Computer Network Fundamentals

Lecture 5:

OSI Model Network layer protocols

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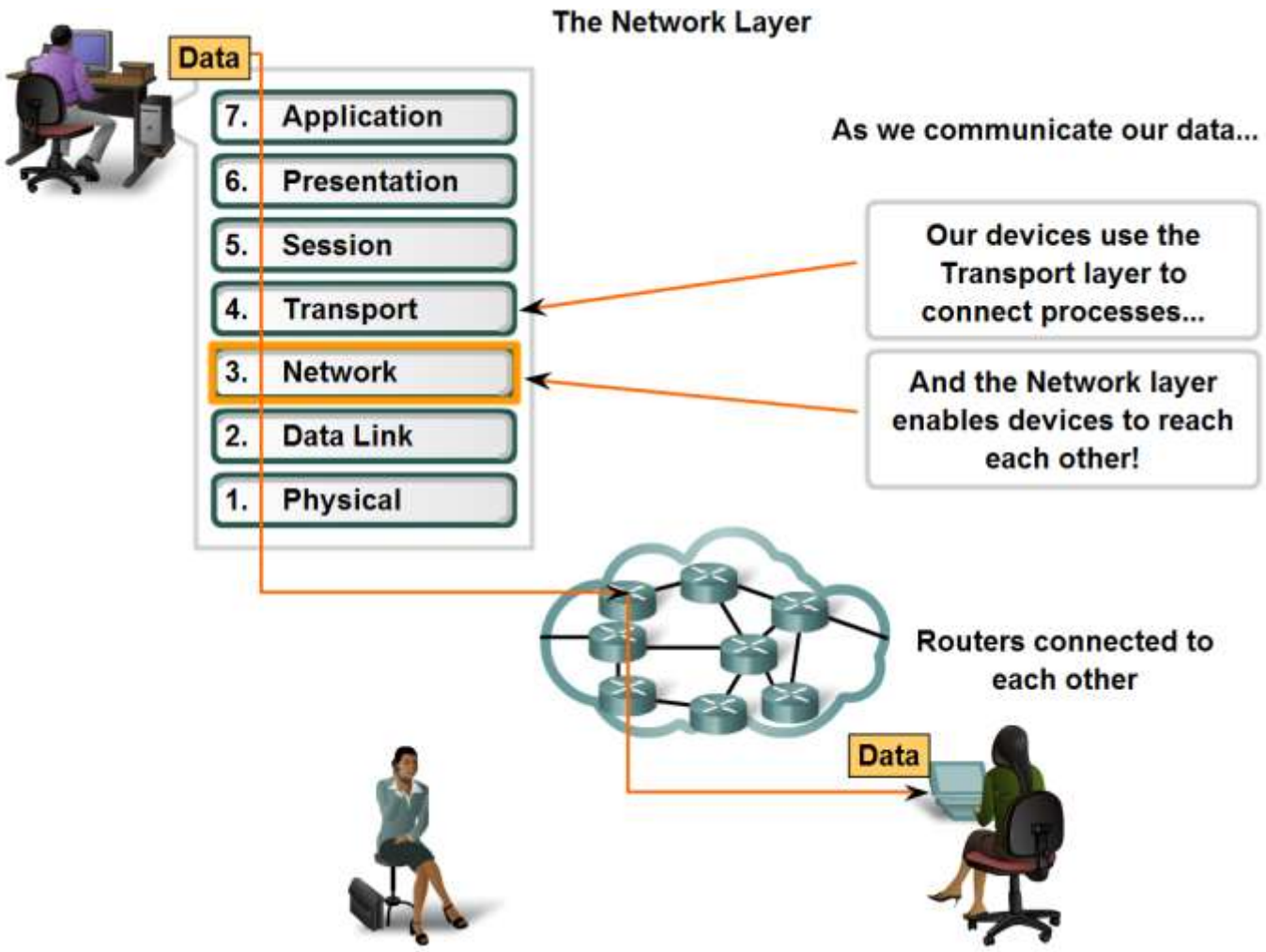
Network Layer Protocols and Internet Protocol (IP)



The Network Layer

Layer 3 uses four basic processes:

- Addressing
- Encapsulation
- Routing
- Decapsulation

The Network Layer (Cont.)

