Name: Aswath S

College: Vellore Institute of Technology, Vellore

Reg.No: 21BEC2188

Wi-Fi Training Program 2025

Module 4

Question 8:

Describe the Medium Access Control methodologies

Solution:

1. **Contention-Based Access (Random Access)**

   Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)

   - **Used in Wi-Fi (802.11).**
   - **A station first listens (carrier sense) before transmitting.**
   - **If the channel is idle, the station waits for a random backoff period and then transmits.**
   - **If the channel is busy, the station defers its transmission.**
   - **Collision Avoidance: Instead of detecting collisions (like Ethernet's CSMA/CD), 802.11 tries to avoid them using:**
     - **Interframe spacing (DIFS, SIFS)**
     - **Random backoff**
     - **RTS/CTS to reserve the channel**

   CCA = Clear Channel Assessment

   CCA is a key component of the CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) mechanism used in IEEE 802.11 (Wi-Fi) networks.

2. Contention-Free Access (Scheduled Access)

Point Coordination Function (PCF)

- An optional method in **802.11**.
- **Access Point (AP)** acts as a **central coordinator**.
- AP **polls** each station in a round-robin fashion to allow transmission.
- Avoids collisions completely but is rarely implemented due to complexity.

Hybrid Coordination Function Controlled Channel Access (HCCA)

- Part of **802.11e** for QoS.
- The **Hybrid Coordinator (HC)** allocates transmission times based on traffic requirements.
- Enables **guaranteed bandwidth** for voice/video.

3. Scheduled Access in Modern Standards

Target Wake Time (TWT) – IEEE 802.11ax (Wi-Fi 6)

- AP **negotiates specific wake-up schedules** with clients.
- Enables **collision-free and energy-efficient** communication.
- Very useful in **IoT** and dense environments.

OFDMA (Orthogonal Frequency Division Multiple Access)

- Introduced in **802.11ax**.
- AP can divide the channel into **Resource Units (RUs)**.
- Multiple clients transmit/receive **simultaneously** on different RUs.
- Highly efficient for low-latency, high-density networks.