UNIT III

APPLICATION AND LAYERED ARCHITECTURE

By Sucheta Raut

THE OSI MODEL

- **Established** in 1947, the *International Standards Organization (ISO)* is a multinational body dedicated to worldwide agreement on international standards. Almost three-fourths of countries in the world are represented in the ISO. An ISO standard that covers all aspects of network communications is the *Open Systems Interconnection (OSI)* model. It was first introduced in the late 1970s.
- an open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture.
- The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible, robust, and interoperable.

OSI Reference Model

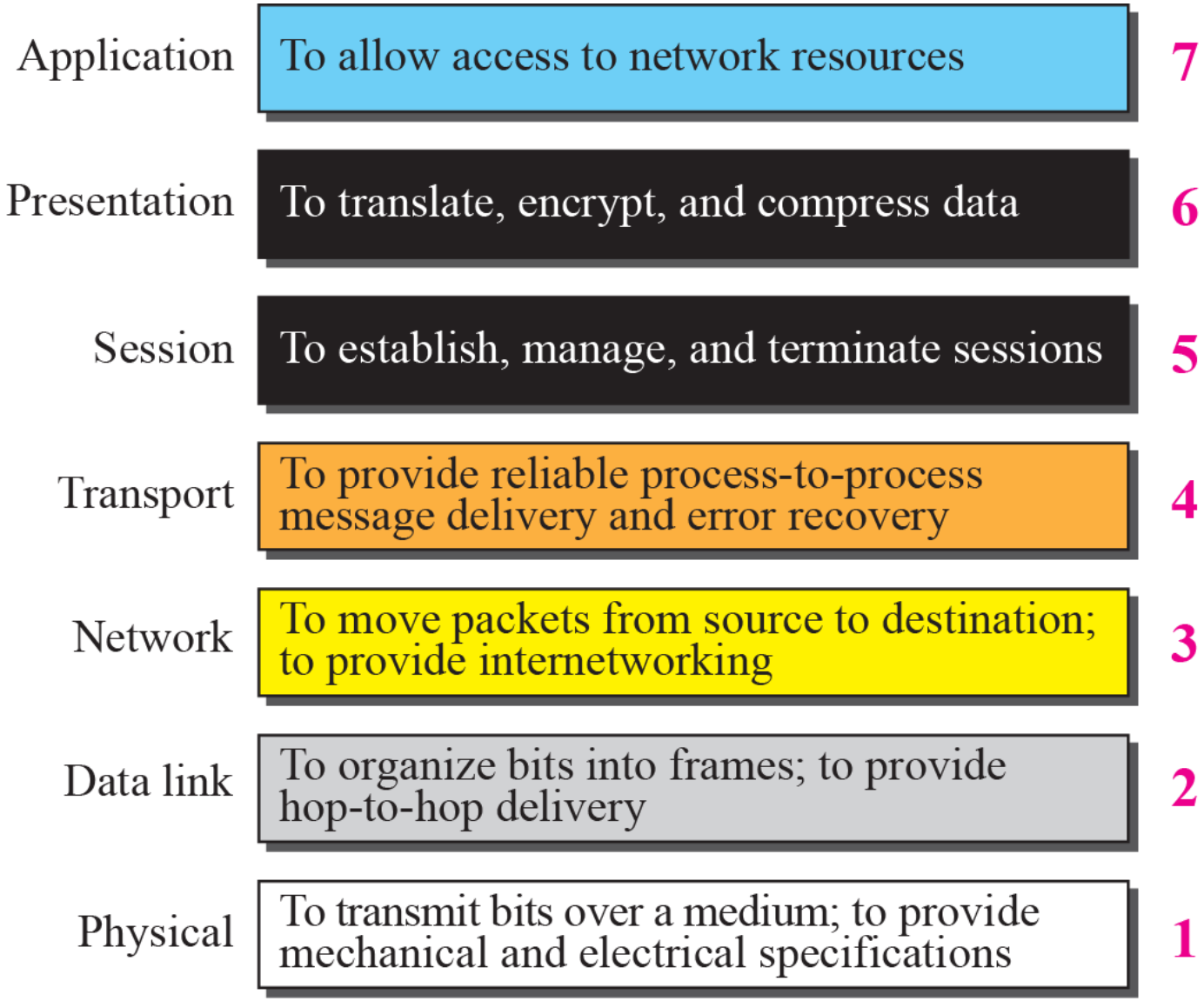
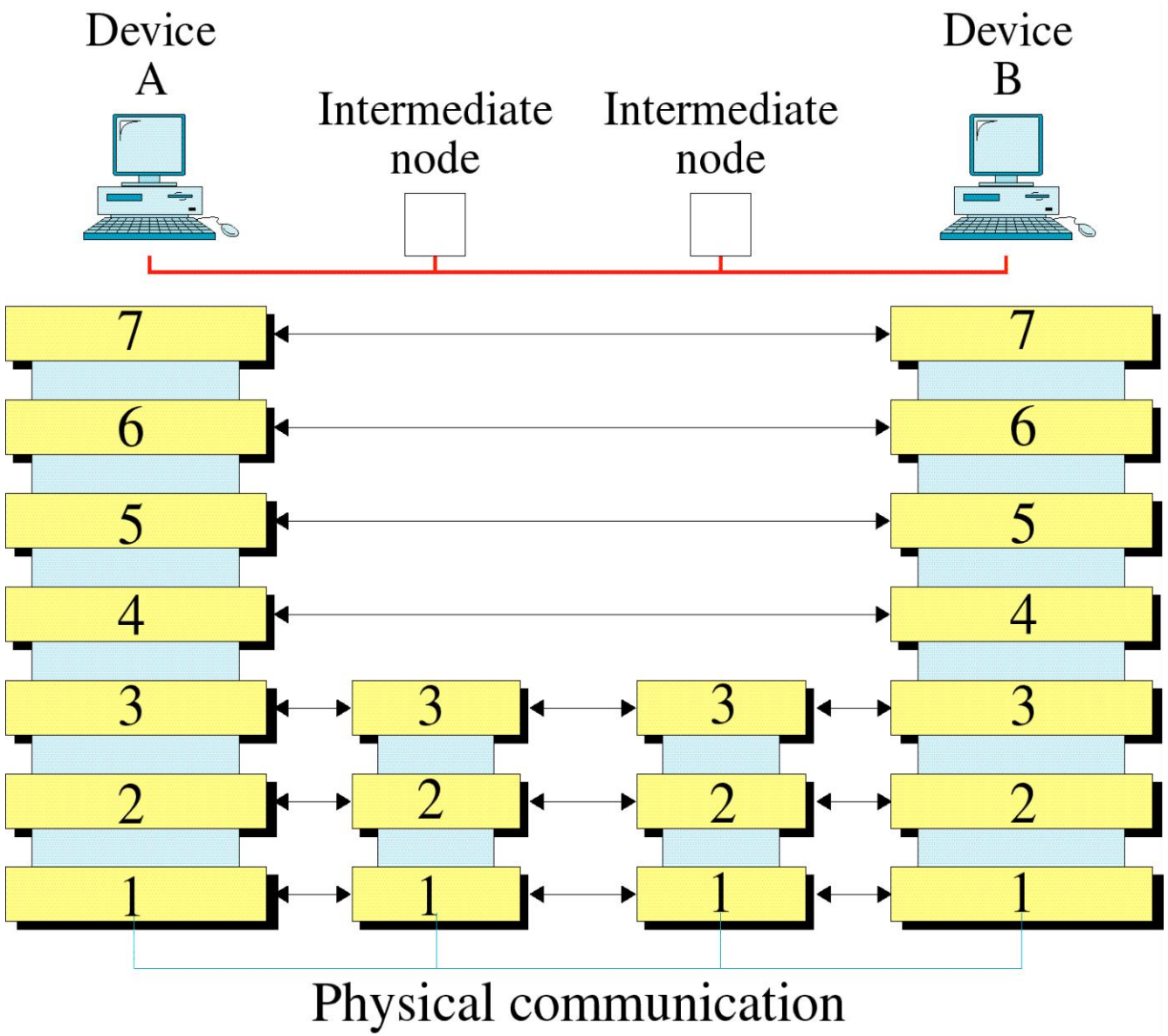


Figure 3-2

OSI Layers



- The Intermediate nodes usually involve Only the first three layers of the OSI model.
- Within a single machine each layer calls upon the services of the layer just below it. Layer 3 for example, uses the services provided by layer 2 and provides services for layer

The 7 Layers is belonging to a 3 Subgroup

- **Layers 1,2 and 3- Physical, data link and Network – are the network support layers; they deal with the physical aspects of moving data from one device to another .**

- **Layers 5,6,7 –Session, Presentation and Application are allow interoperability among unrelated software systems.**

- **Layer 4- Transport Layer links the two subgroups and ensures that what the lower layers have transmitted is in a form that the upper layers can use.**

Figure 3-3

An Exchange Using the OSI Model

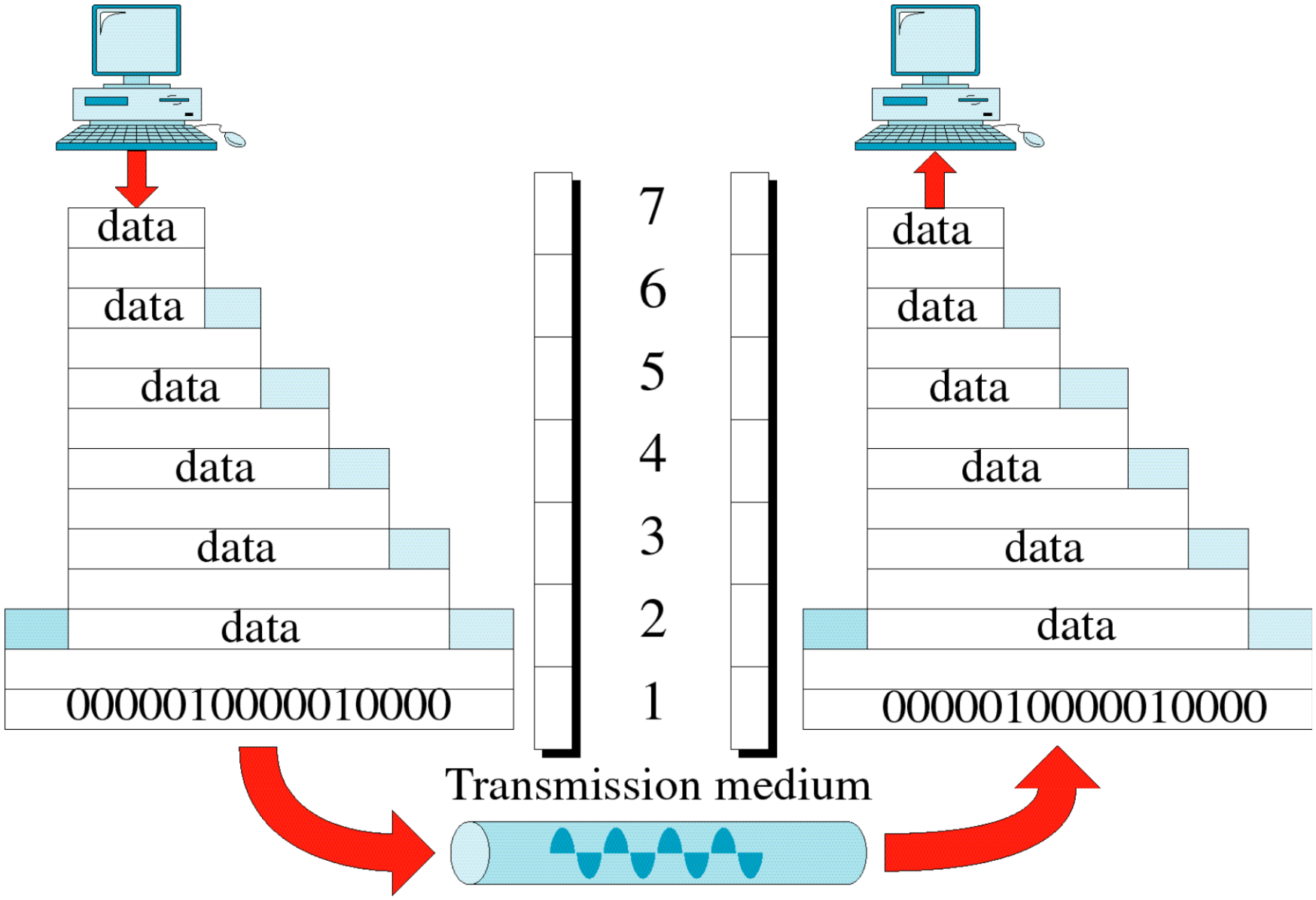
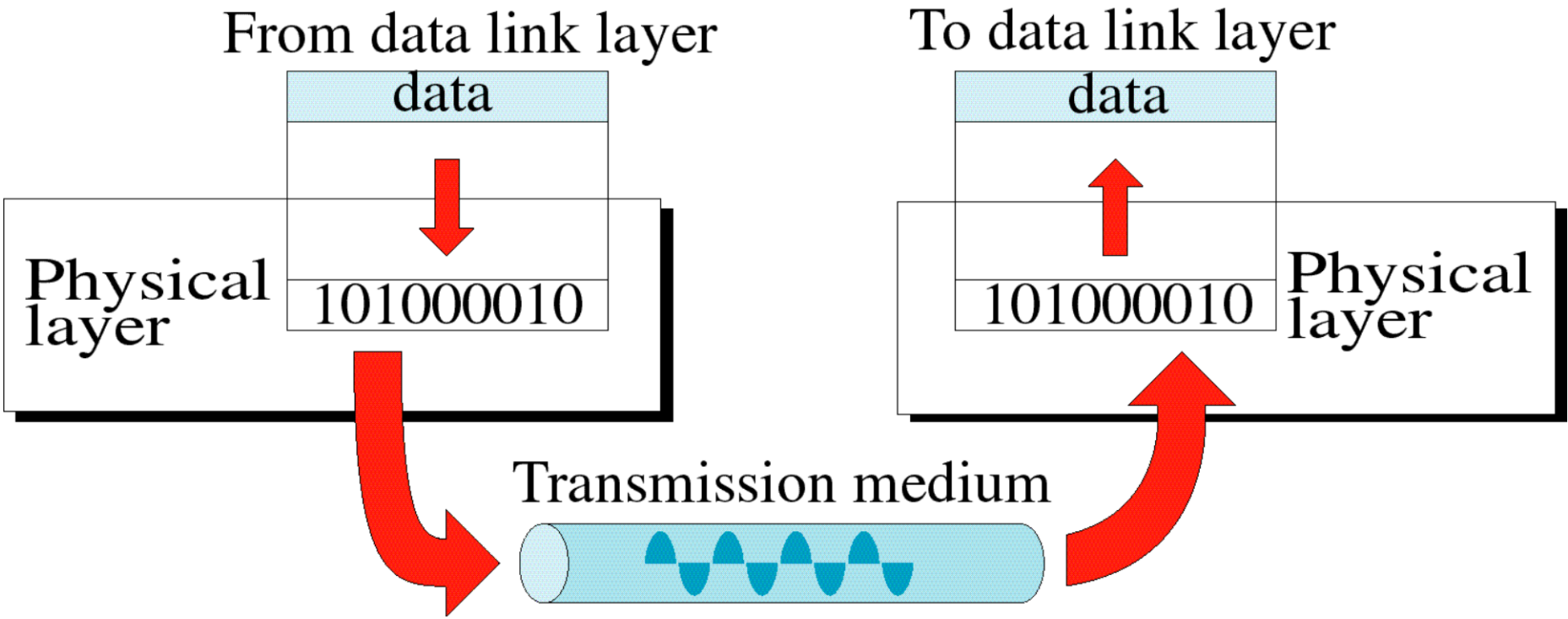