1- Addressing

- First, the Network layer must provide a mechanism for addressing these end devices. If individual pieces of data are to be directed to an end device, that device must have a unique address.

- In an IPv4 network, when this address is added to a device, the device is then referred to as a host .

The Network Layer (Cont.)

2- Encapsulation

Second, the Network layer must provide encapsulation.

- During the encapsulation process, Layer 3 receives the Layer 4 data and adds a Layer *3* header, or label, to create the Layer 3 data. When referring to the Network layer, we call this data a **packet**.
- Layer 4 data +Layer *3* header, or label = packet
- When a packet is created, the *header must contain*, among other information, the destination address. The Layer 3 header also contains the source address.

The Network Layer (Cont.)

3- Routing

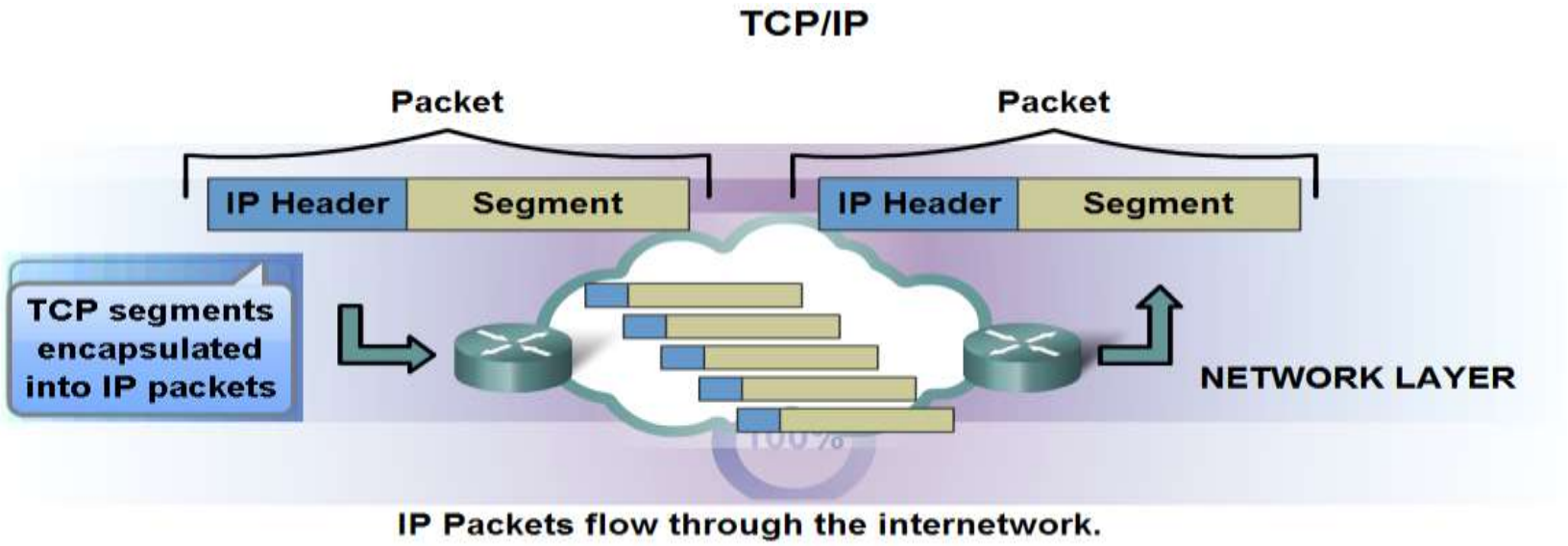
Next, the Network layer must provide services to "direct" these packets to their destination host. The source and destination hosts are *not always connected to the same network*. In fact, the packet might have to travel through many different networks. Along the way, each packet must be guided through the network to reach its final destination. Intermediary devices that connect the networks are called **routers**. The *role of the router* is to ***select paths for and direct packets toward their destination***. This process is known as **routing**.

