### **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.