Figure 3-4

Physical Layer

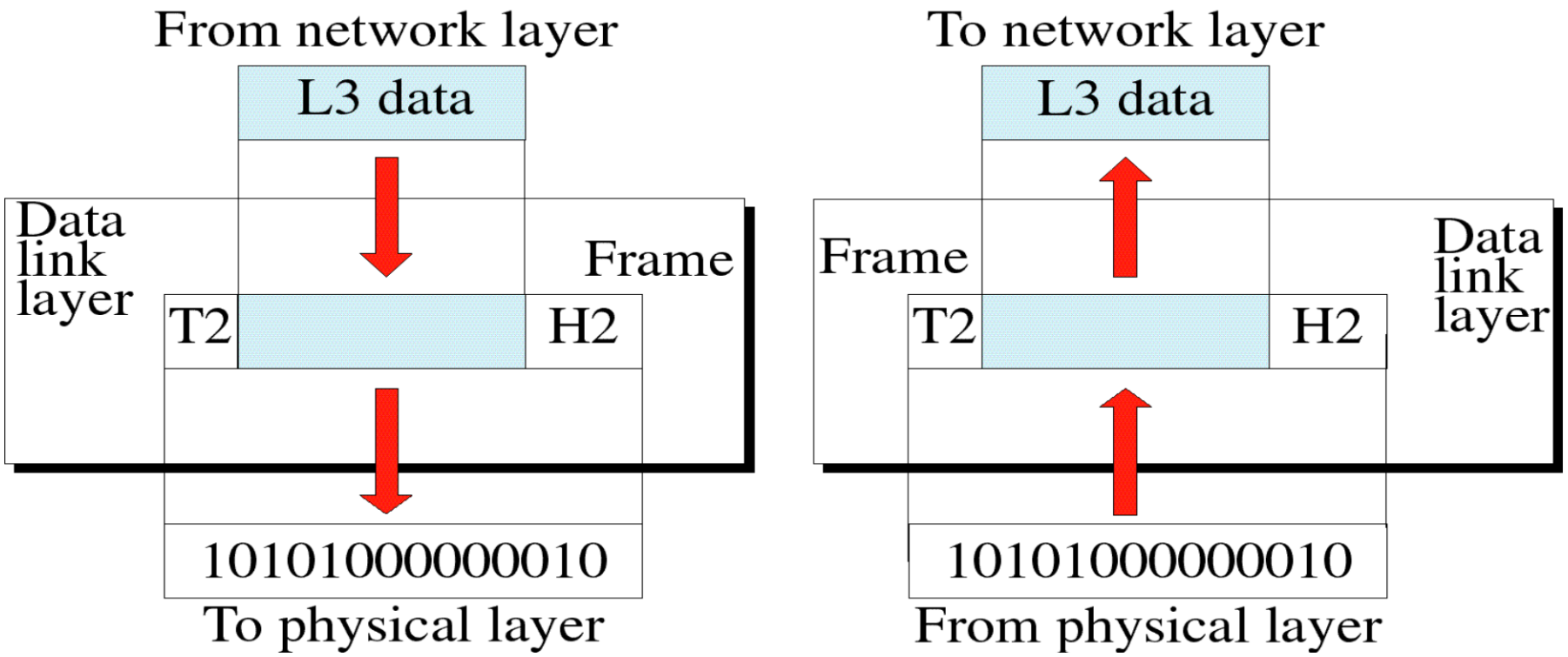


Responsibilities of Physical Layer

- Representation of bits
- Data Rate
- Synchronization of bits
- Line Configuration
- Physical Topology
- Transmission mode

Figure 3-5

Data Link Layer



Responsibilities of Data Link Layer

- Framing
- Physical Addressing
- Flow Control
- Error Control

Figure 3-6

Data Link Layer Example

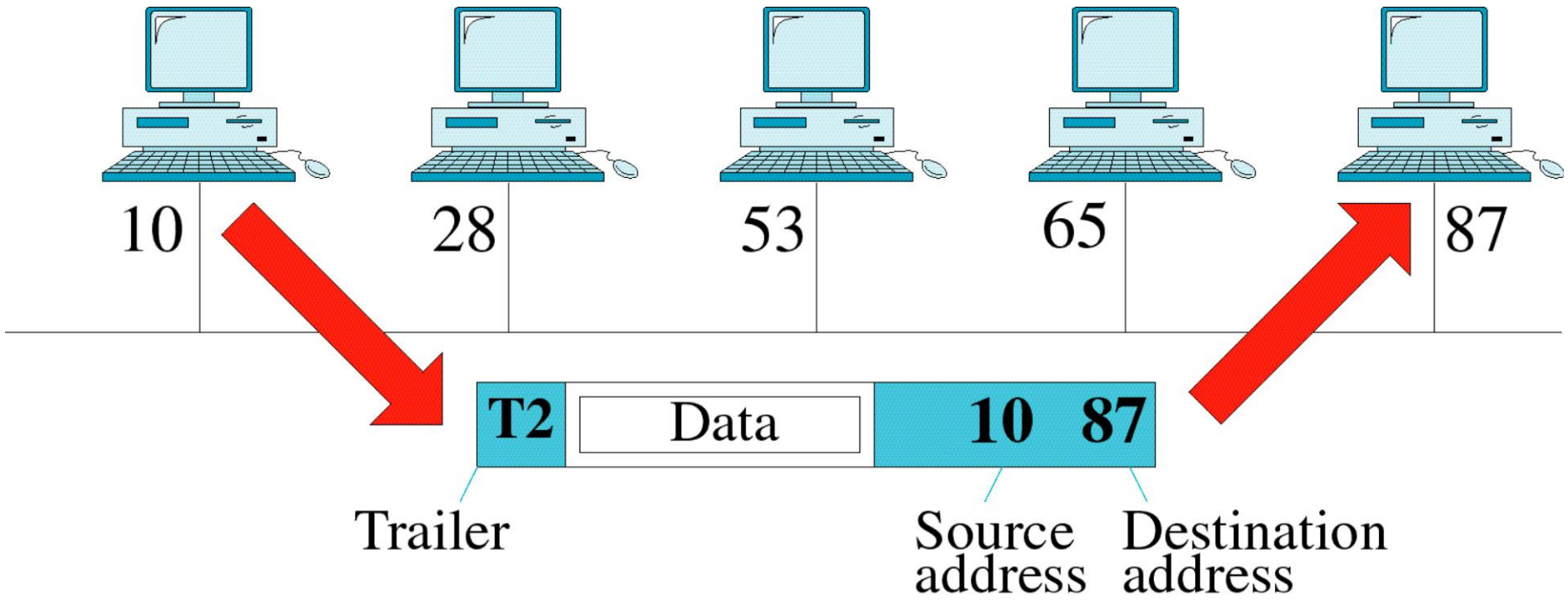
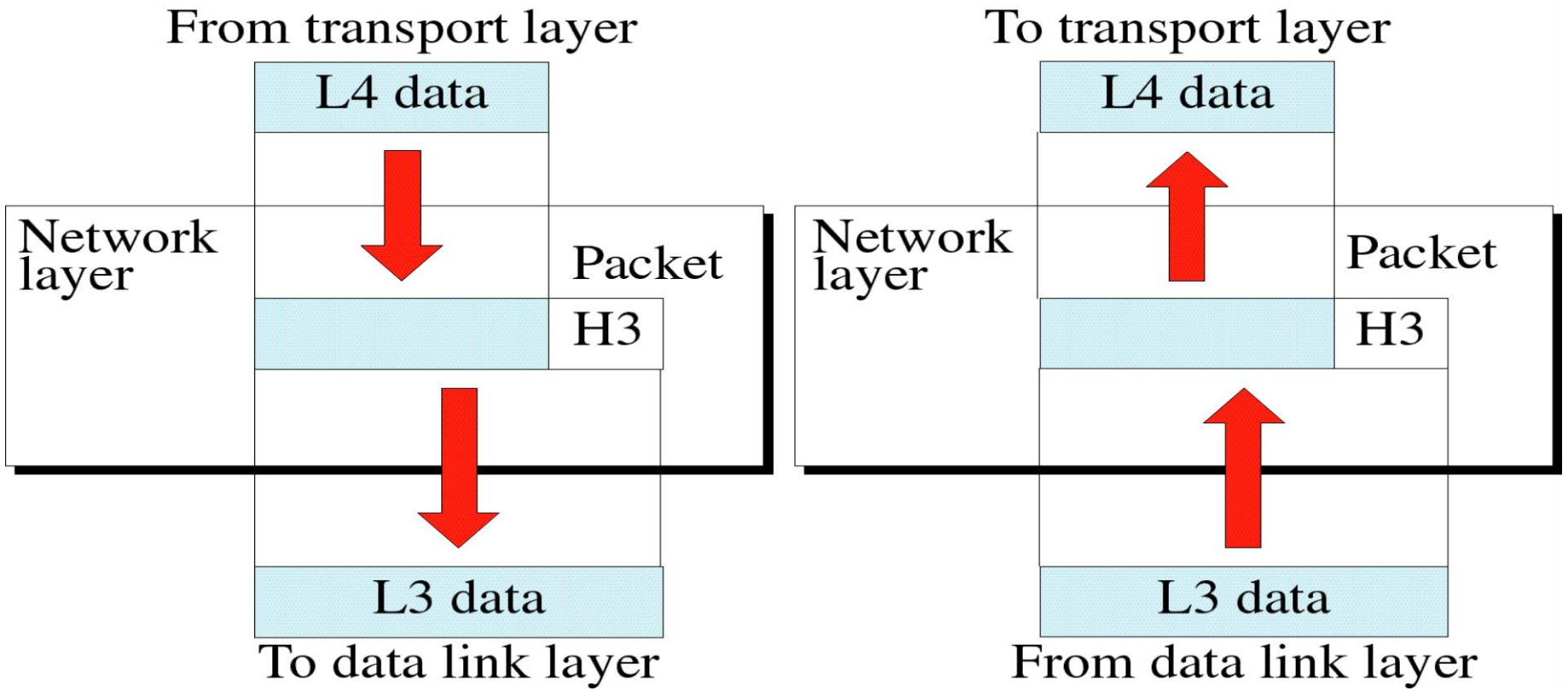


Figure 3-7

Network Layer



Responsibilities of Network Layer

- Responsible for the delivery of individual packets from the source to the destination.
- **Logical Addressing**
- **Routing**

