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Computer Networks

Lecture [10]: Encapsulation, Decapsulation & Addressing

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(Lecturer)

Topics discussed in Today's Lectures

- Encapsulation at the Source Host

- Decapsulation and Encapsulation at the Router

- Decapsulation at the Destination Host

- Addressing in TCP/IP Protocol Suite

Encapsulation and Decapsulation

- One of the important concepts in protocol layering in the Internet is encapsulation / decapsulation

- No encapsulation/decapsulation occurs in data link layers switches

- Encapsulation in the source host, decapsulation in the destination host, and encapsulation and decapsulation in the router

Encapsulation at the Source Host

At the source, there is only encapsulation

1. At **Application layer**, data to be exchanged is referred to as a message
   - Message normally does not contain any header or trailer
   - Message is passed to the transport layer

2. **Transport layer** takes message as payload (message):
   - It *adds the transport layer header* to payload, which contains:
     - Identifiers of the source & destination app. programs that want to communicate
     - Some more info., such as info. needed for flow control, error control, or congestion control
   - Result is transport-layer packet, which is called the segment (in TCP) & user datagram (in UDP)
   - Transport layer then passes the packet to the network layer

Encapsulation at the Source Host (Contd…)

3. **Network layer** takes transport-layer packet as data and *adds its own header*
   - Header contains addresses of source & destination hosts & some more info. used for:
     - Error checking of the header
     - Fragmentation* information etc
   - Result is the network-layer packet (datagram) which is then passed to data-link layer

4. **Data-Link layer** takes network-layer packet as data & adds its own header

   - Header contains Data-link layer addresses of the host or the next hop (router)

   - Result is the link-layer packet, which is called a Frame

   - Frame is passed to physical layer for transmission

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Decapsulation and Encapsulation at the Router

At the router, both decapsulation and encapsulation occur because router is connected to two or more links

1. After set of bits are delivered to **data-link layer,** this layer decapsulates datagram from frame and passes it to the network layer

2. **Network layer:**

- Inspects source and destination addresses in datagram header

- Consults its forwarding table to find next hop to which datagram is to be delivered

3. Contents of datagram should not be changed by the network layer in the router unless there is a need to fragment the datagram if it is too big

  • Datagram is then passed to data-link layer of the next link

4. **Data-link layer** of the next link encapsulates datagram in a frame & passes it to physical layer for transmission

Decapsulation at the Destination Host

- At the destination host, each layer:

  - Decapsulates the packet received

  - Removes the headers

  - Delivers the payload to the next-higher layer until the message reaches the application layer

