**Data Link Layer: Medium Access Control in WLANs (CLO-C4)**

**Q#1: Function of MAC Sub Layer and Role of PCF and DCF in WLANs**

The Medium Access Control (MAC) sublayer plays an important role in the data link layer of the OSI, model especially in Wireless Local Area Networks (WLANs). Its main function is to control access to shared communications to ensure that various devices can send and receive information without interference.

The MAC sublayer achieves this by using two coordination functions:

* Point Coordination Function (PCF)
* Distributed Coordination Function (DCF).

1. **Distributed Coordination Function (DCF):**
   * DCF is the coordination function in IEEE 802.11 WLAN.
   * Uses the Carrier Sensing Multiple Access with Collision Avoidance (CSMA/CA) protocol to control access to shared media.
   * The device must listen to the channel before communicating to avoid collisions. If the channel is busy, the device will delay transmission until it becomes free.
   * DCF uses an argument-based process in which instruments compete for the mean. Conflict windows and reverse processes are used to reduce conflicts and manage contention.
2. **Point Coordination Function (PCF):**
   * PCF is an optional feature in IEEE 802.11 WLAN.
   * It is a centralized method by which an access point (AP) controls access to the environment.
   * Allows AP electors and referees to transmit during specific time slots.
   * PCF has more discretion than DCF and allows control of the medium access.

**Q#2: MAC Enhancements in IEEE 802.11e and Transmission Opportunity (TXOP)**

**IEEE 802.11e Overview:**

IEEE 802.11e is a revision of the IEEE 802.11 standard designed to meet the needs for quality of service (QoS) improvement in wireless networks, especially to support the use of different environments with different needs. It provides a mechanism of prioritizing and differentiating different types of traffic, allowing real time applications to be handed better than non-real time applications

**Major MAC Enhancements:**

1. **Enhanced Distributed Channel Access:**
   * EDCA is an important part of IEEE 802.11e, providing a simpler and more significant way to access the channel compared to traditional Cooperative Communications (DCF).
   * EDCA defines four access categories (ACs), each associated with a priority. AC is audio, video, best effort, and background in order of importance.
   * Sites compete for channel access in their ACs in order of priority, and each AC has its own Conflict Window (CW) and Arbitrated Interframe Space (AIFS) to manage the discussion process.
   * The goal is to ensure that priority traffic has a higher probability of reaching the channel immediately.
2. **Hybrid Coordination Function:**

HCF is an architecture that provides central integration and distribution of access channels. It includes two functions: HCCA (HCF Controlled Channel Access) and EDCF (Advanced Distributed Channel Access).

**HCCA (Centralized Approach):**

* HCCA works similar to the Point Coordination Function (PCF).
* A central controller, usually an access point (AP), controls the access channel from polling stations and assigns specific times. This centralized approach supports decision making, which is useful for applications with strict QoS.

**EDCF (Decentralized Approach):**

* + EDCF is similar to the distributed coordination method (DCF).
  + Allows adversaries to access the channel using the Enhanced DCF (EDCF) protocol. However, unlike traditional DCF, EDCF incorporates the basic principles introduced by EDCA.

**Transmission Opportunity (TXOP):**

TXOP is an important concept in wireless communications, especially in the context of the IEEE 802.11e standard. It represents a specific period of time during which a station (device or node) is exclusively authorized to transmit data without having to compete for access to the wireless channel.

The concept of transmission time (TXOP) refers to a special period of time in which a station in the wireless network is allowed to transmit only data without competing with other stations parked for access to the communication medium. This concept is particularly important in the context of the IEEE 802.11e standard, which introduces improvements to the media access control (MAC) protocol to support quality of service (QoS) in wireless networks.

Key features include reducing contention, supporting quality of service (QoS) through kernel processing, continuous data transfer for applications such as streaming, and improving communication decisions. TXOP improves network performance by reducing contention delays and ensuring data delivery.

In summary, IEEE 802.11e uses EDCA and HCF as the main MACs presents as. Functionality to meet enhanced QoS requirements. EDCA prioritizes traffic based on access to the cluster, while HCF provides centralized routing and distribution. TXOP is an important part that allows data centers to send data without contention, thus improving performance.

**References:**

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