Figure 3-8

Network Layer Example

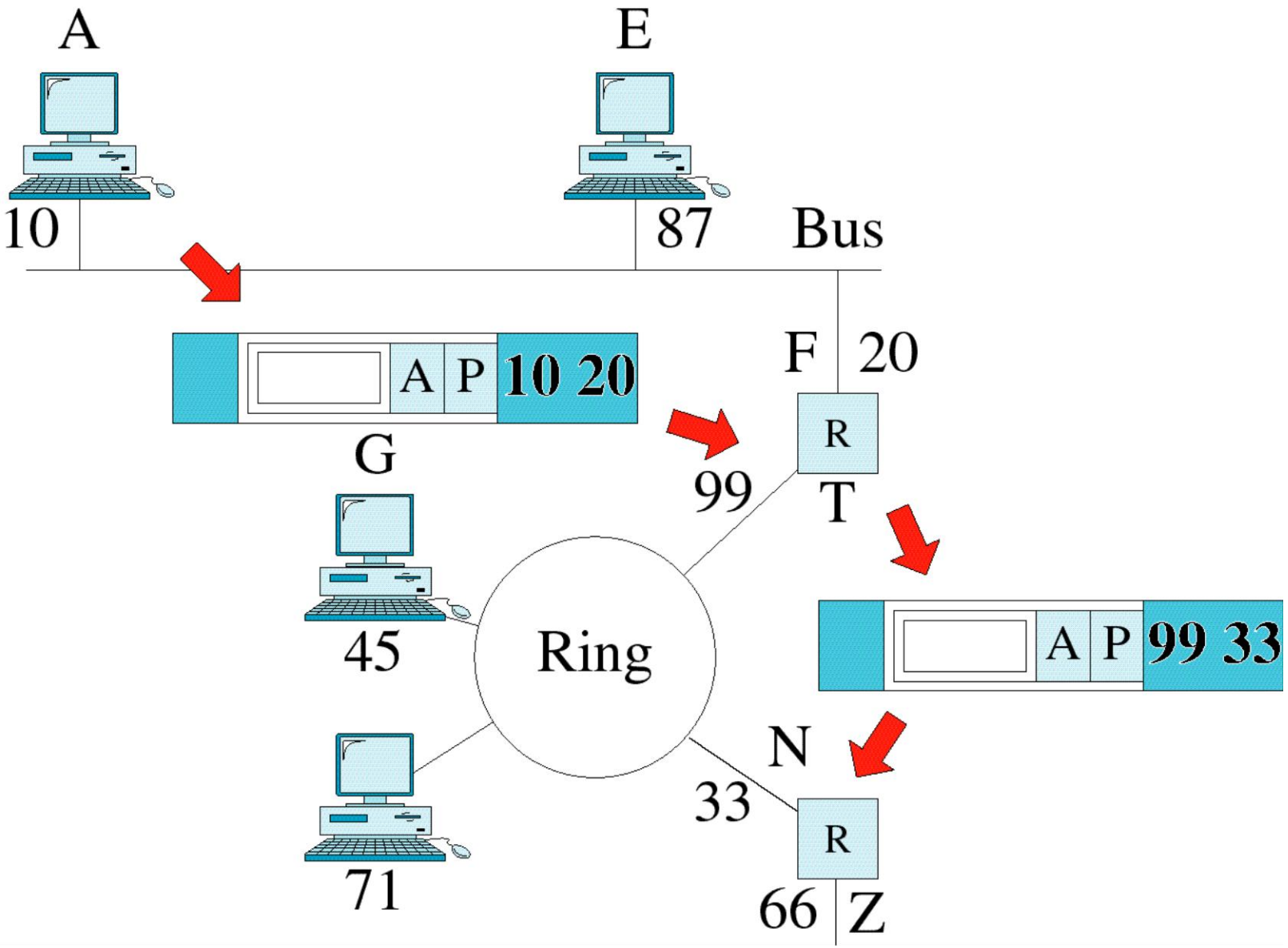


Figure 3-8-continued

Network Layer Example

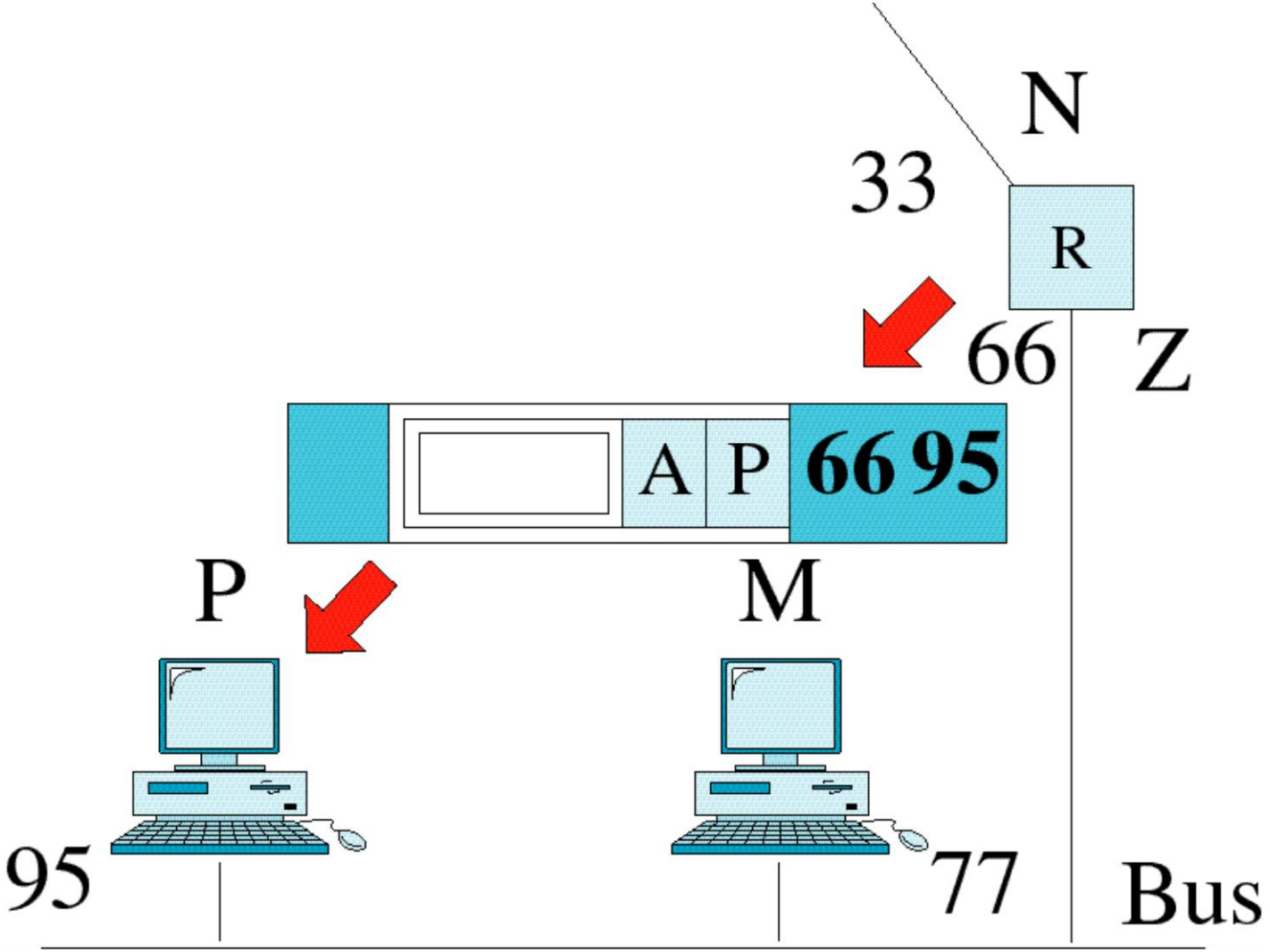
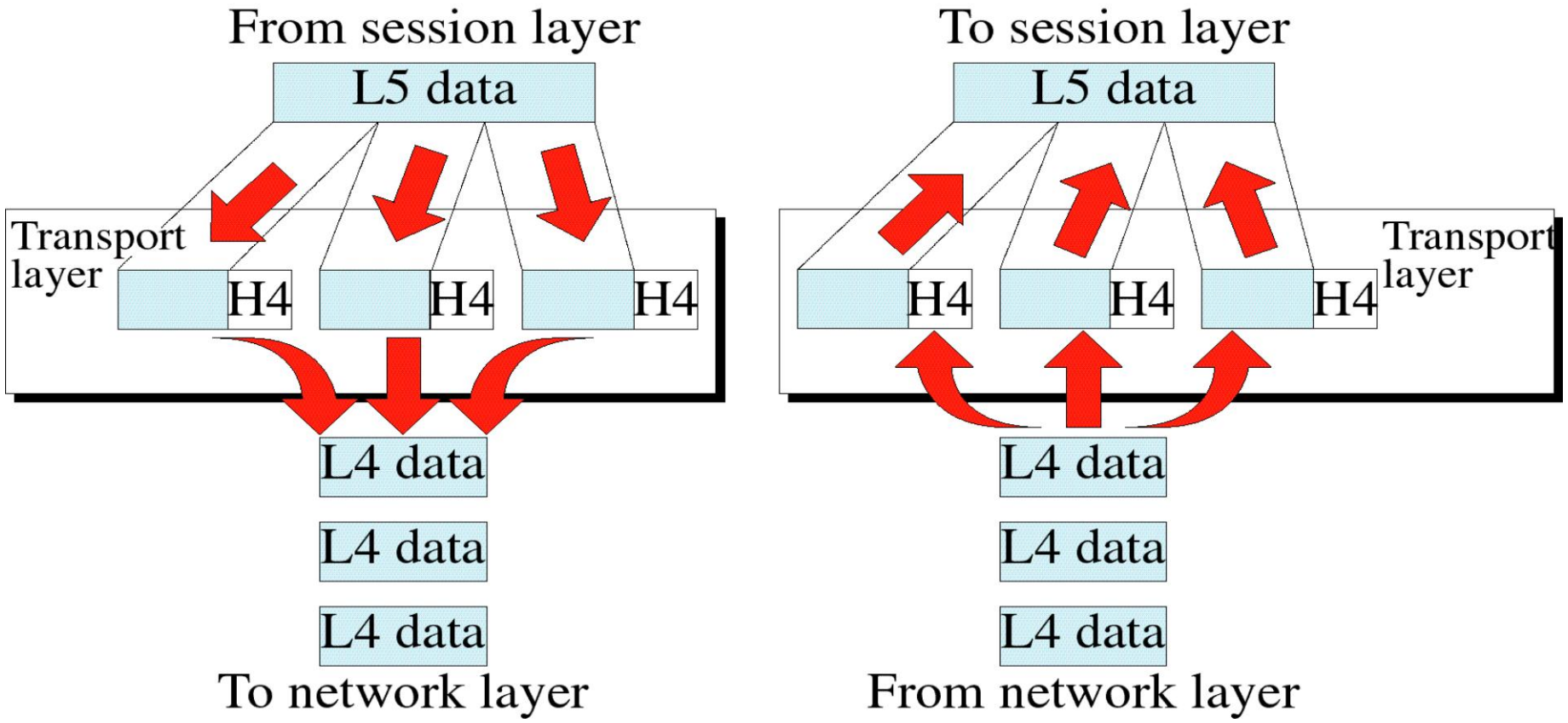


Figure 3-9

Transport Layer

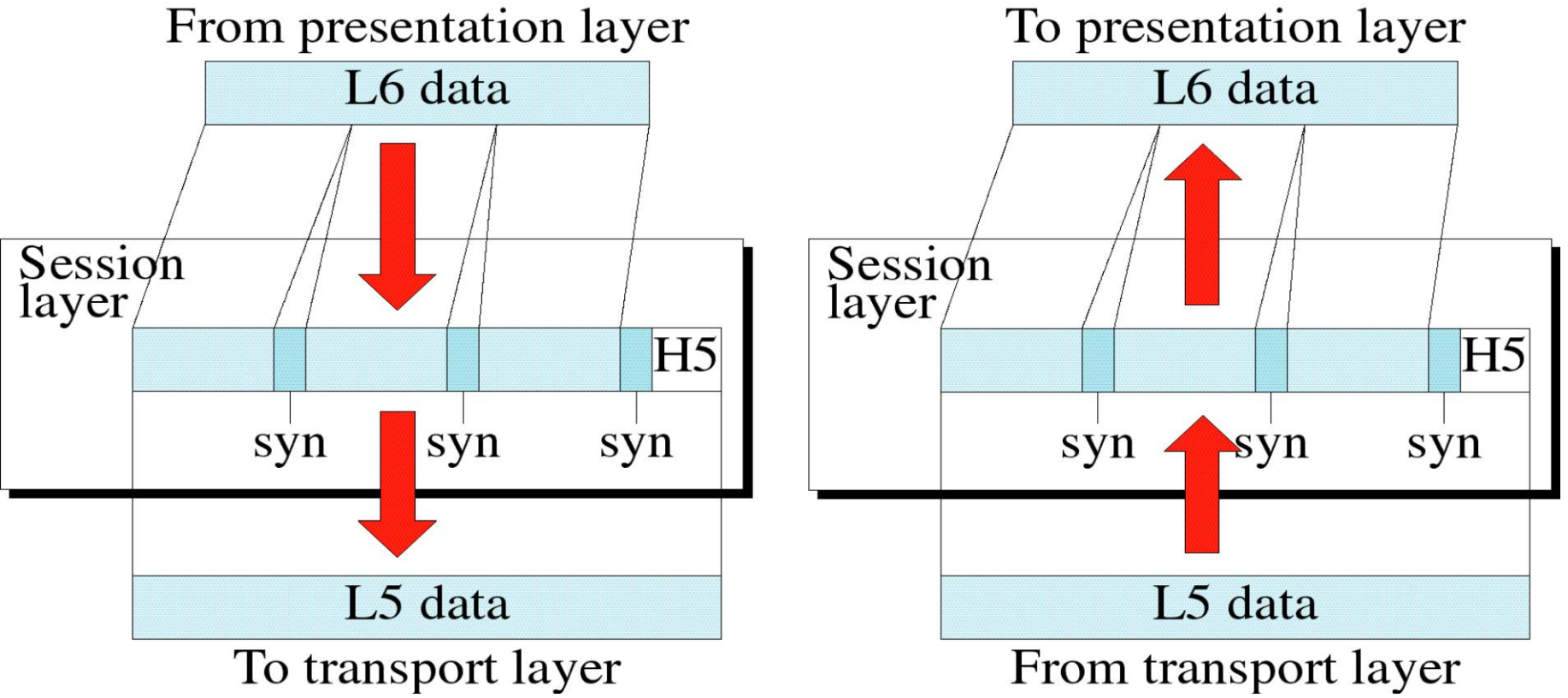


Responsibilities of Transport Layer

- It is responsible for process to process delivery of the entire message. (Exa. Several program run simultaneously in a PC)
- Segmentation & reassembly.
- Flow Control process to process.
- Error Control in process to process.

Figure 3-11

Session Layer

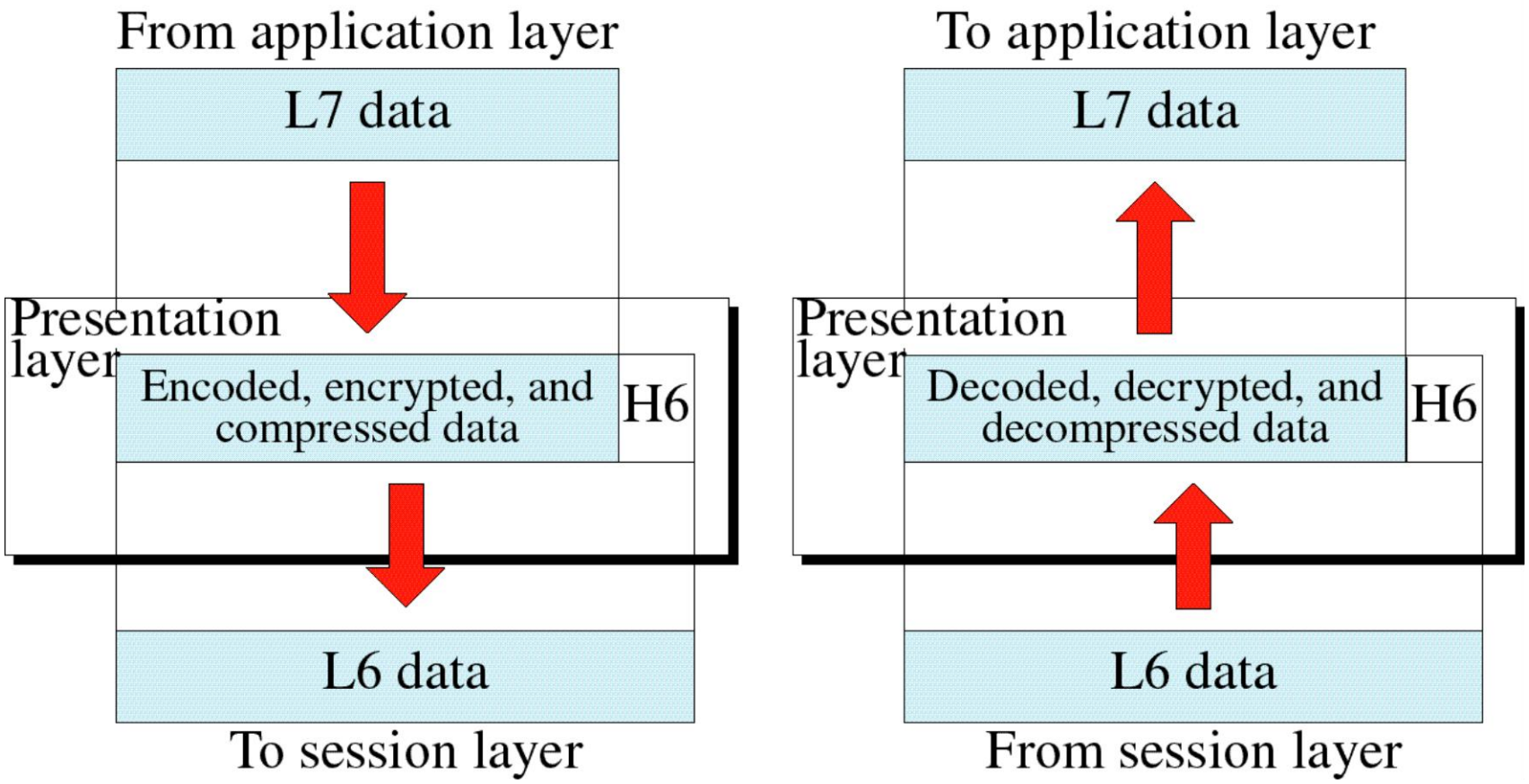


Responsibilities of Session Layer

- **Dialog Control.(Half duplex or Full duplex mode)**
- **Synchronization. (Add Checkpoint in to a stream of data.)**