Network Layer Protocols(Cont.)

Protocols implemented at the Network layer include:

- Internet Protocol version 4 (IPv4)
- Internet Protocol version 6 (IPv6)
- Novell Internetwork Packet Exchange (IPX)
- AppleTalk
- Connectionless Network Service (CLNS/DECNet)

IPv4 protocol Basic characteristics



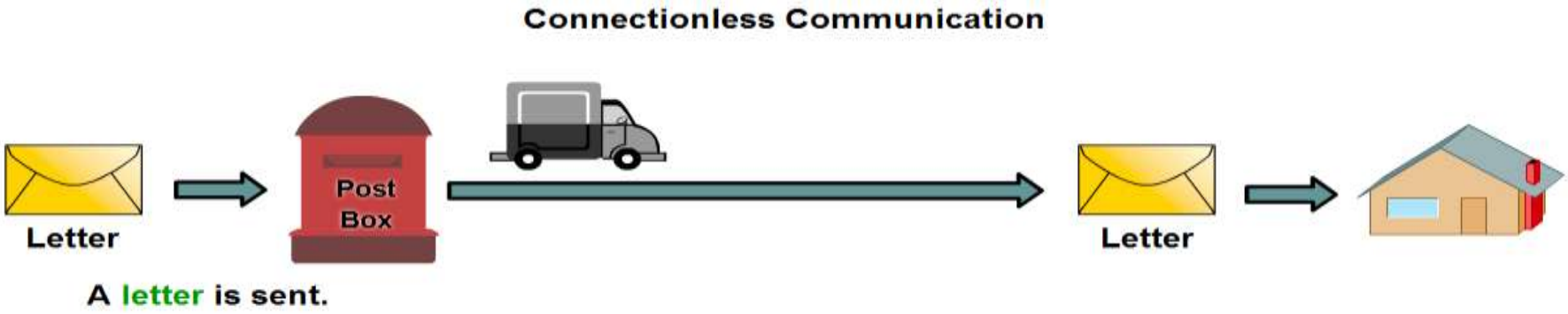
IP Packets flow through the internetwork.

- Connectionless - No connection is established before sending data packets.
- Best Effort (unreliable) - No overhead is used to guarantee packet delivery.
- Media Independent - Operates independently of the medium carrying the data.

Internet Protocol IPv4 was designed as a protocol with low overhead. It *provides* only the functions that are necessary to deliver a packet from a source to a destination over an interconnected system of networks .

Internet Protocol (IP):Example

- Describe the implications for the use of the IP protocol as it is connectionless and Unreliable protocol



The sender doesn't know:

