**WiFi Training Program 2025**

**Name: Aswath S**

**University: VIT Vellore**

**Reg.No: 21BEC2188**

**Question-5:**

**How the CAPWAP tunnel is maintained between AP and controller**

**CAPWAP) tunnel between an Access Point (AP) and a Wireless LAN Controller (WLC) entails ongoing communication via the Control Tunnel and optionally the Data Tunnel. The process provides reliability, security, and uninterrupted connectivity between the AP and controller.**

**1. Tunnel Initialization**

**Upon AP boot-up, it tries to find a controller with:**

- **DHCP (Option 43)**
- **DNS**
- **Static IP configuration**

**After discovery, the AP sends a Discovery Request to the controller. The controller replies with a Discovery Response.**

**2. Tunnel Establishment (Control Tunnel)**

- **The AP sends a Join Request to the controller over UDP port 5246.**
- **The controller validates the AP and replies with a Join Response.**
- **DTLS (Datagram Transport Layer Security) is established to encrypt and authenticate the control messages.**

**3. AP Configuration**

- **The controller pushes configuration settings (SSID, security policies, QoS, etc.) to the AP.**
- **Configuration messages are exchanged through the Control Tunnel.**

**4. Data Tunnel Establishment**

- **If operating in Tunnel Mode, a separate Data Tunnel is established over UDP port 5247 for forwarding user data traffic.**

**5. Heartbeat Mechanism (Keep-alive)**

- **To maintain the tunnel, the AP periodically sends Keep-Alive or Echo messages to the controller through the Control Tunnel.**
- **The controller responds to confirm its presence.**
- **If multiple missed heartbeats occur, the AP considers the controller unavailable and may attempt re-discovery.**

**6. Tunnel Re-establishment**

- **If the connection is lost (e.g., controller failure, network issues), the AP will retry discovery and re-join the controller.**
- **The controller may initiate a re-establishment process if it detects AP disconnection.**

**7. Management & Monitoring**

- **The controller continuously monitors the AP's status and performance metrics through the Control Tunnel.**
- **Firmware updates, configuration changes, and troubleshooting are all handled through this tunnel.**

**8. Termination**

- **The tunnel is terminated if:**
    - **The AP is manually removed or rebooted.**
    - **The controller sends a Deauthentication message.**
    - **Network issues cause a permanent loss of connectivity.**