1. How DHCP protocol works?

The normal process for DHCP (Dynamic Host Configuration Protocol) involves several steps that allow a client device to obtain an IP address and other network configuration parameters from a DHCP server. This process is known as the **DORA** process, which stands for **Discovery**, **Offer**, **Request**, and **Acknowledgement**. Here’s a detailed breakdown of each step:

**DHCP Process: The DORA Sequence**

1. **Discovery (DHCPDISCOVER):**
   * When a client device (such as a computer, smartphone, or tablet) connects to the network and needs an IP address, it sends out a **DHCPDISCOVER** message.
   * This is a broadcast message to all devices on the local network (typically using the address 255.255.255.255) because the client doesn't yet have an IP address.
   * The message includes the client's MAC address so that any responding DHCP server can identify the requesting device.
2. **Offer (DHCPOFFER):**
   * One or more DHCP servers on the network receive the DHCPDISCOVER message and respond with a **DHCPOFFER** message.
   * The DHCPOFFER message includes an available IP address, subnet mask, default gateway, DNS server addresses, and lease duration.
   * This message is typically sent as a broadcast message because the client may not yet have an IP address to receive unicast messages.
3. **Request (DHCPREQUEST):**
   * The client receives one or more DHCPOFFER messages but selects one of the offers to accept.
   * The client responds by sending a **DHCPREQUEST** message, indicating which server's offer it is accepting.
   * This message is also broadcasted, indicating the client is formally requesting the offered IP address.
   * The DHCPREQUEST message can also include the server identifier (IP address) of the chosen DHCP server.
4. **Acknowledgement (DHCPACK):**
   * The DHCP server that receives the DHCPREQUEST message processes the request and responds with a **DHCPACK** message.
   * The DHCPACK message confirms that the IP address has been allocated to the client and includes all the necessary configuration information.
   * The client can now use the provided IP address and network configuration to communicate on the network.

**Additional Steps and Renewal Process**

* **Lease Renewal:**
  + The IP address assigned to the client has a lease time. Before the lease expires, the client will attempt to renew the lease by sending a **DHCPREQUEST** message directly to the DHCP server.
  + The server responds with a **DHCPACK** to renew the lease.
  + If the server does not respond, the client will continue trying to renew. If the lease expires, the client must start the DHCP process again from the DHCPDISCOVER step.

**DHCP Release:**

* If the client device no longer needs the IP address (e.g., it is shutting down or leaving the network), it can send a **DHCPRELEASE** message to the DHCP server to inform it that the IP address can be returned to the pool of available addresses.

**Summary:**

The normal DHCP process ensures that each device on a network can automatically obtain a valid IP address and other configuration settings needed for network communication, reducing the need for manual network configuration by network administrators.

1. Give example

**Example Scenario: DORA Process**

**Network Setup:**

* A network has a DHCP server with an IP address pool ranging from 192.168.1.100 to 192.168.1.200.
* A client device, such as a laptop, connects to the network for the first time.

**Step-by-Step DORA Process:**

1. **Discovery (DHCPDISCOVER):**
   * The laptop connects to the network and realizes it needs an IP address.
   * The laptop sends a DHCPDISCOVER message as a broadcast to all devices on the network (destination IP: 255.255.255.255).
   * The message includes the client's MAC address (e.g., 00:1A:2B:3C:4D:5E).

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DHCPDISCOVER

From: 00:1A:2B:3C:4D:5E (Client's MAC address)

To: 255.255.255.255 (Broadcast)

1. **Offer (DHCPOFFER):**
   * The DHCP server on the network receives the DHCPDISCOVER message.
   * The server selects an available IP address from its pool (e.g., 192.168.1.101) and prepares a DHCPOFFER message.
   * The server sends the DHCPOFFER message as a broadcast because the client does not yet have an IP address.

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DHCPOFFER

From: 192.168.1.1 (DHCP Server's IP)

To: 255.255.255.255 (Broadcast)

Offered IP: 192.168.1.101

Subnet Mask: 255.255.255.0

Gateway: 192.168.1.1

DNS Server: 192.168.1.1

1. **Request (DHCPREQUEST):**
   * The laptop receives the DHCPOFFER message from the DHCP server.
   * The laptop sends a DHCPREQUEST message to the server, indicating that it accepts the offer.
   * The DHCPREQUEST message is also broadcasted to inform all potential DHCP servers on the network of the client's choice.

yaml

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DHCPREQUEST

From: 00:1A:2B:3C:4D:5E (Client's MAC address)

To: 255.255.255.255 (Broadcast)

Requested IP: 192.168.1.101

DHCP Server Identifier: 192.168.1.1

1. **Acknowledgement (DHCPACK):**
   * The DHCP server receives the DHCPREQUEST message from the laptop.
   * The server sends a DHCPACK message to the laptop, confirming the IP address assignment and providing the network configuration details.
   * The DHCPACK message is sent as a unicast message to the client's newly assigned IP address.

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DHCPACK

From: 192.168.1.1 (DHCP Server's IP)

To: 192.168.1.101 (Client's new IP)

Assigned IP: 192.168.1.101

Subnet Mask: 255.255.255.0

Gateway: 192.168.1.1

DNS Server: 192.168.1.1

Lease Time: 86400 seconds (24 hours)

**Completion:**

* The laptop configures its network interface with the assigned IP address (192.168.1.101) and other network settings provided by the DHCPACK message.
* The laptop can now communicate on the network using its assigned IP address.

**Summary:**

The DORA process ensures that the laptop dynamically receives an IP address and necessary network configuration, allowing it to connect to and communicate on the network seamlessly.