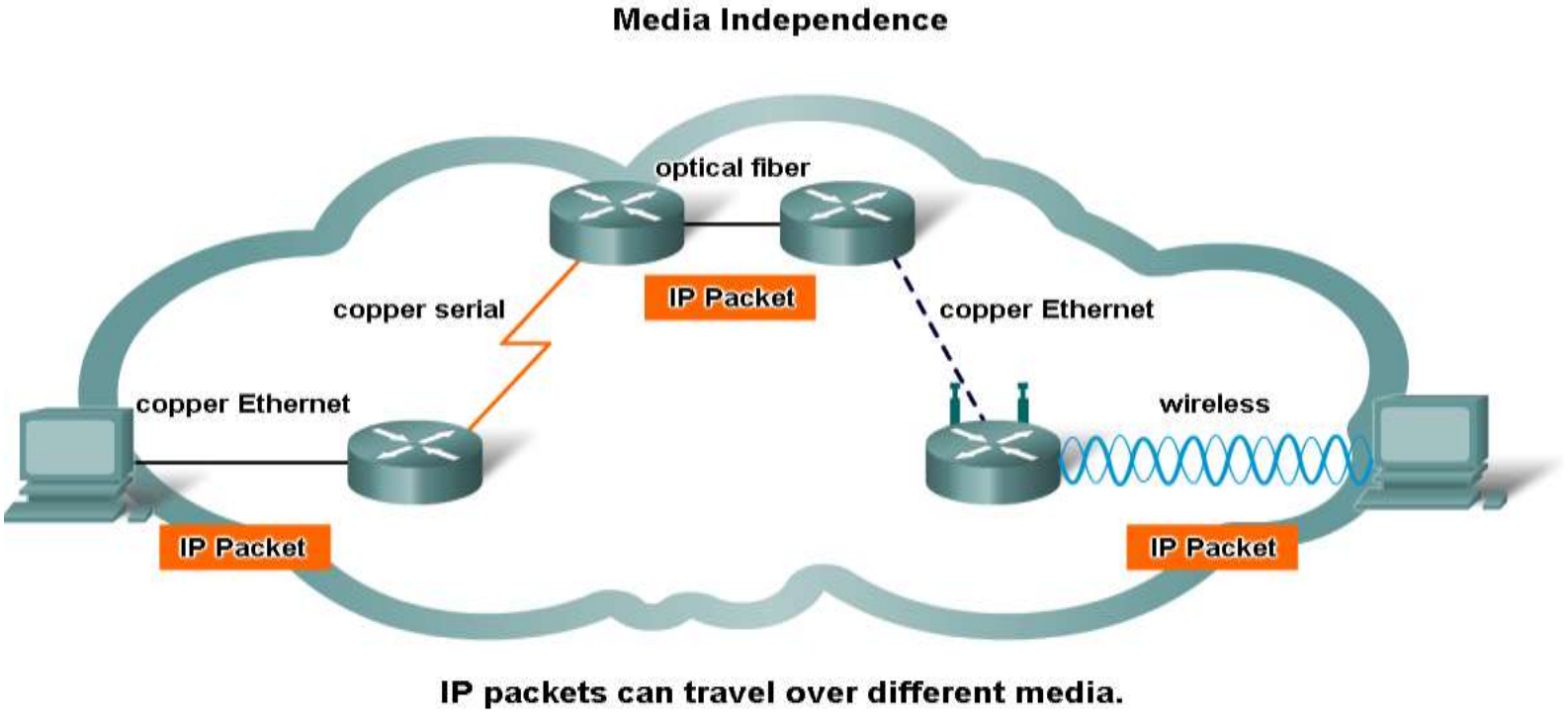
- if the receiver is present
- if the letter arrived
- if the receiver can read the letter

The receiver doesn't know:

