Q5) **Client Association Process – Detailed Explanation**

The **client association process** is the procedure through which a wireless device (client) connects to a wireless Access Point (AP) to access the network. It consists of **four main steps**:

**1. Scanning**

* The client device first **discovers nearby access points**.
* There are two types of scanning:
  + **Passive scanning**: The client listens for **beacon frames** broadcasted by APs at regular intervals.
  + **Active scanning**: The client sends **probe request frames**, and APs respond with **probe response frames**.
* The client collects information like SSID, signal strength, channel, and supported rates.

**2. Authentication**

* After choosing an AP, the client starts the **authentication process**.
* In basic Wi-Fi (IEEE 802.11), there are two types:
  + **Open System Authentication**: No credentials are required; the AP simply accepts the client.
  + **Shared Key Authentication**: A challenge-response method is used, typically with WEP (now outdated).
* If **WPA/WPA2/WPA3** is used, this stage involves **4-way handshakes and key exchanges** after association.

**3. Association**

* Once authenticated, the client sends an **Association Request Frame** to the AP.
* The AP responds with an **Association Response Frame**.
* This step:
  + Allocates **resources** for the client.
  + Assigns an **Association ID (AID)**.
  + Officially **joins the client to the network**.

**4. IP Configuration**

* After association, the client must obtain an **IP address** to start communication.
  + Usually done via **DHCP** (Dynamic Host Configuration Protocol).
* Once IP is assigned, the client can **transmit and receive data** through the AP to/from the broader network (e.g., internet).
* **4-Way Handshake** (WPA2/WPA3):
  + Used to derive and install encryption keys.
  + Ensures mutual authentication and data protection.
* **Roaming**:
  + If the client moves, it may disassociate from one AP and **re-associate with another** (seamless handoff in enterprise networks).