Figure 3-12

Presentation Layer

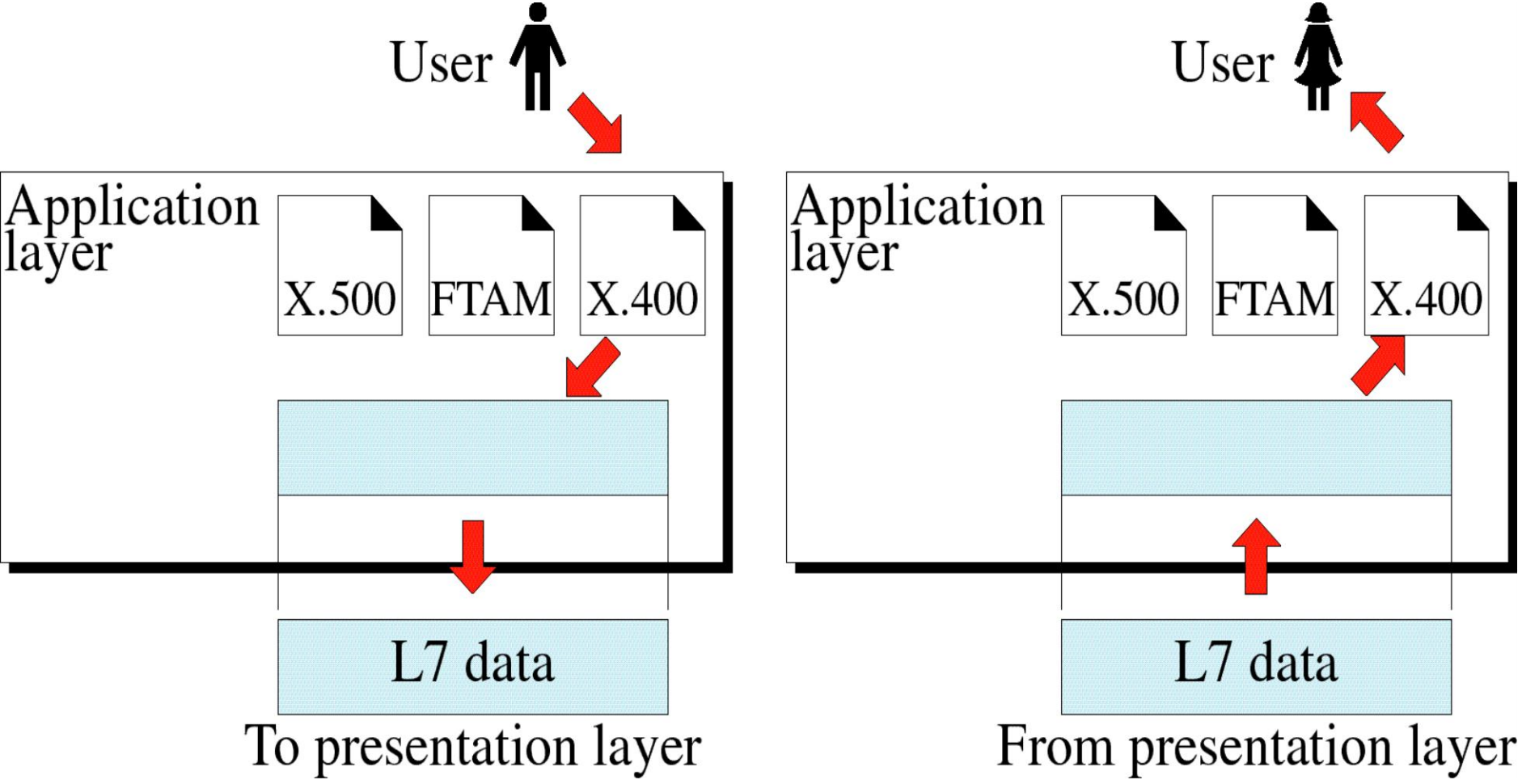


Responsibilities of Presentation Layer

- **Translation.**
- **Encryption.**
- **Compression.**

Figure 3-13

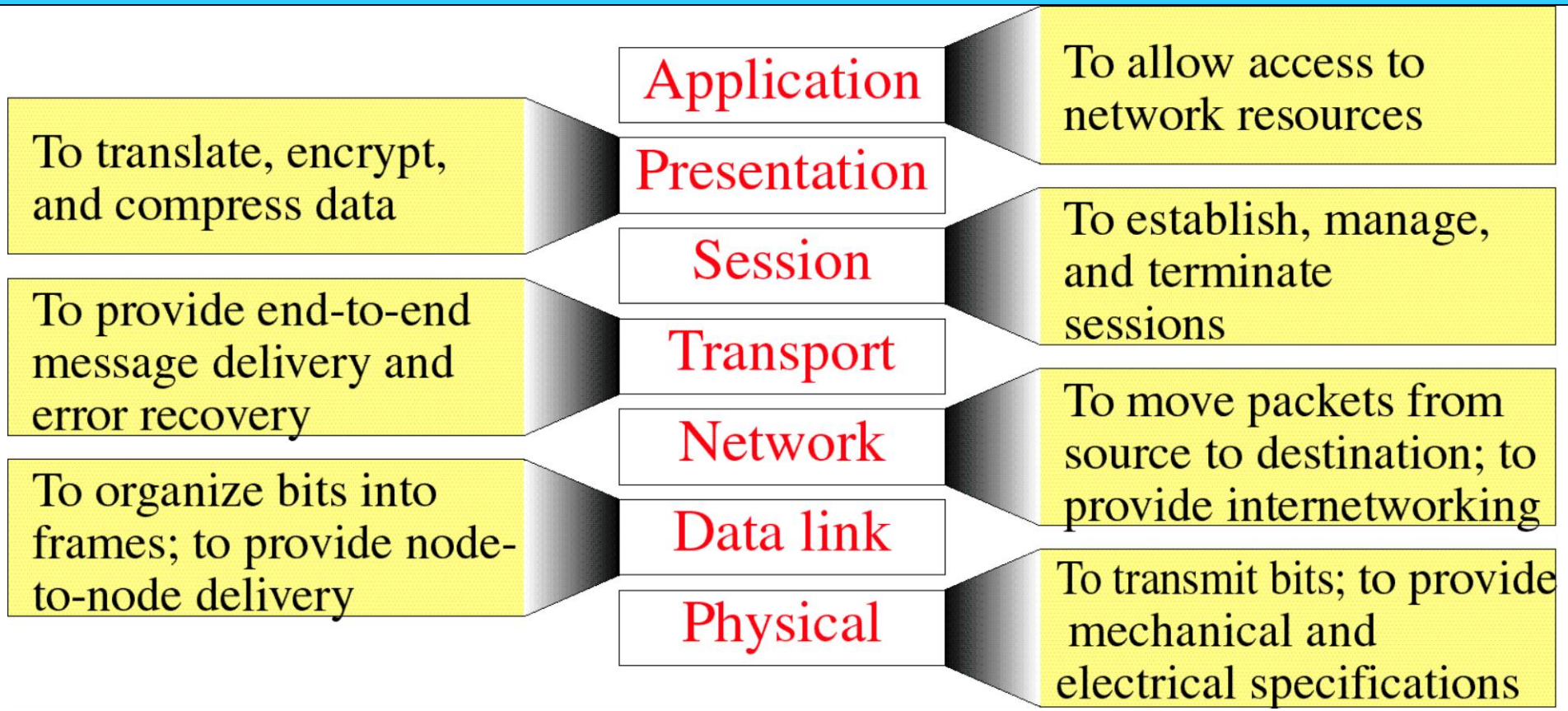
Application Layer



Responsibilities of Application Layer

- responsible for providing services to the user.
- X.400-(Message Handling services), FTAM-(file transfer access and management),X.500-(Directory Services).

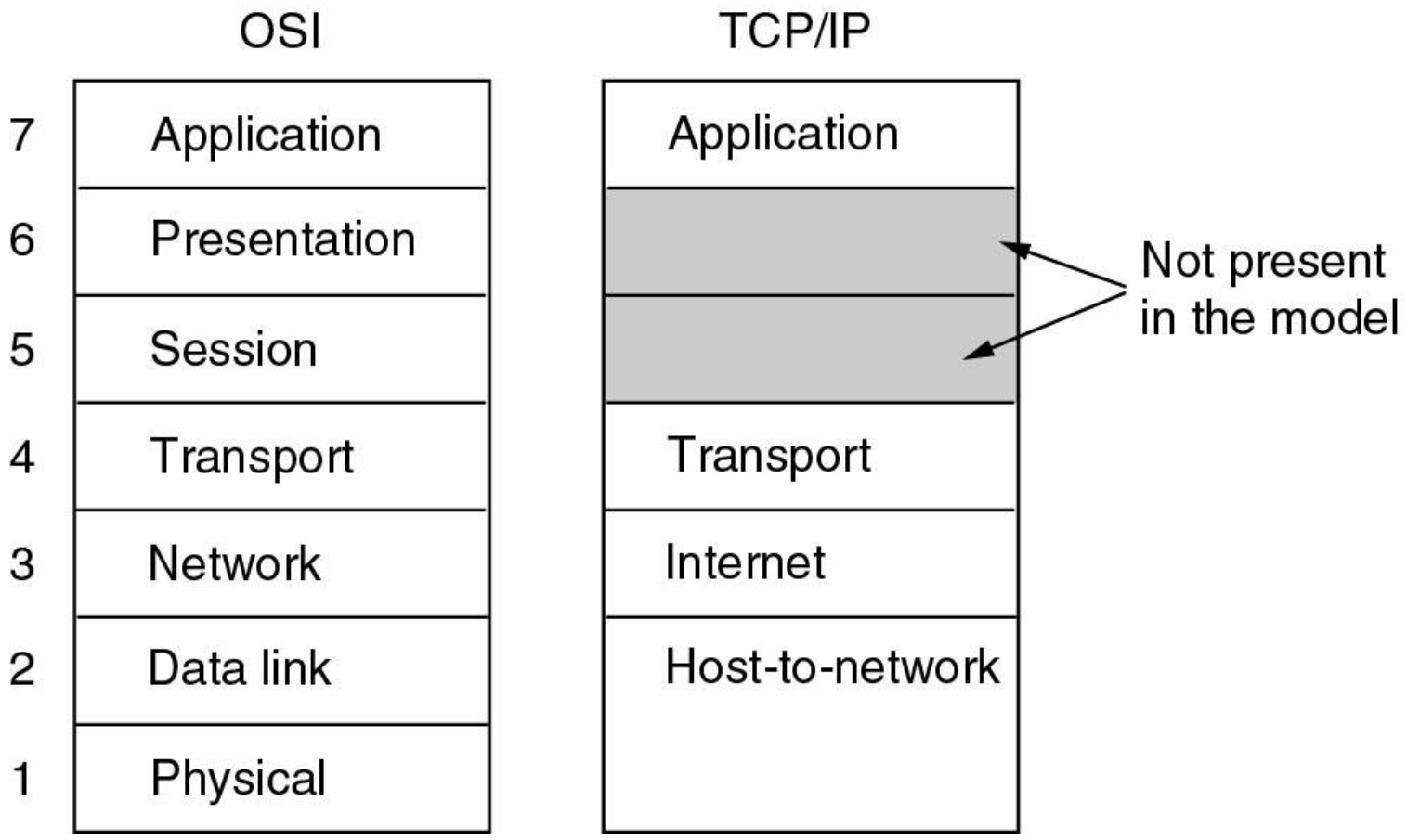
2-3 OSI MODEL PROTOCOL SUITE



TCP/IP PROTOCOL SUITE

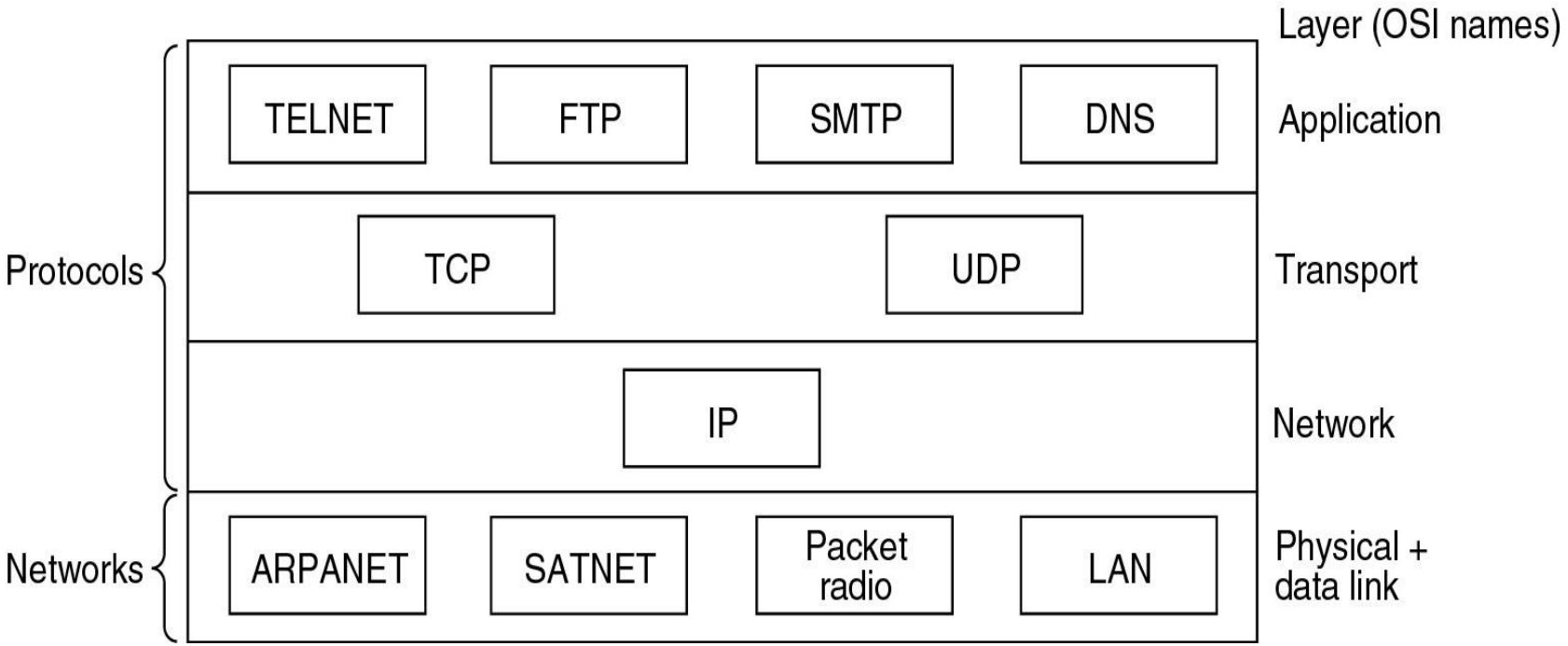
The TCP/IP protocol suite was developed prior to the OSI model. Therefore, the layers in the TCP/IP protocol suite do not match exactly with those in the OSI model. The original TCP/IP protocol suite was defined as four software layers built upon the hardware. Today, however, TCP/IP is thought of as a five-layer model with the layers named similarly to the ones in the OSI model. Figure 2.7 shows both configurations.

Reference Models (2)



The TCP/IP reference model.

Reference Models (3)



Protocols and networks in the TCP/IP model initially.

Comparing OSI and TCP/IP Models

Concepts central to the OSI model

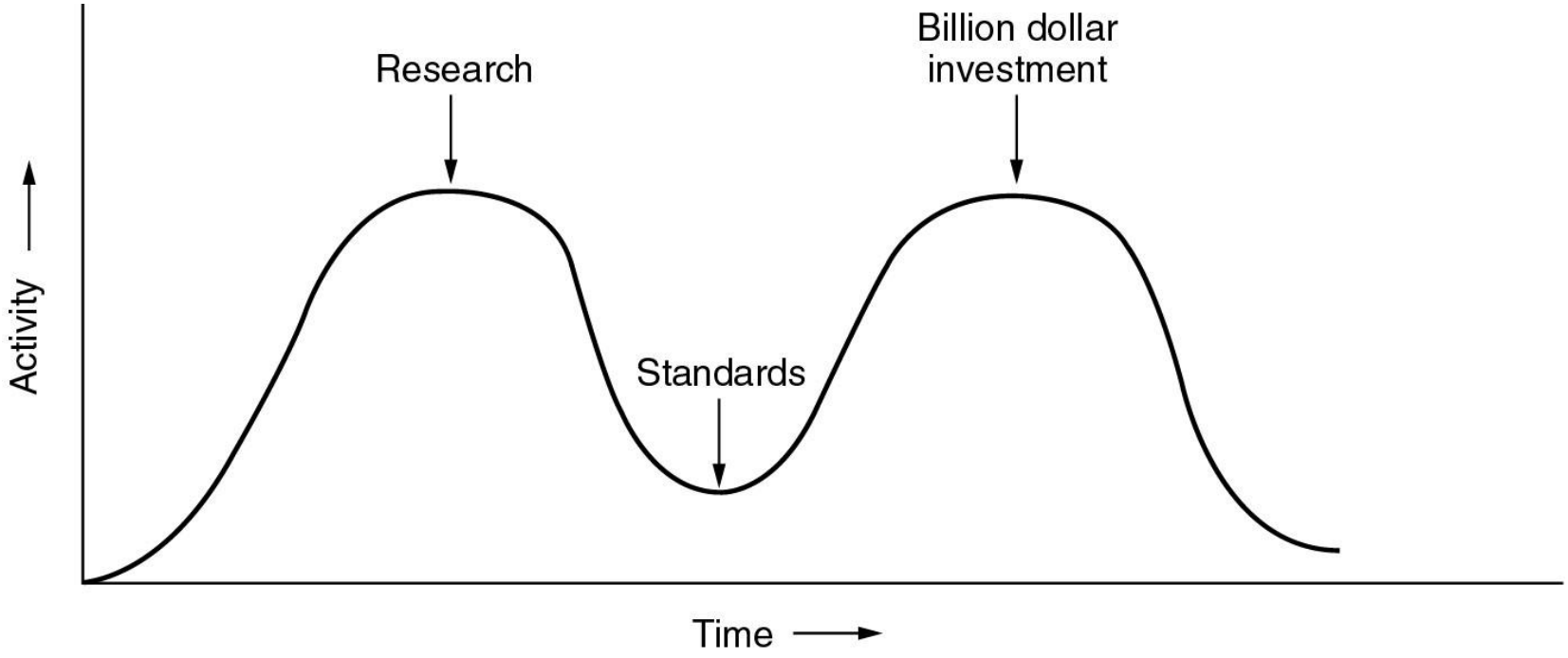
- **Services**(What layer does)
- **Interfaces**(How to access it & result except)
- **Protocols**(It's own business)

A Critique of the OSI Model and Protocols

Why OSI did not take over the world

- Bad timing
- Bad technology
- Bad implementations
- Bad politics

Bad Timing



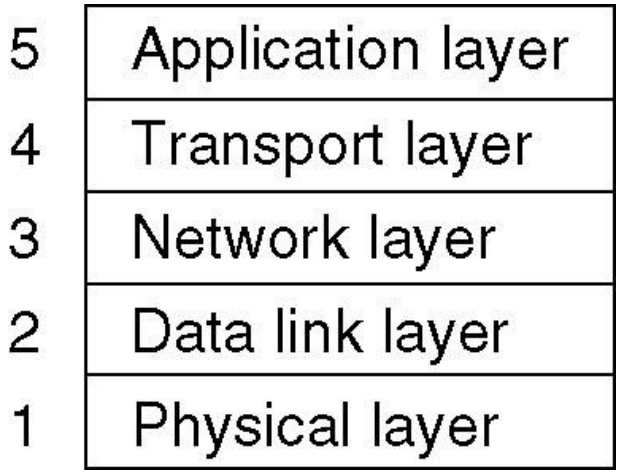
The apocalypse of the two elephants.