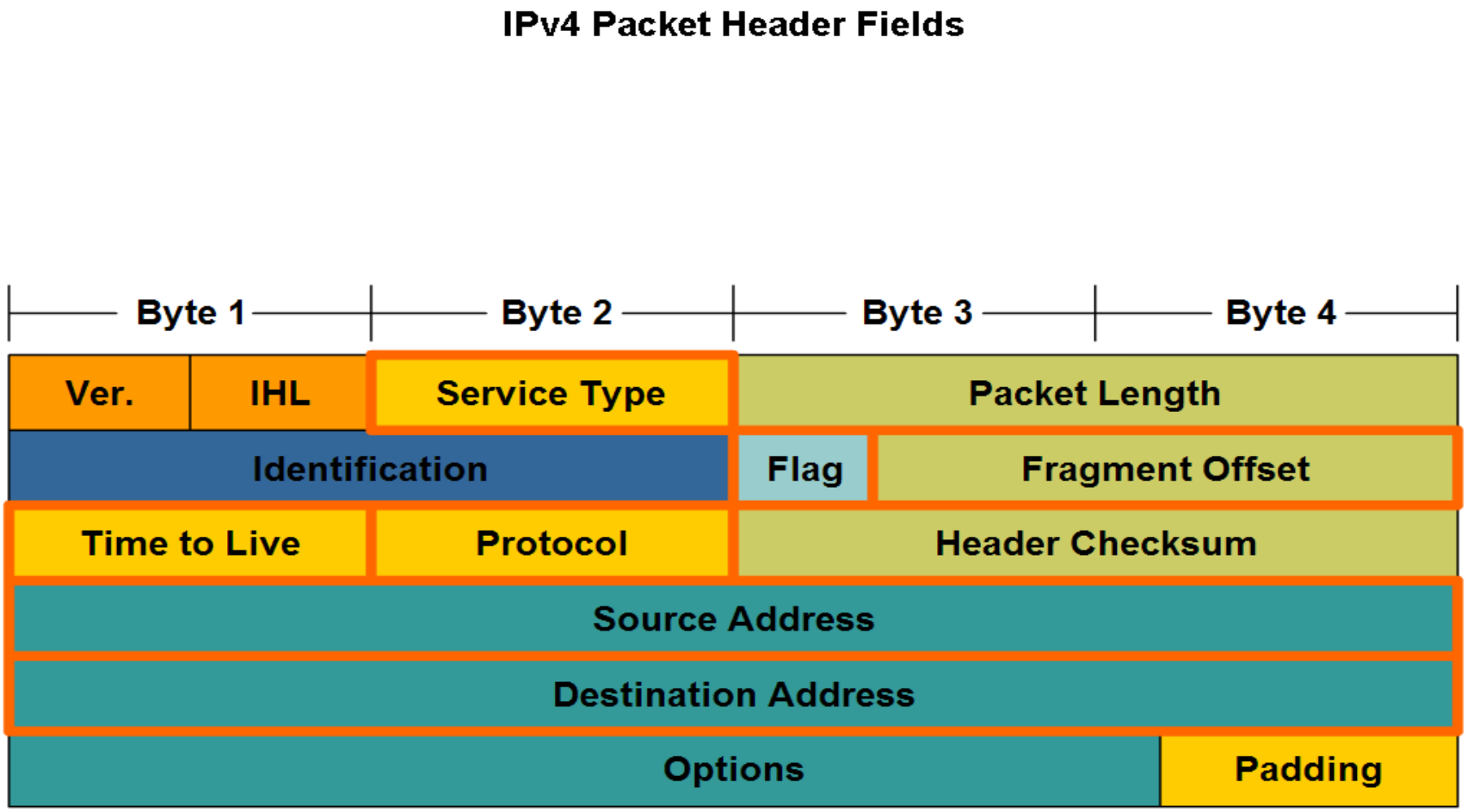
- when it is coming

Internet Protocol (IP):Example

Use of the IP as it is media independent



Internet Protocol (IP) Header fields



Internet Protocol (IP) header fields

IP Destination Address

The IP Destination Address field contains a 32-bit binary value that represents the packet destination Network layer host address.

IP Source Address

The IP Source Address field contains a 32-bit binary value that represents the packet source Network layer host address.

Time to Live (TTL)

The 8-bit TTL field describes the maximum hops the packet can take before it is considered “lost”.

Version

Indicates IP version 4 or 6.

Addressing

- In the network, there are three types of addressing:
  1. Physical Address
  2. Logical Address
  3. Port Addressing

Physical Addresses

- Physical Addresses

it is the Media Access Control (MAC)address that assign to the device in the data link layer of OSI model.

- Each frame contains source MAC address and destination MAC address.
- When a network interface card is manufactured, it is assigned an address—called a *burned-in address* (BIA)—that doesn't change when the network card is installed in a device and is moved from one network to another.
- The MAC address concerned with the person not where live, and this address doesn't change when the person move from one place to another.

Physical Addresses (Con.)

- MAC Address

The BIA is a 48-bit value. The upper 24 bits are an Organizational Unique Identifier (OUI) representing the vendor that makes the device. The lower 24 bits are a unique value for that OUI, typically the device's serial number.

