Here's a simple scenario to illustrate how **logical addresses**, **physical addresses**, and **port addresses** work together during network communication:

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## 1. Logical Address (IP Address)

- **What it is:** Identifies a device on a network (like 192.168.1.10).

- **How it is used:**

  - Your computer (Client) wants to send an email to a server (e.g., mail.example.com).

  - The Domain Name System (DNS) translates "mail.example.com" to its IP address (e.g., 203.0.113.2).

  - The email is sent from your IP (e.g., 192.168.1.10) to the server's IP (203.0.113.2).

## 2. Port Address

- **What it is:** Identifies a specific process or service on a device (like port 25 for SMTP, port 80 for HTTP).

- **How it is used:**

  - The email application on your computer sends data to the mail server's **port 25** (SMTP server).

  - Your computer's operating system might use an ephemeral source port (e.g., 49152) for this connection.

  - This way, the server knows the email data is meant for the mail service, not for web or other services.

## 3. Physical Address (MAC Address)

- **What it is:** Unique hardware identifier for the network interface card (NIC), e.g., 00:0A:95:9D:68:16.

- **How it is used:**

  - On a local network, your computer needs to send data to the router.

  - It uses **ARP (Address Resolution Protocol)** to resolve the router's IP address (e.g., 192.168.1.1) to its MAC address (e.g., 00:14:22:01:23:45).

  - The Ethernet frame is sent from your NIC's MAC address to the router's MAC address.

  - When the packet travels further (to the internet), each hop's router uses MAC addresses for the next local delivery.

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Here's a simplified step-by-step communication flow:

1. **Application Layer (Email Client):**

   o Wants to talk to mail.example.com (resolved to 203.0.113.2).

   o Communicates using **port 25** (SMTP).

2. **Transport Layer (TCP):**

   o Encapsulates the message with source and destination **port numbers**.

3. **Network Layer (IP):**

   o Adds **source and destination IP addresses**.

4. **Data Link Layer (Ethernet):**

   o On the local network, wraps the packet with **source and destination MAC addresses**.

5. **Physical Transmission:**

   o Actual bits sent over wire or Wi-Fi; MAC address used locally, IP/port used end-to-end.

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**Example Table:**

| Layer/Address Type | Example on Client | Example on Server | Purpose |
|---|---|---|---|
| Physical / MAC | 00:0A:95:9D:68:16 | 00:14:22:01:23:45 | Device on Local Network |
| Logical / IP | 192.168.1.10 (private) | 203.0.113.2 (public) | Device on Internet/Network |
| Port | 49152 (ephemeral, client) | 25 (SMTP, server) | Specific Application or Service |

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**Summary:**

- **MAC Address:** Used for identifying devices on the local network segment.

- **IP Address:** Used to identify devices across networks (including routing).

- **Port Address:** Used to identify **specific applications/services** on a device.

Let me know if you'd like a diagram or further examples for other network scenarios!