A Critique of the TCP/IP Reference Model

Problems:

- Service, interface, and protocol not distinguished
- Not a general model
- Host-to-network “layer” not really a layer
- No mention of physical and data link layers
- Minor protocols deeply entrenched, hard to replace

Hybrid Model

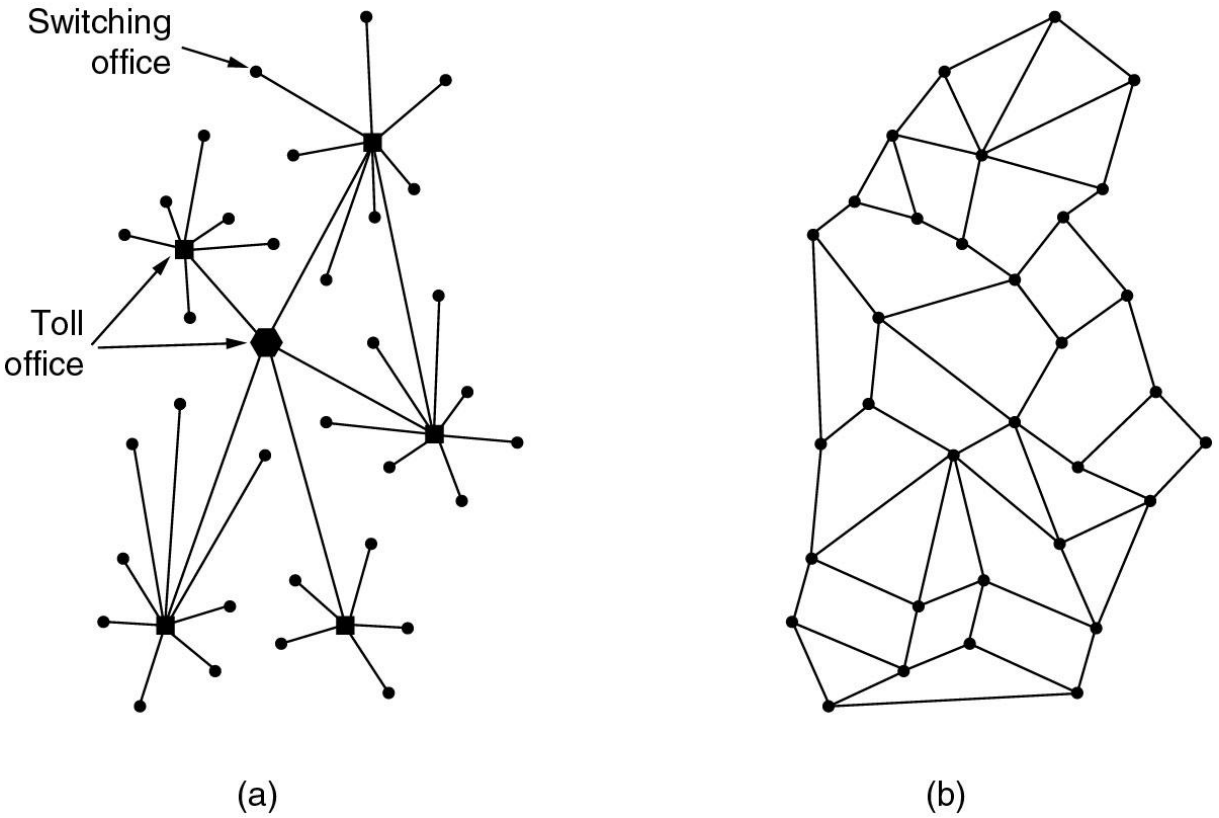


The hybrid reference model to be used in this book.

Example Networks

- The Internet
- Connection-Oriented Networks:
  X.25, Frame Relay, and ATM
- **Ethernet**(type of LAN as Token ring,Token Bus,FDDI & ATM LAN)
- **Wireless LANs: 802.11**

The ARPANET



(a) Structure of the telephone system.

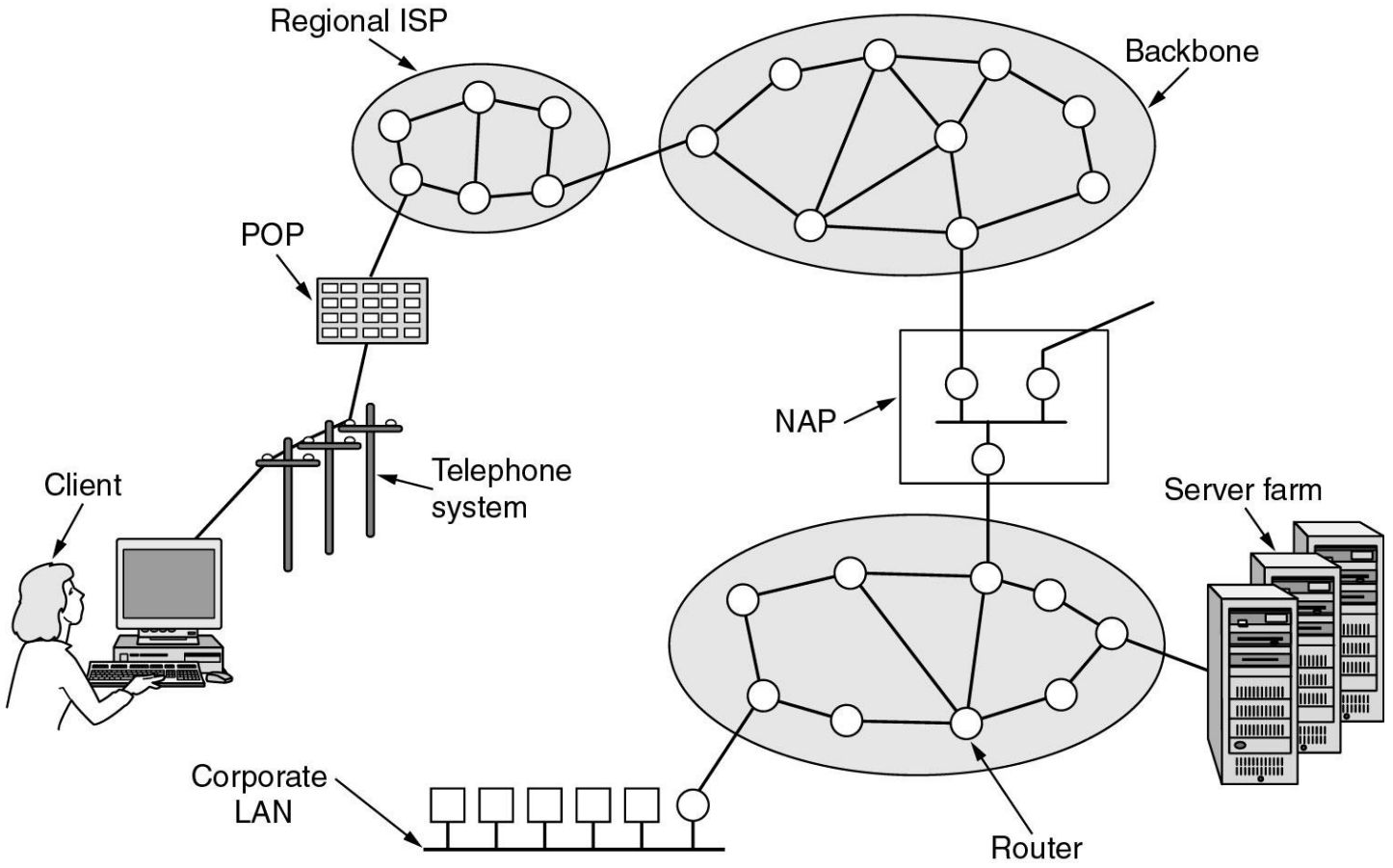
(b) Baran's proposed distributed switching system.

Internet Usage

Traditional applications (1970 – 1990)

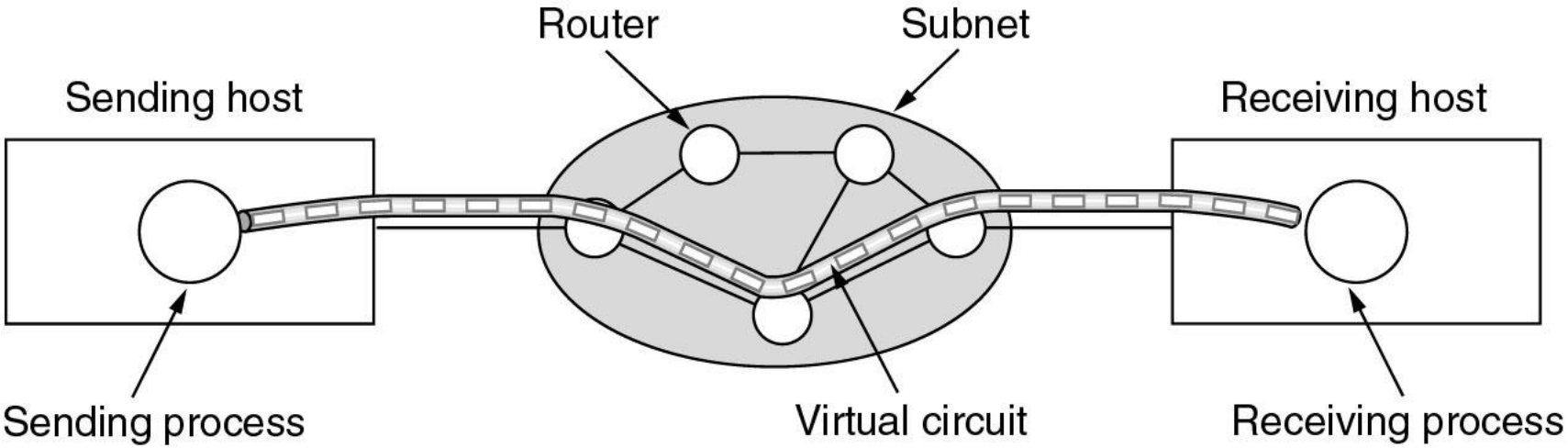
- E-mail
- News
- Remote login
- File transfer

Architecture of the Internet



Overview of the Internet.

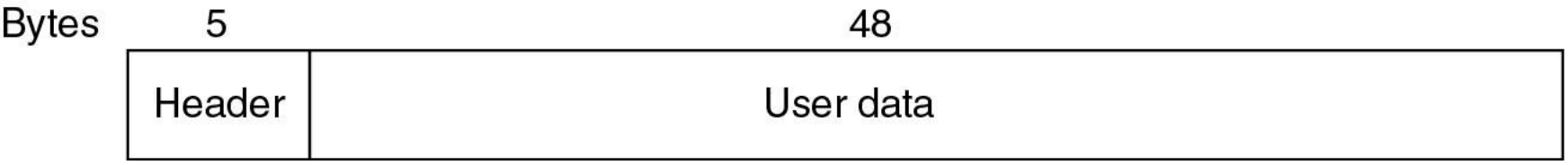
ATM Virtual Circuits



A virtual circuit.

- ATM stands for Asynchronous transfer mode
- The router make the entry of existing connection and reserving whatever resources are needed for it.
- ATM is tranmitted information in small, fixed size packet called cells. The cells are 53 byte long, of which 5byte are header and 48 byte are user data.

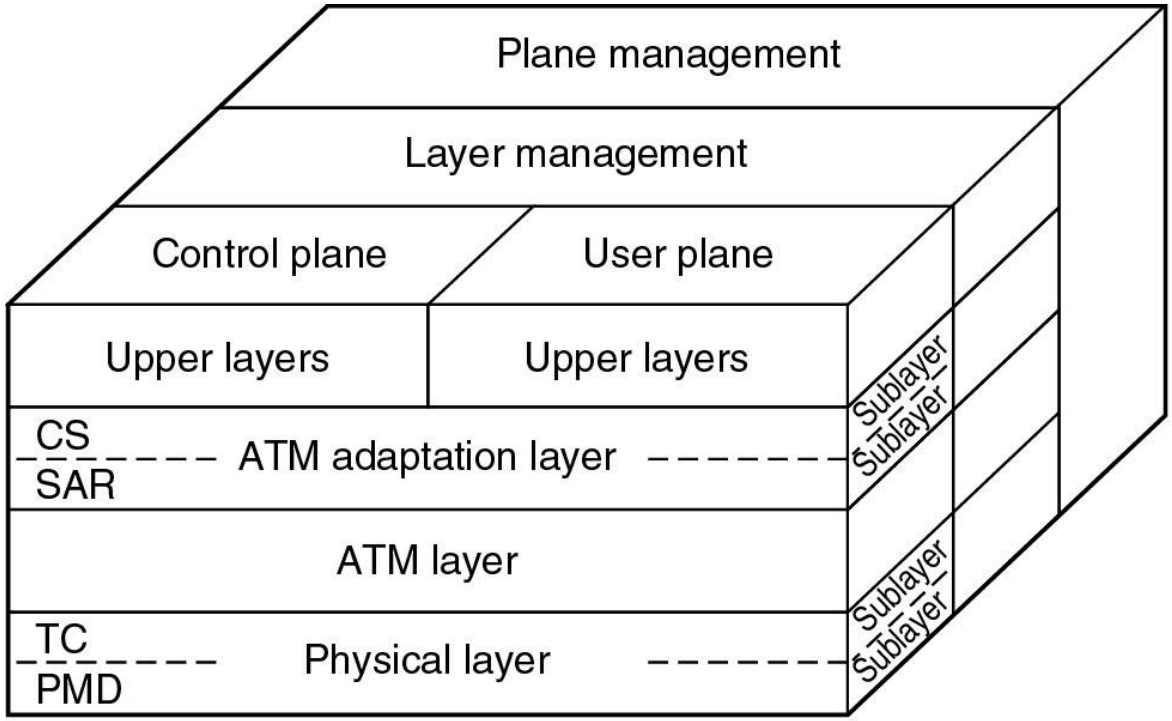
ATM Virtual Circuits (2)



An ATM cell.

- ATM network support 155 to 622 Mbps speeds
- The 155 Mbps is chosen for High definition television.
- The 622 Mbps is chosen for four 155Mbps channels sent over it.

The ATM Reference Model



CS: Convergence sublayer
SAR: Segmentation and reassembly sublayer
TC: Transmission convergence sublayer
PMD: Physical medium dependent sublayer

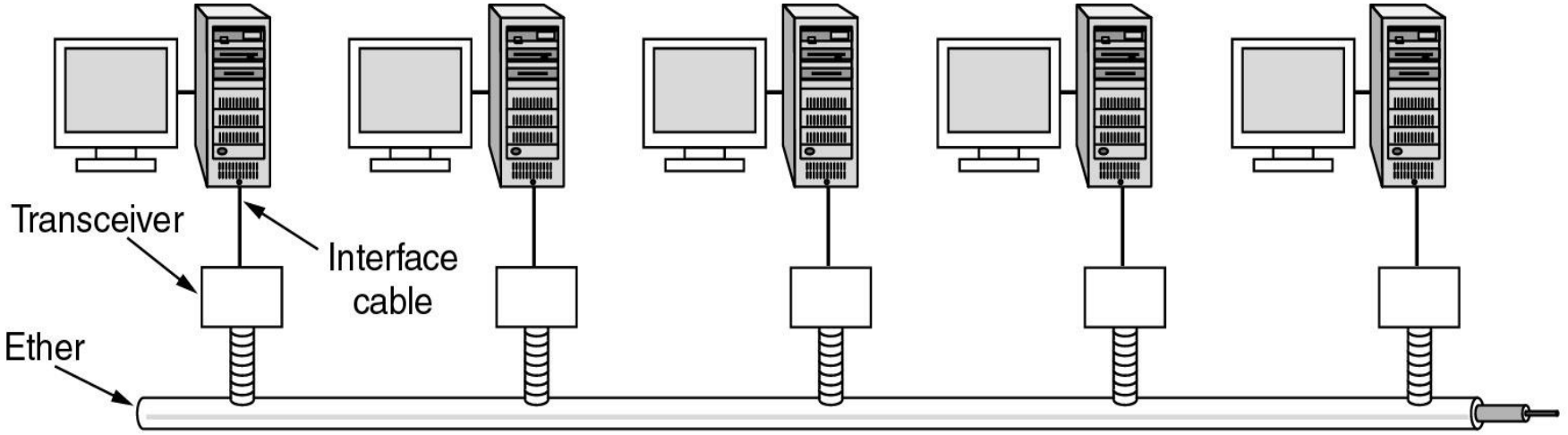
The ATM reference model.