Logical Address

- Logical Address

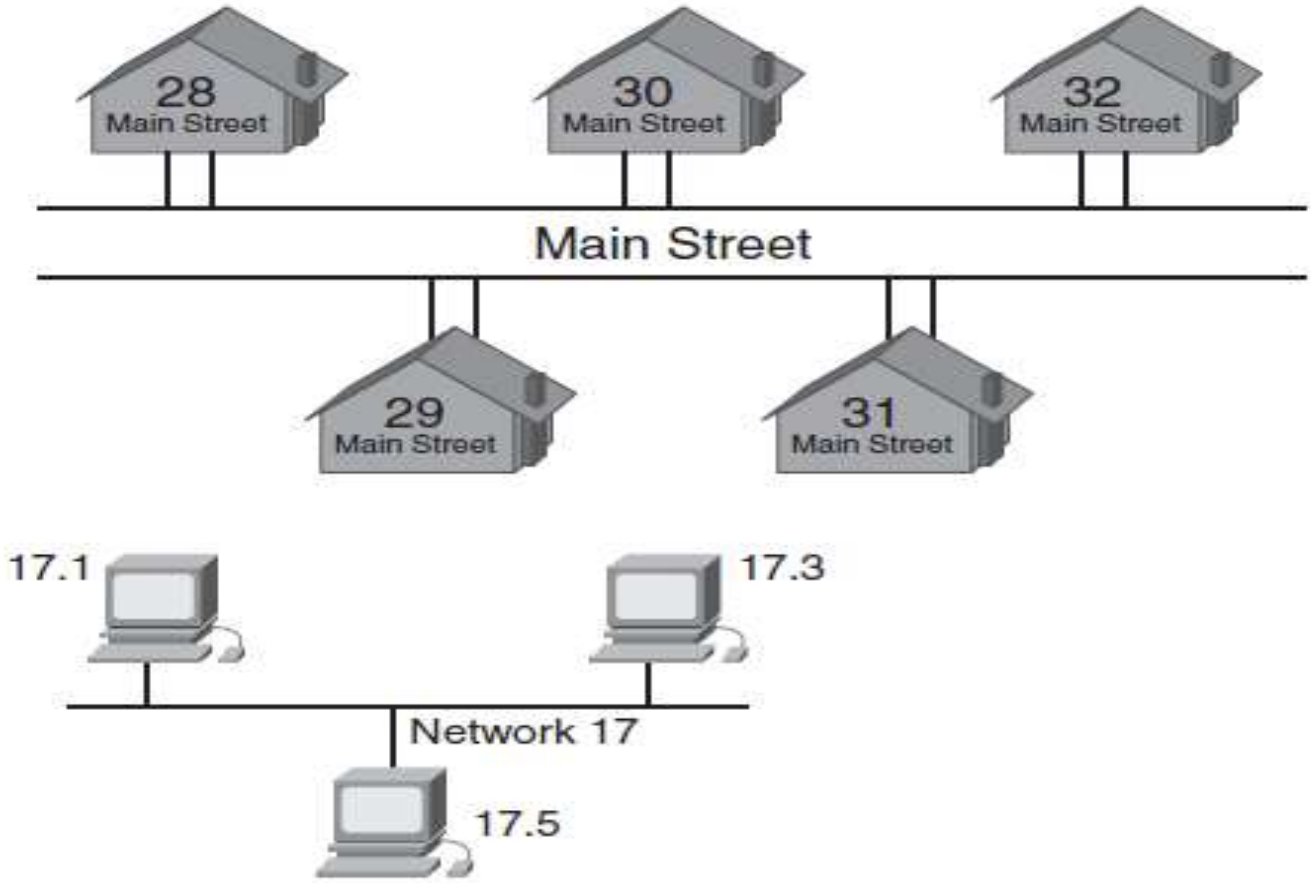
it is the Internet Protocol (IP) address that assign to the device in the network layer of OSI model.