- Decapsulation in the host involves only error checking

Encapsulation and Decapsulation

Figure 2.8   Encapsulation/Decapsulation
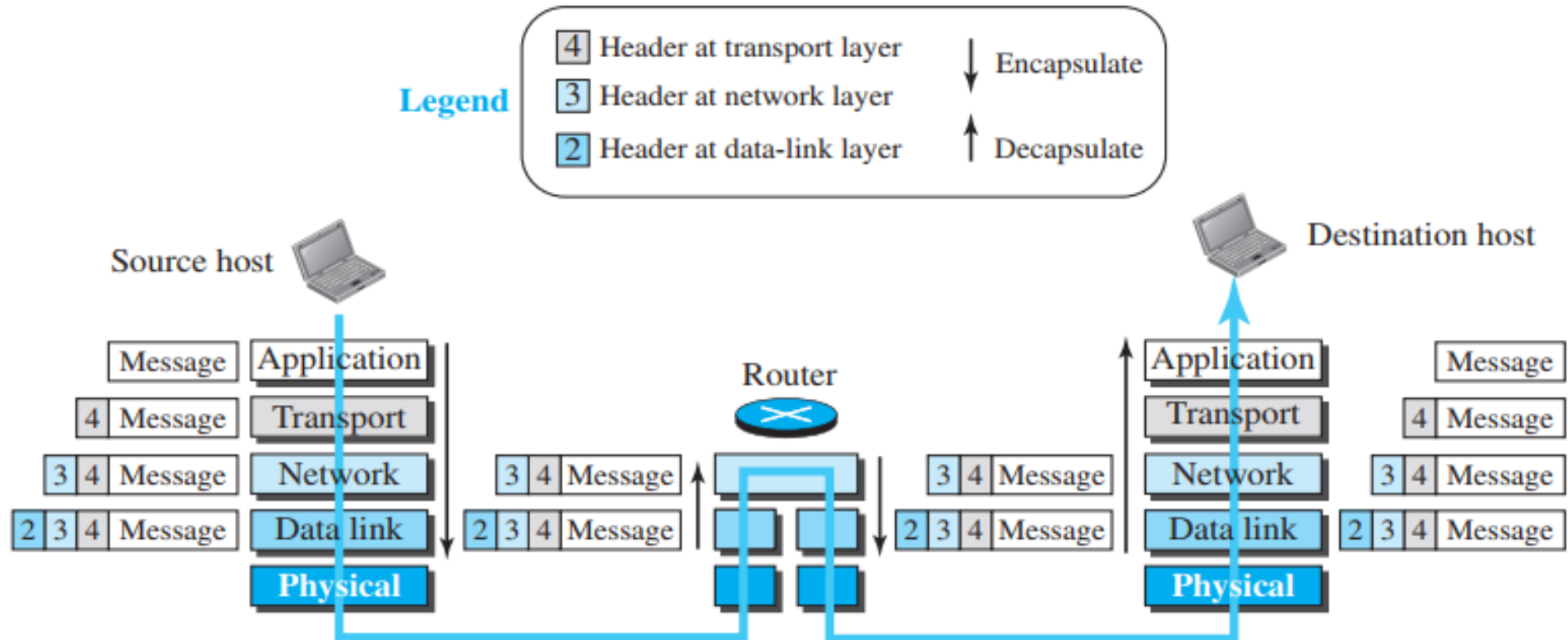
Addressing
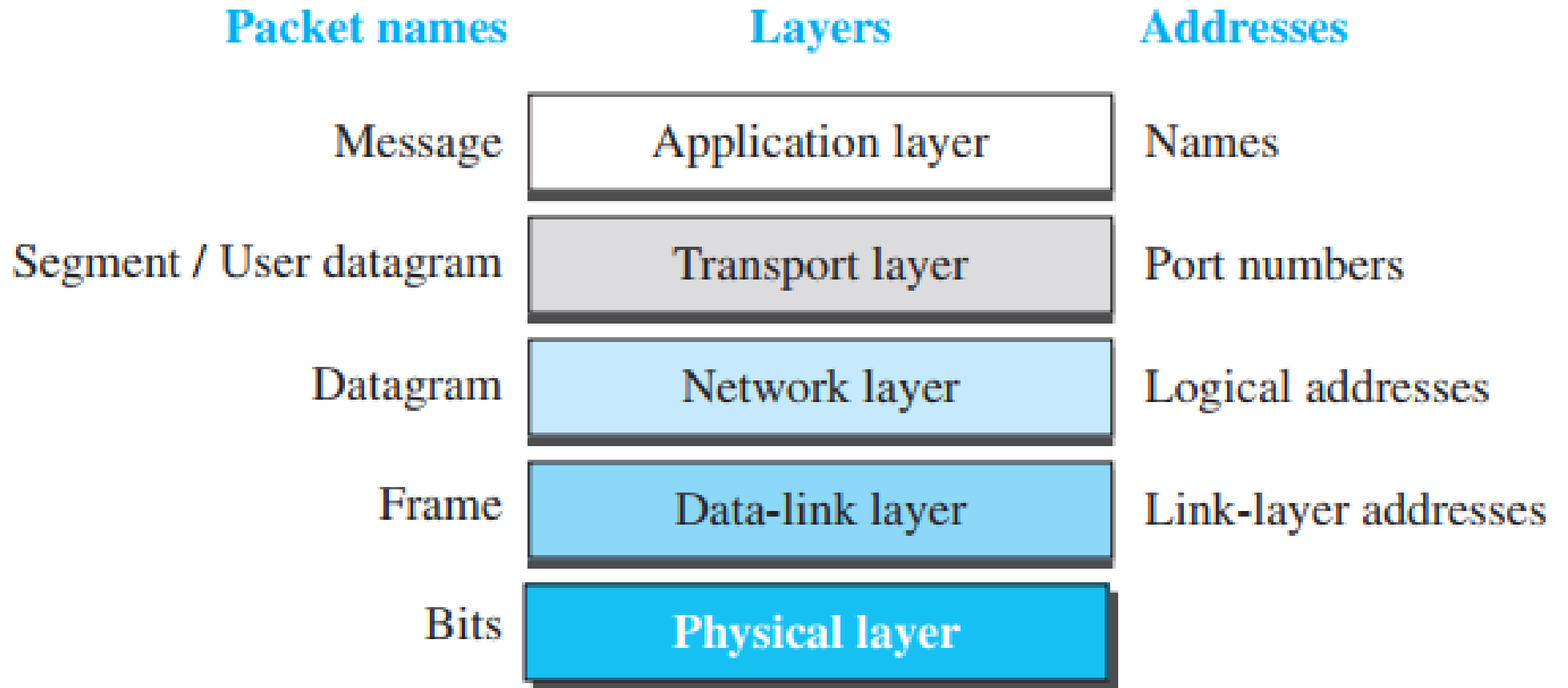
- There exist logical comm. b/n pairs of layers in TCP/IP model

- Any comm. that involves two parties needs two addresses: source address & destination address

- Generally there are only four address (one pair per layer) because the physical layer does not need addresses:

  - Unit of data exchange at the physical layer is a bit, which definitely cannot have an address

- There is a relationship b/n the layers, the **address** used in that layer, & the **packet name** at that layer

Addressing (Contd…)

- At the **Application layer**, names are used to define site that provides services, such as *someorg.com*, or the *e-mail address*
- At **Transport layer**, addresses are called port numbers*, & these define application-layer programs at the source & destination
  - Port numbers is a way to identify a specific process to which an internet message is to be forwarded when it arrives at a server
- **Network-layer**, addresses are global, with whole Internet as the scope
  - Network-layer address uniquely defines connection of a device to Internet
- **Data Link-layer** addresses, sometimes called MAC addresses, are locally defined addresses, each of which defines a specific host or router in a network (LAN or WAN)

Addressing (Contd…)

Figure 2.9 *Addressing in the TCP/IP protocol suite*

Packet names	Layers	Addresses
Message	Application layer	Names
Segment / User datagram	Transport layer	Port numbers
Datagram	Network layer	Logical addresses
Frame	Data-link layer	Link-layer addresses
Bits	Physical layer	

References

Chapter 2
Data Communication and Networking (5th Edition)
By Behrouz A. Forouzan

THANKS