connected mesh topology and three computers connected in a star topology.



5. What do the following terms stand for?

- i) TCP/IP
- ii) UDP
- iii) PDU
- iv) WiMAX
- v) D2S
- vi) CSMA/CD

i) Transmission Control Protocol/ Internet Protocol

ii) User Datagram Protocol

iii) Protocol Data Unit

iv) Worldwide Interoperability for Microwave Access

v) Device to Server

vi) Carrier Sense Multiple Access with Collision Detection

6. What does a sensor and an actuator do when used in IoT devices? What are the three primary factors driving the deployment of sensor technology?

A sensor measures physical phenomenon. It converts a non-electrical input into an electrical signal that can be sent to an electronic circuit. [2 marks]

The technological complement to a sensor is an actuator, a device that converts an electrical signal into action, often by converting the signal to nonelectrical energy, such as motion

There are three primary factors driving the deployment of sensor technology:

- Price
- Capability
- Size.

7. a) What are the key features of the Bluetooth protocol?

b) Bluetooth Low Energy (BLE) consumes about half the power of a Bluetooth Classic device. What is the mechanism adopted to enable this energy conservation?

Key features of the Bluetooth protocol are:

Robustness, Low power, and Low cost.

BLE devices have much **shorter scanning time** than the Bluetooth classic which results in energy conservation.

8. What are the characteristics of Wifi and Low Power Wifi?

- Wi-Fi is a wireless technology that is widely popular and known for its high-speed data transfer rates in personal and local area networks.
- Typically, Wi-Fi devices keep latency, or delays low by remaining active even when no data are being transmitted.
- Such Wi-Fi connections are often set up with a dedicated power line or batteries that need to be charged after a couple of hours of use.
- Lower-power Wi-Fi devices “sleep” when not transmitting data and need just 10 milliseconds to “wake up” when called upon.
- Low Power Wi-Fi with batteries can be used for remote sensing and control applications.

9. Describe the two different types of MAC protocols.

Reservation based protocols

- Required knowledge of network topology
- Schedule for each end node
- Fairness, priority
- E.g. Token Ring and Time division Multiple Access (TDMA)

Contention based protocols

- No requirement for synchronization and topology knowledge
- Nodes compete for resources
- E.g. ALOHA and Carrier Sense Multiple Access

10. Slotted Aloha is a contention-based access technique. Briefly describe its procedure.

- Time is divided into equal size slots, time to transmit one frame
- All stations need to wait until the beginning of each frame to transmit
- If two or more nodes transmit in slot, all nodes detect collision
- When node obtains fresh frame, it transmits in next slot
- No collision, node can send new frame in next slot
- If collision occurs, node retransmits frame in subsequent slot with probability p until success

11. In CSMA/CD protocol, a truncated exponential back-off mechanism is employed after collisions. Explain how this mechanism works.

- When the transmitting station detects collision, it will stop its transmission and wait for a random back-off time. This is the slot time it has to wait before attempting retransmission.
- The back-off timer is determined through choosing a random number from a set:
 - $(0, 2N - 1)$, when N is between 1 and 10. (N is the collision number or number of retransmission attempt).
 - $(1, 1023)$ when N is between 11 and 16.
- If after 16 attempts, a collision is encountered, the frame is dropped.