Day 12 (Life of a Packet)

Overview

When data travels across a network, it moves through several layers, each with its own addressing and encapsulation rules. A packet's journey involves interaction between different devices (hosts, switches, and routers) and their respective protocols.

Key Concepts

1. **MAC (Media Access Control) Address:**
   - Unique to each device's network interface.
   - Used for communication within the same network or broadcast domain.
2. **IP (Internet Protocol) Address:**
   - Identifies devices at the network layer.
   - Used to communicate across different networks.
3. **Headers:**
   - **TCP Header:** Contains source and destination IP addresses.
   - **Ethernet Header:** Contains destination and source MAC addresses.

Key Header Sequence

1. **TCP Header:**
   - **Source IP Address** precedes **Destination IP Address**.
2. **Ethernet Header:**
   - **Destination MAC Address** precedes **Source MAC Address**.

Packet Journey

1. **Host Sends Data:**
   - The host encapsulates data with headers (TCP, IP, and Ethernet).
   - The source IP and destination IP remain unchanged throughout the journey.
   - The source MAC and destination MAC are updated at each hop.
2. **Switching Within a LAN:**
   - The switch uses the **destination MAC address** in the Ethernet header to forward the packet to the appropriate device or port.
3. **Routing Across Networks:**
   - When a packet reaches a router, the **Ethernet header** is stripped and replaced with a new one.
   - The **destination MAC** is updated to the next-hop router or destination device.

○ The **source MAC** becomes the router's outgoing interface.
4. **Reaching the Destination Host:**
   ○ The final router forwards the packet with the destination MAC address set to the target host's MAC.
   ○ The destination host processes the packet using the IP layer.

MAC vs. IP Addresses in Transit

- **IP Addresses (Source and Destination):**
  ○ Do **not** change during the journey, ensuring end-to-end delivery.
- **MAC Addresses (Source and Destination):**
  ○ Change at every hop as the packet moves through routers and switches.

Illustration of the Journey

1. **Source Host:**
   ○ Creates a packet with:
      ■ Source IP: `Host A`
      ■ Destination IP: `Host B`
      ■ Source MAC: `Host A's MAC`
      ■ Destination MAC: `Default Gateway's MAC`
2. **Switch:**
   ○ Forwards the packet based on the destination MAC.
3. **Router (First Hop):**
   ○ Strips the Ethernet header and replaces it with:
      ■ Source MAC: Router's outgoing interface.
      ■ Destination MAC: Next-hop router's MAC.
4. **Intermediate Routers:**
   ○ Repeat the process until the packet reaches the destination network.
5. **Destination Router:**
   ○ Updates the Ethernet header:
      ■ Source MAC: Router's outgoing interface.
      ■ Destination MAC: Target host's MAC.
6. **Destination Host:**
   ○ Processes the packet and responds back with its own MAC as the source.

Manually Configure Mac Address

○ View Mac Address: R1# show int g0/0 or C:\> ipconfig /all
○ Configure Mac Address: go into the interface -> mac-address (0000.01a.aaaa)

Key Takeaways

1. **IP Addresses:** Remain constant throughout the journey, enabling end-to-end communication.
2. **MAC Addresses:** Change at every hop, enabling local delivery within a network segment.
3. **Encapsulation and Decapsulation:** Essential processes at each hop for addressing and forwarding.