The ATM Reference Model (2)

OSI layer	ATM layer	ATM sublayer	Functionality
3/4	AAL	CS	Providing the standard interface (convergence)
		SAR	Segmentation and reassembly
2/3	ATM		Flow control Cell header generation/extraction Virtual circuit/path management Cell multiplexing/demultiplexing
2	Physical	TC	Cell rate decoupling Header checksum generation and verification Cell generation Packing/unpacking cells from the enclosing envelope Frame generation
1		PMD	Bit timing Physical network access

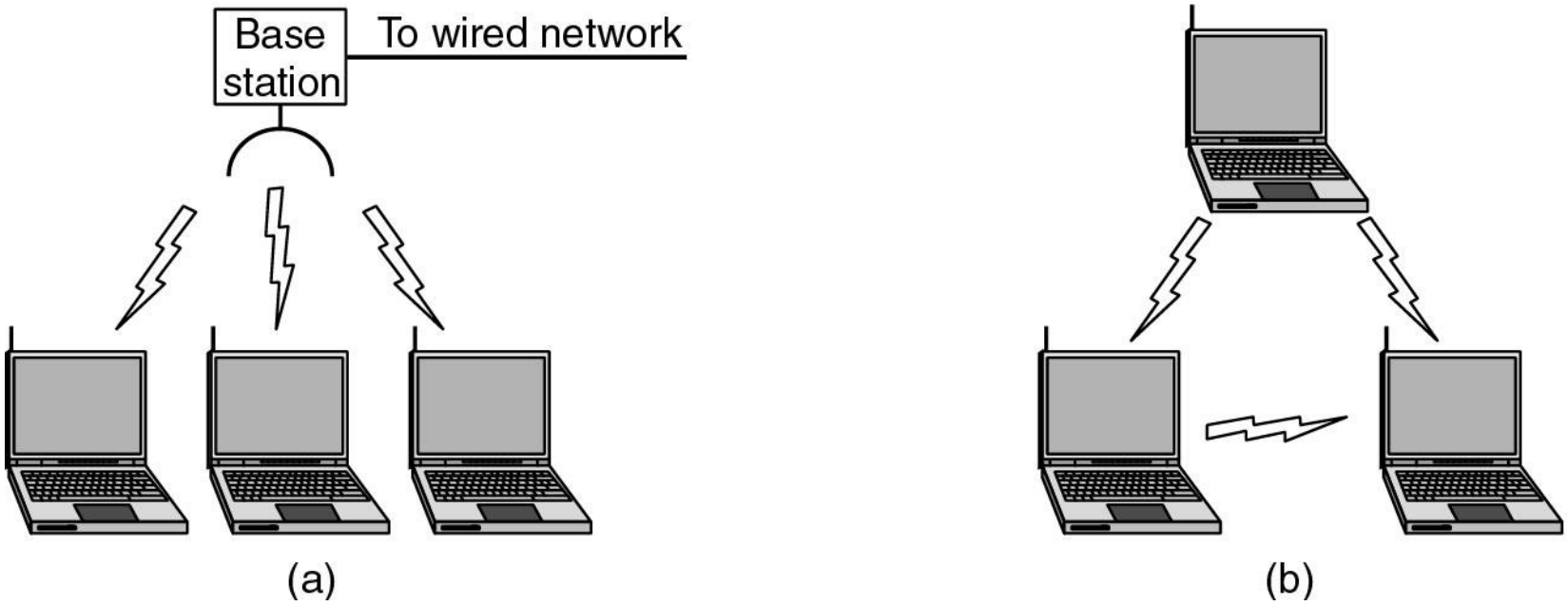
The ATM layers and sublayers and their functions.

Ethernet



Architecture of the original Ethernet.

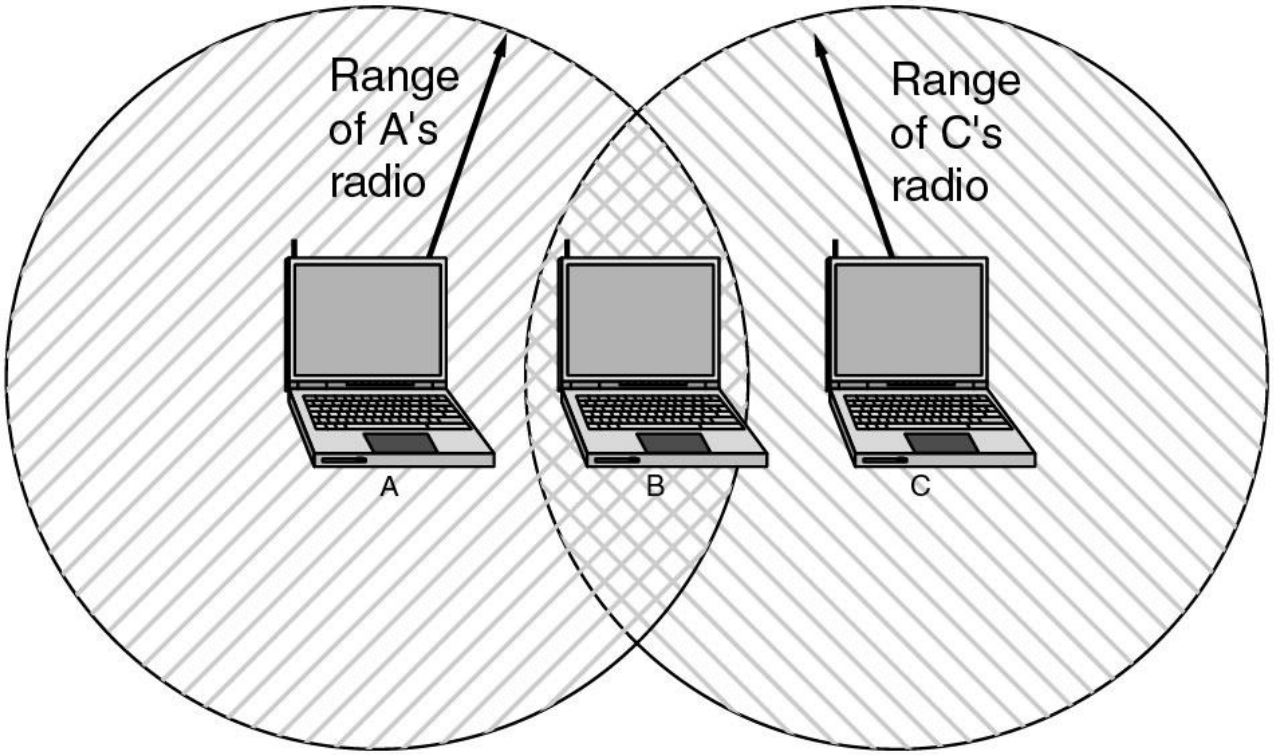
Wireless LANs



(a) Wireless networking with a base station.

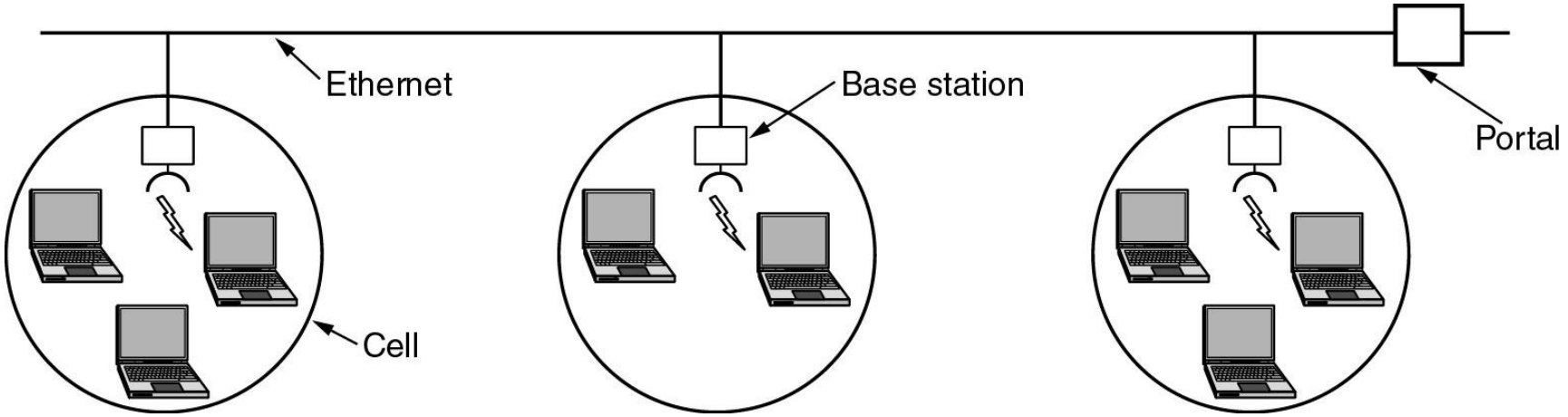
(b) Ad hoc networking.

Wireless LANs (2)



The range of a single radio may not cover the entire system.

Wireless LANs (3)



A multicell 802.11 network.

Network Standardization

- Who's Who in the Telecommunications World
- Who's Who in the International Standards World
- Who's Who in the Internet Standards World

IEEE 802 Standards

Number	Topic
802.1	Overview and architecture of LANs
802.2 ↓	Logical link control
802.3 *	Ethernet
802.4 ↓	Token bus (was briefly used in manufacturing plants)
802.5	Token ring (IBM's entry into the LAN world)
802.6 ↓	Dual queue dual bus (early metropolitan area network)
802.7 ↓	Technical advisory group on broadband technologies
802.8 †	Technical advisory group on fiber optic technologies
802.9 ↓	Isochronous LANs (for real-time applications)
802.10 ↓	Virtual LANs and security
802.11 *	Wireless LANs
802.12 ↓	Demand priority (Hewlett-Packard's AnyLAN)
802.13	Unlucky number. Nobody wanted it
802.14 ↓	Cable modems (defunct: an industry consortium got there first)
802.15 *	Personal area networks (Bluetooth)
802.16 *	Broadband wireless
802.17	Resilient packet ring

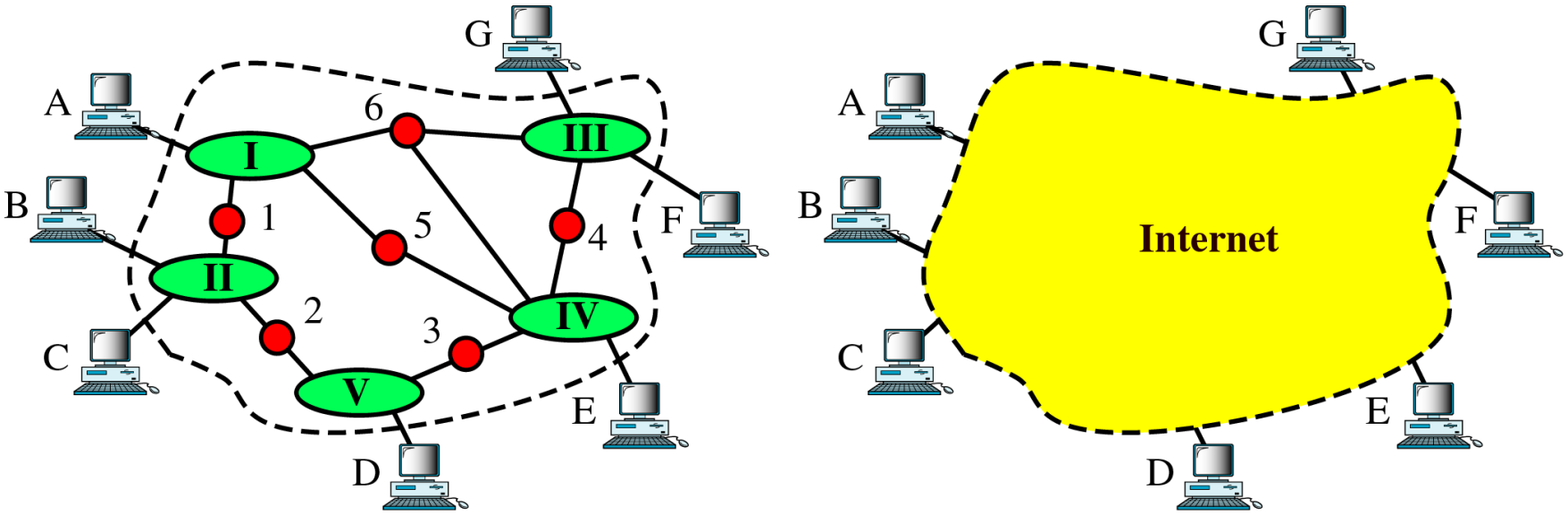
The 802 working groups. The important ones are marked with *. The ones marked with ↓ are hibernating. The one marked with † gave up.

Chapter 24

TCP/IP

Figure 24-1

An Internet According to TCP/IP



a. An actual internet

b. An internet seen by TCP/IP

Figure 24-2

TCP/IP and the OSI Model

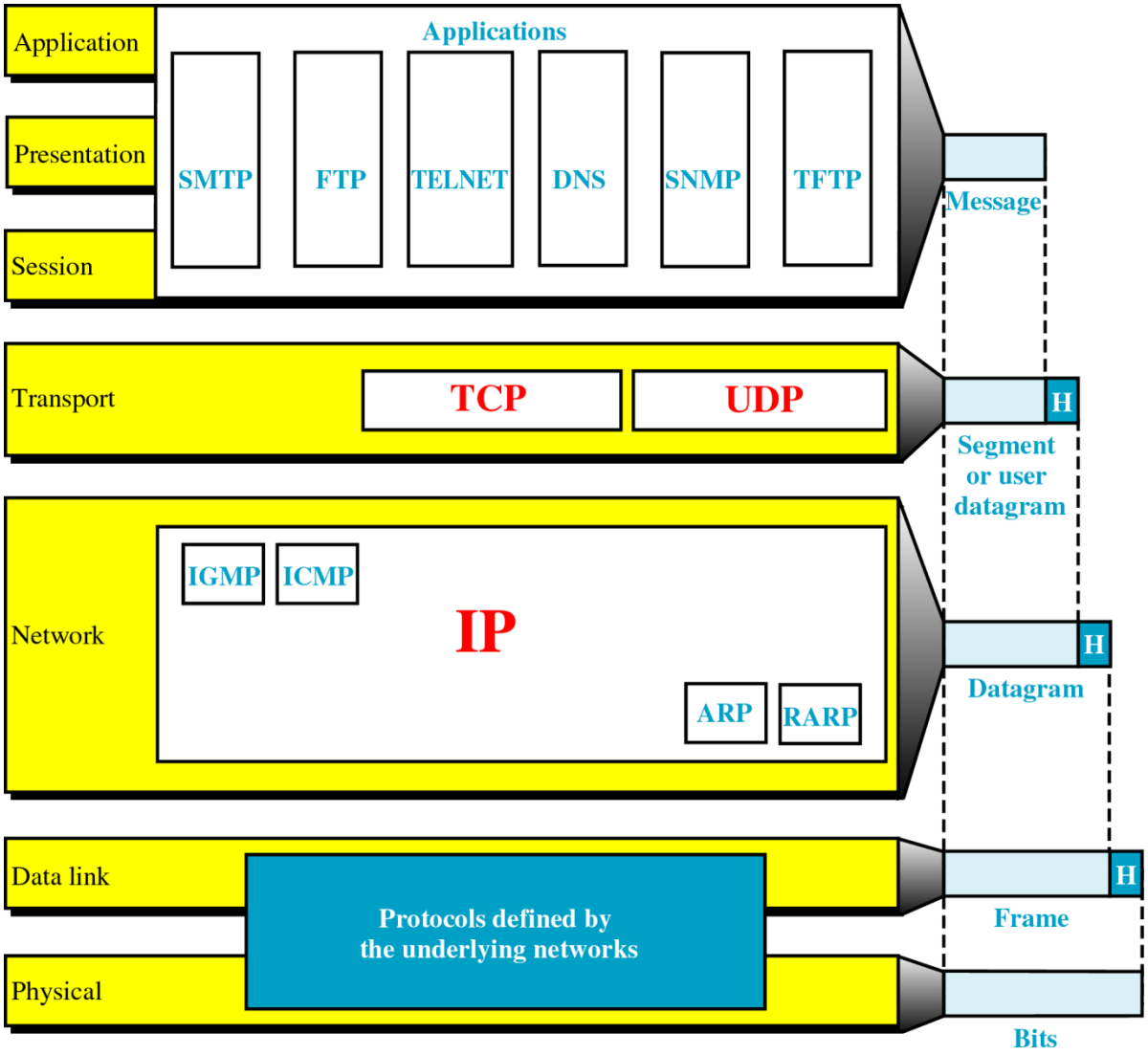
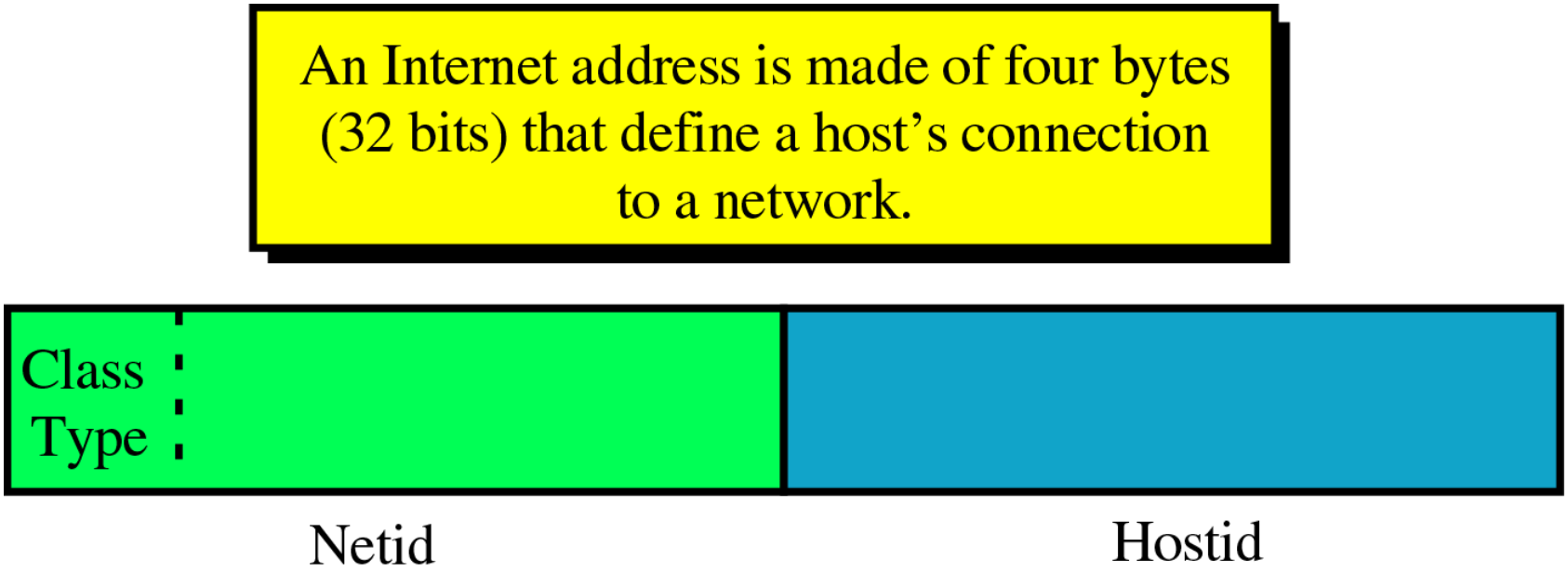