- When you send a letter to someone, you have to know that person's postal address. Because every postal address in the world is unique, you can potentially send a letter to anyone in the world.
- Postal addresses are logical and hierarchical—for example, they include the country, province/ state, street, and building/house number.

Logical Address(Con.)

- Network layer addresses are also logical and hierarchical, and they are either defined statically by an administrator or obtained automatically from a server.
- They have 32 bits and divided into two main parts: the network that the device is on(16 bit) (similar to the street, city, province, and so on) and the device number on that network (16 bits)(similar to the building number).

Logical Address(Con.)

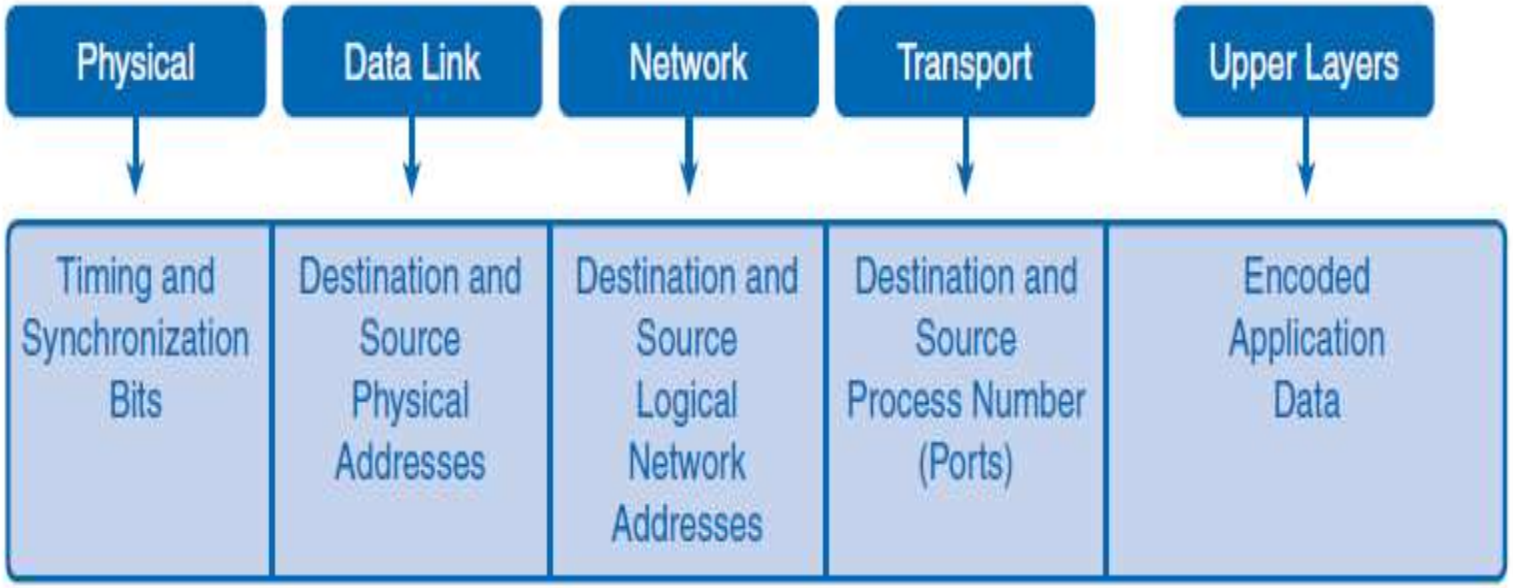


Logical Address(Con.)

- The top portion of Figure illustrates Main Street with various houses. All these houses have one portion of their address in common—Main Street—and one portion that is unique—their house number.

- The lower portion of Figure illustrates a network, 17, with various PCs on it. All these PCs have one portion of their address in common—17—and one part that is unique—their device number. Devices on the same logical network must share the same network portion of their address and have different device portions.

The information added at each layer



Thank You