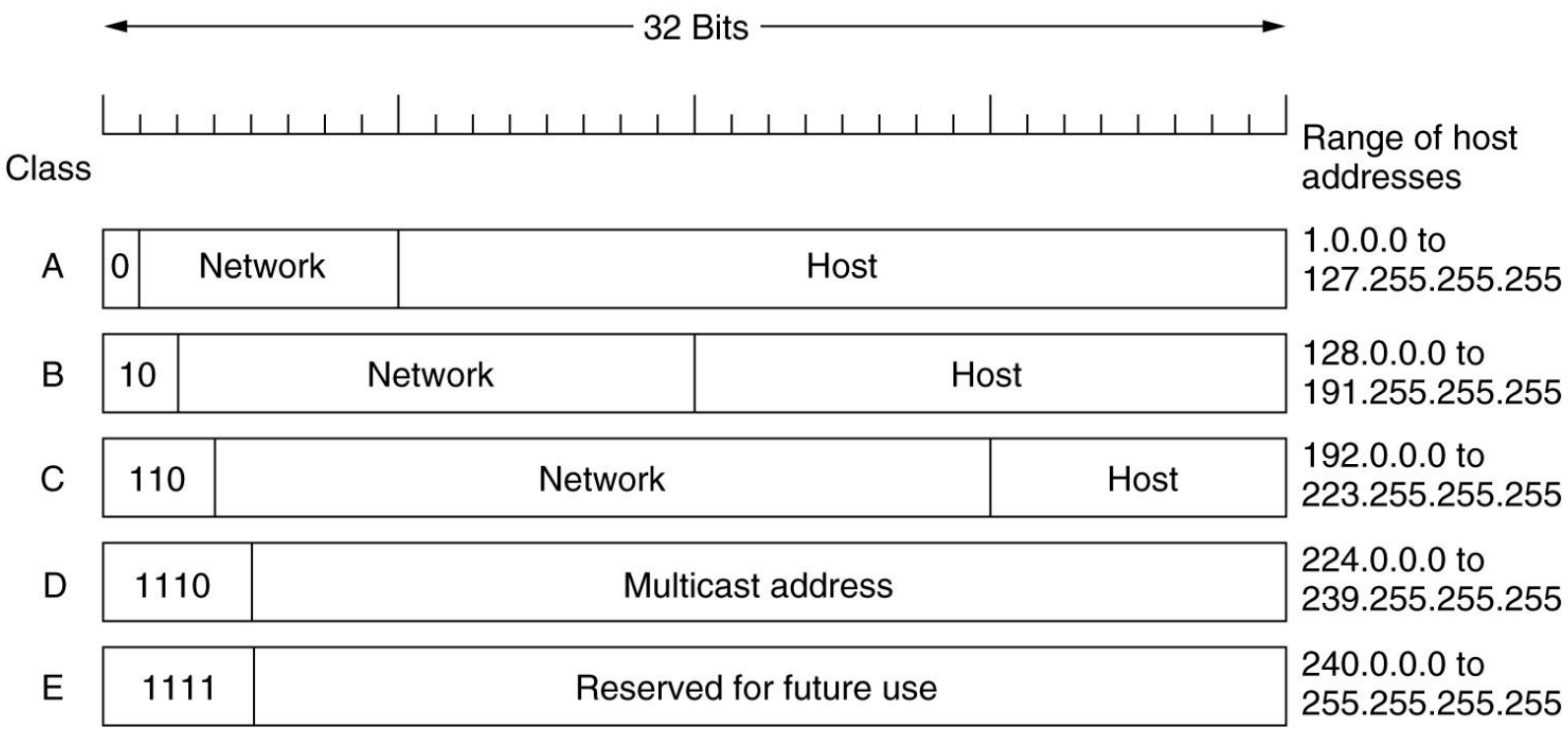
Figure 24-4

Internet Address



IPV4 uses 32 bit addresses which gives address space 2^32 = 4,294,967,296(More than 4 billion)

IP Addresses



IP address formats.

Figure 24-5

Internet Classes

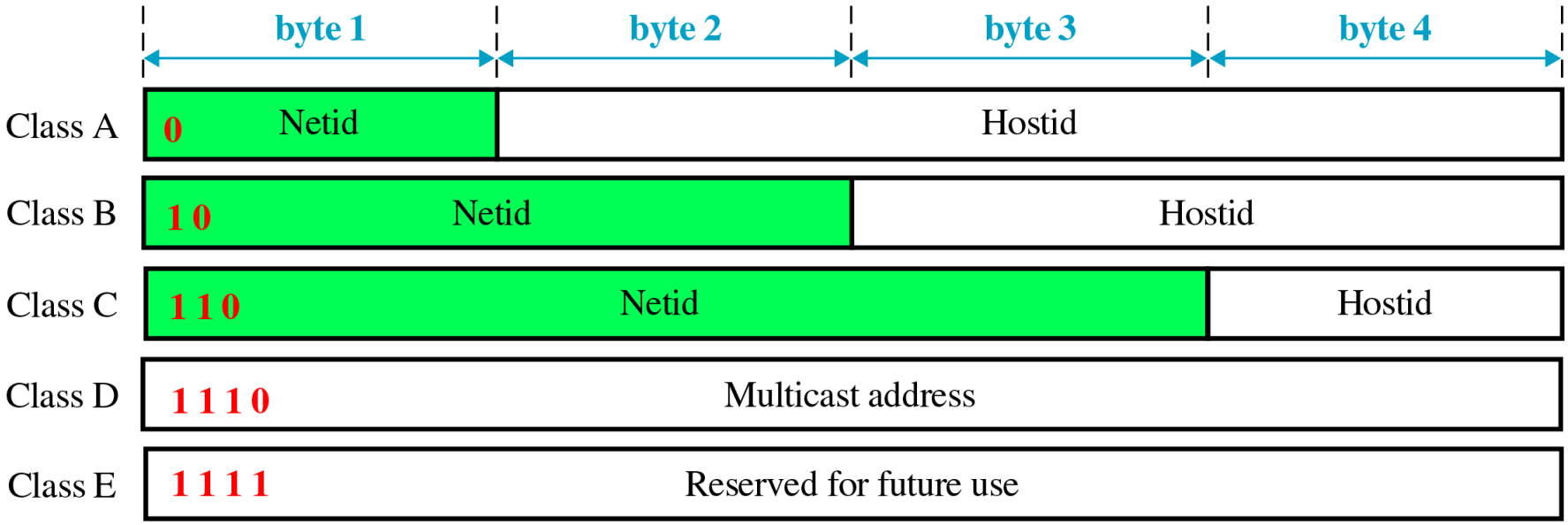
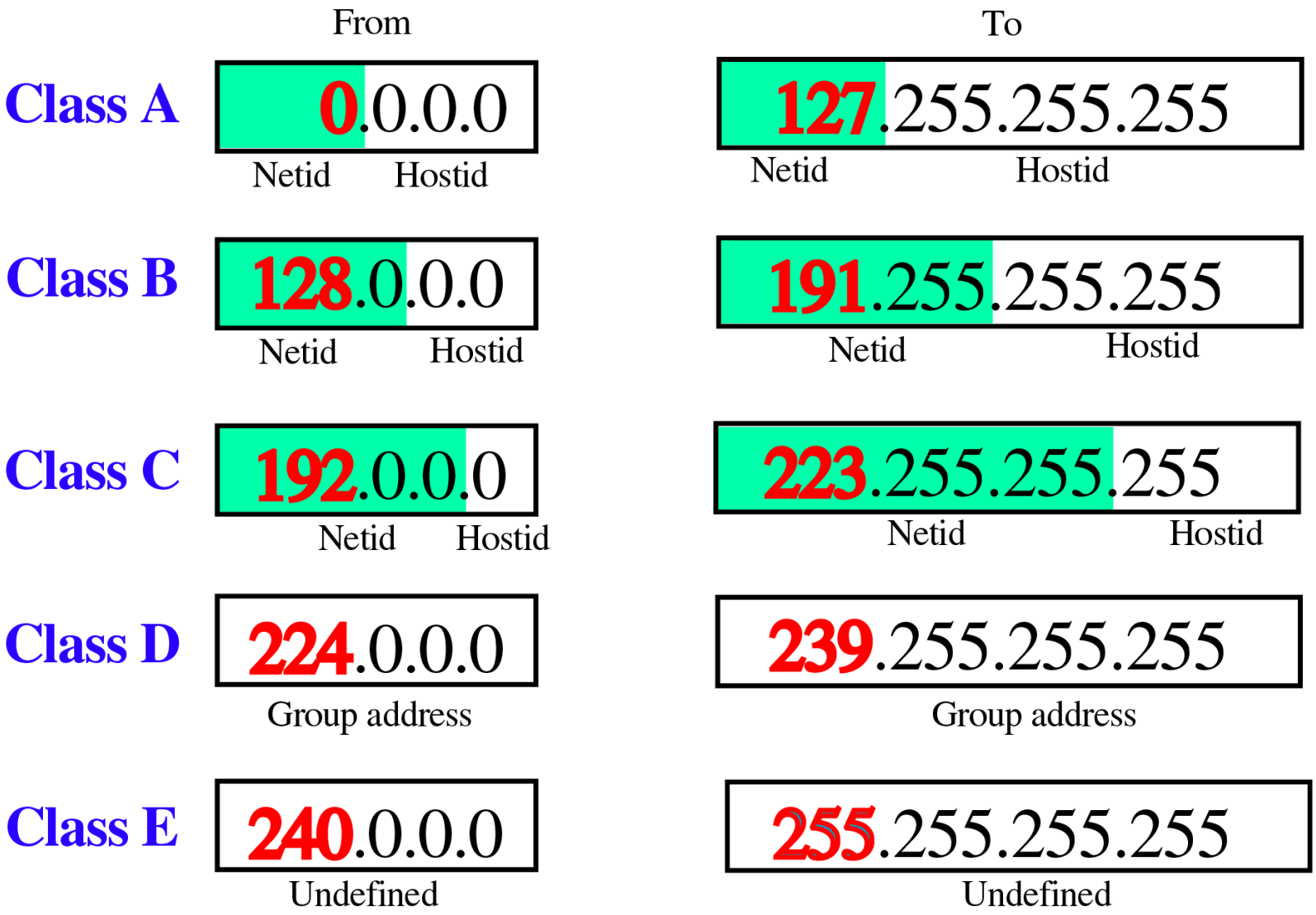
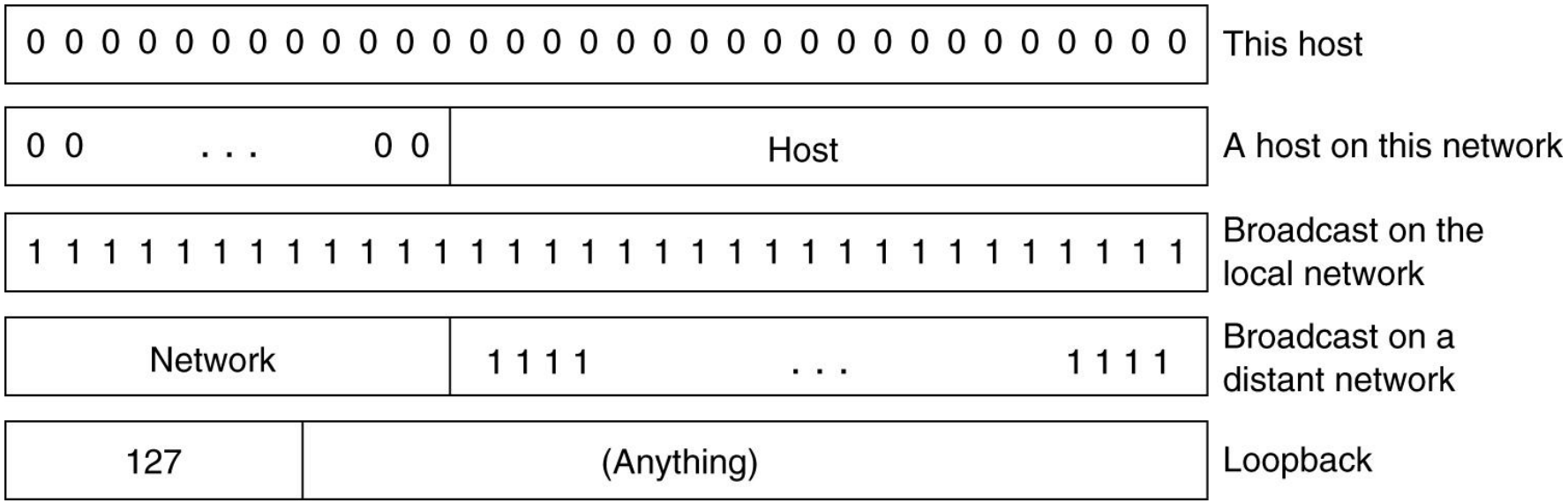


Figure 24-7

Class Ranges of Internet Addresses



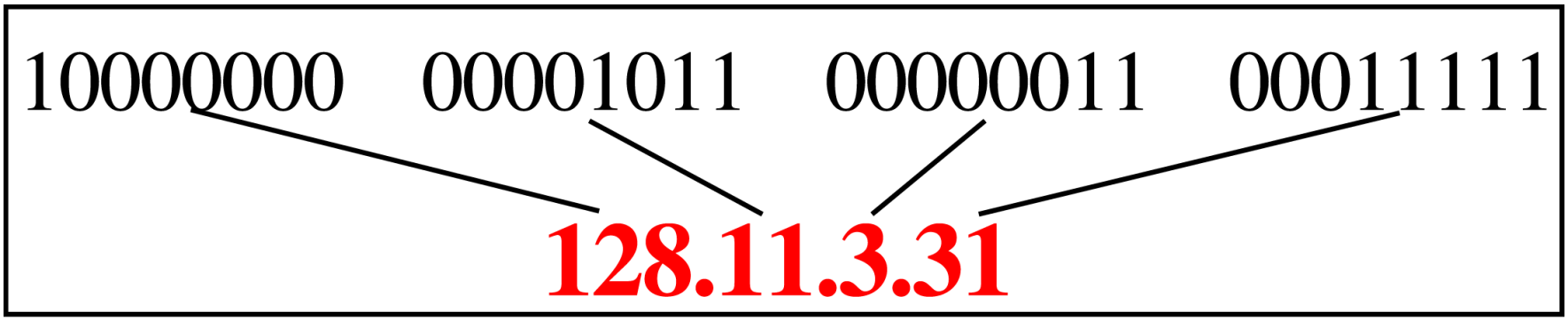
IP Addresses (2)



Special IP addresses.

Figure 24-6

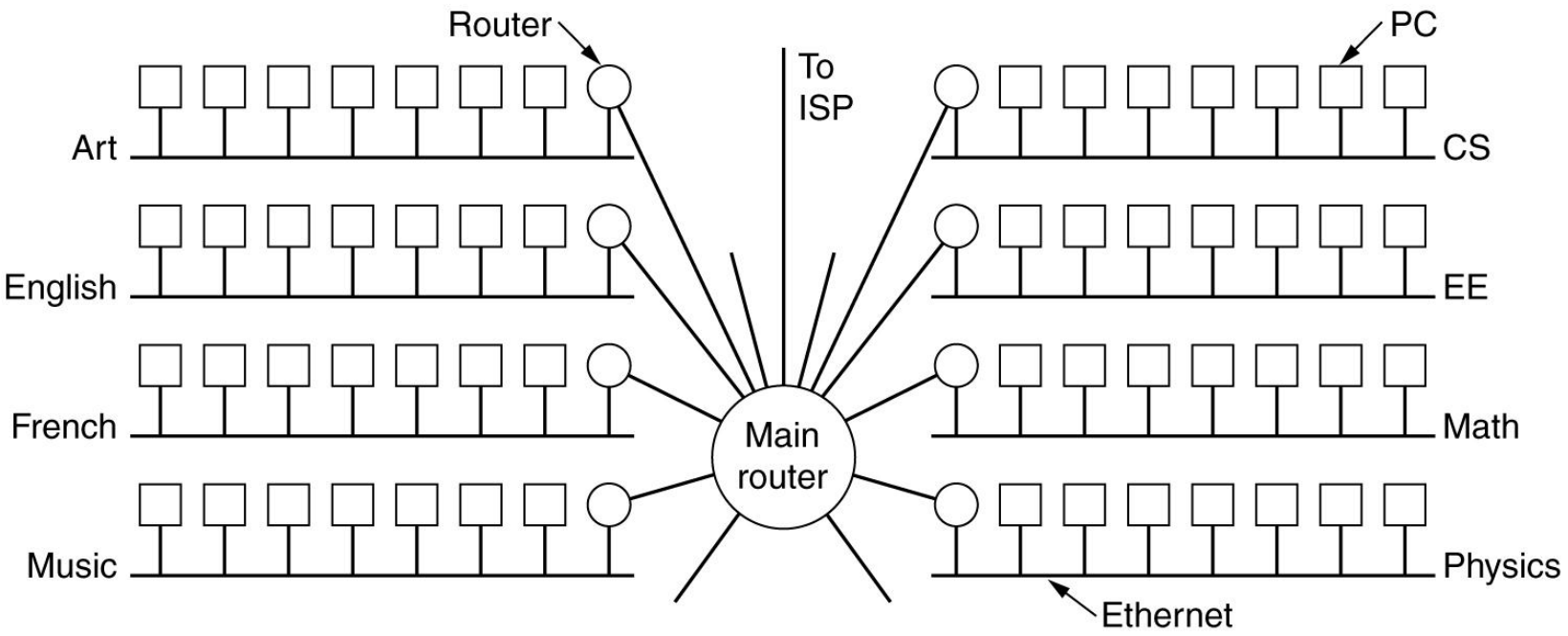
IP Addresses in Decimal Notation



Two types of IP address notation

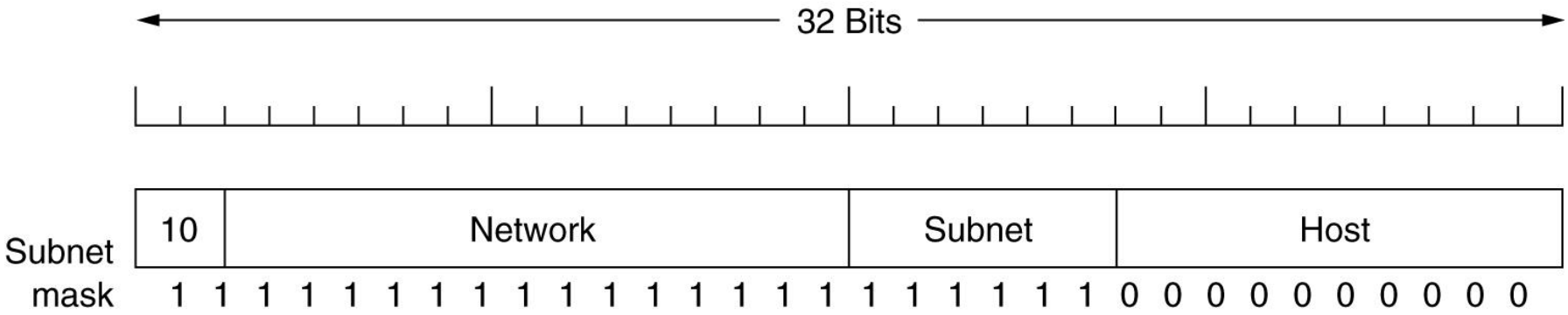
1) Binary Notation
2) Decimal Notation

Subnets



A campus network consisting of LANs for various departments.

Subnets (2)



A class B network subnetted into 64 subnets.

The Subnet mask can be written as 255.255.252.0 an alternative notation is /22
1'st subnet start at 130.50.8.1
2'nd subnet start at 130.50.8.1 and so on

Figure 24-15

UDP Datagram Format

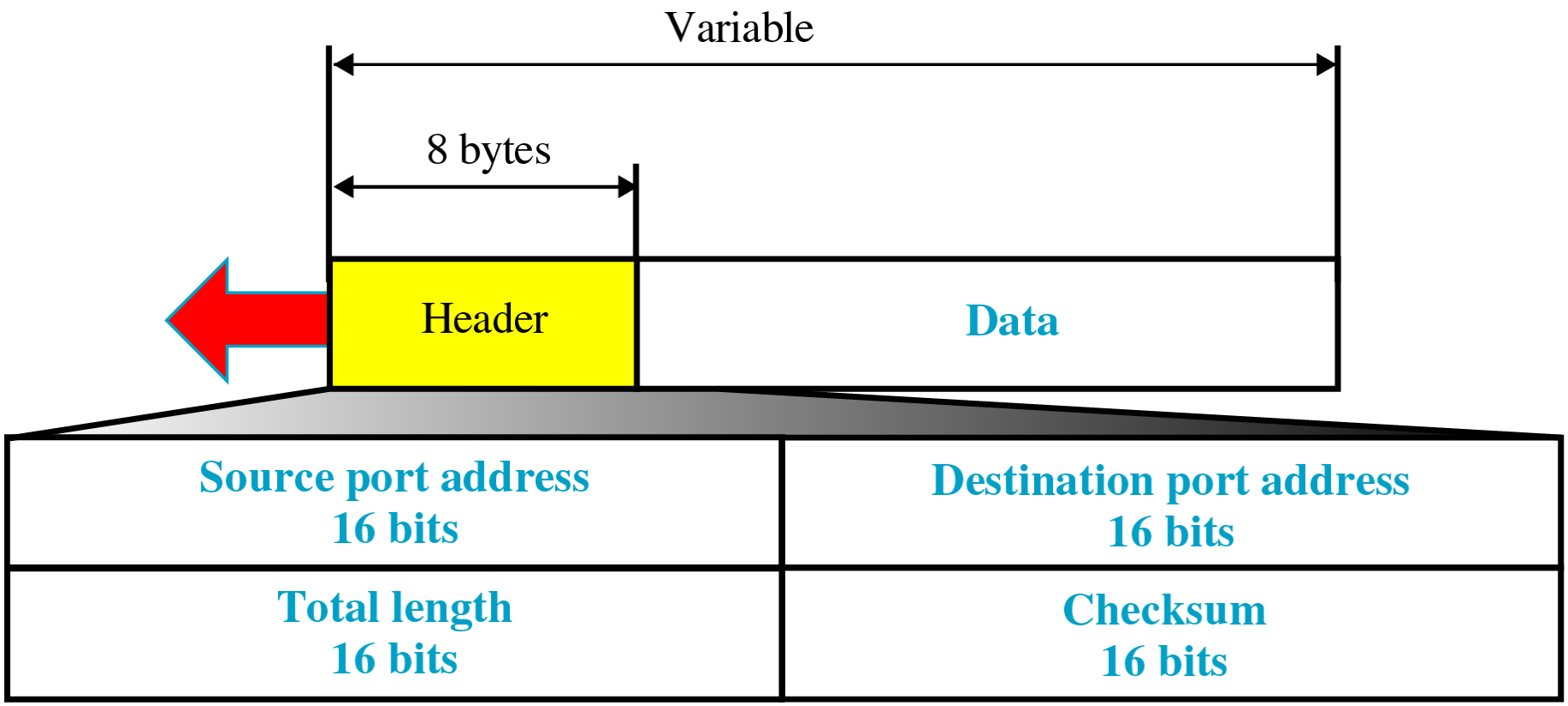
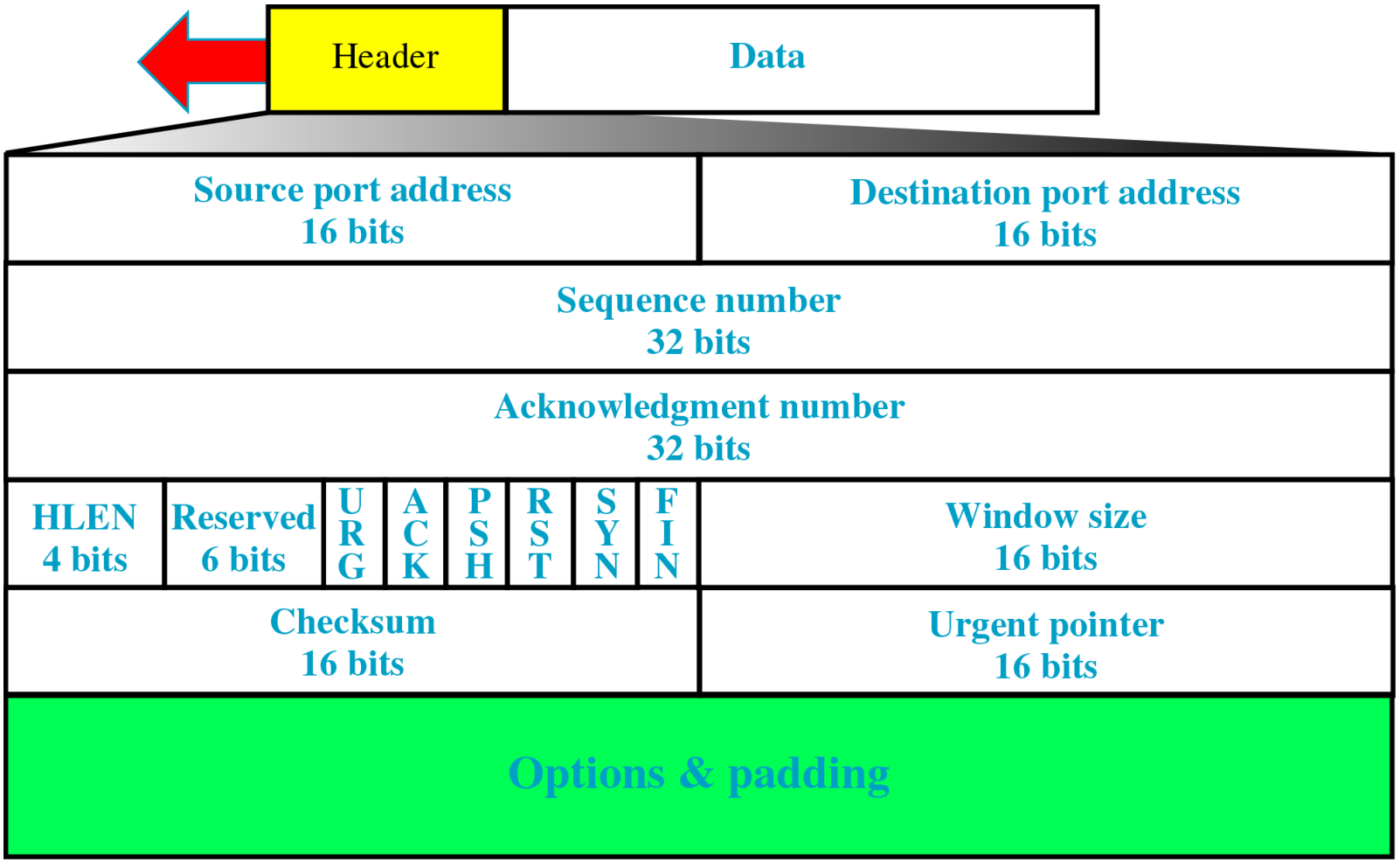


Figure 24-16

TCP Segment Format



ADDRESSING

Figure 2.19 *Physical addresses*

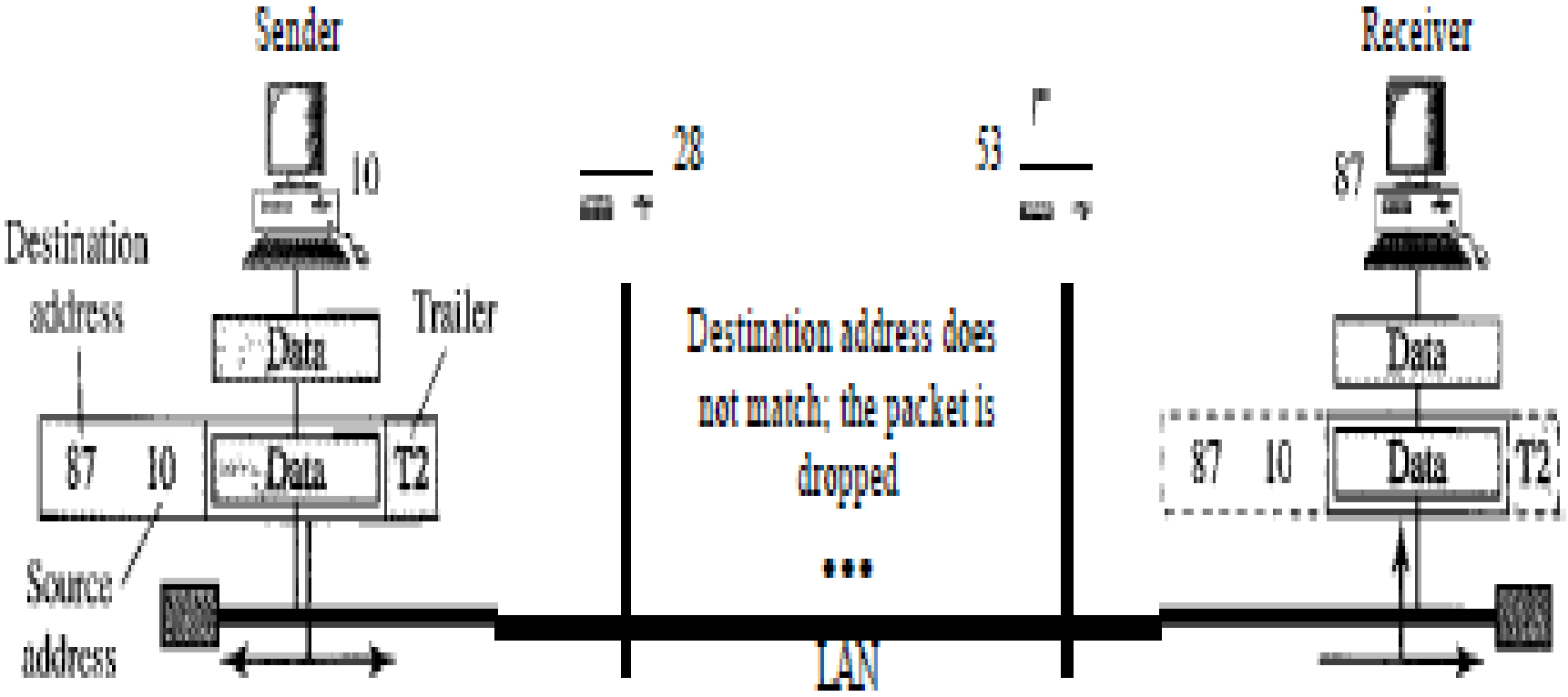


Figure 2.20 *IP addresses*

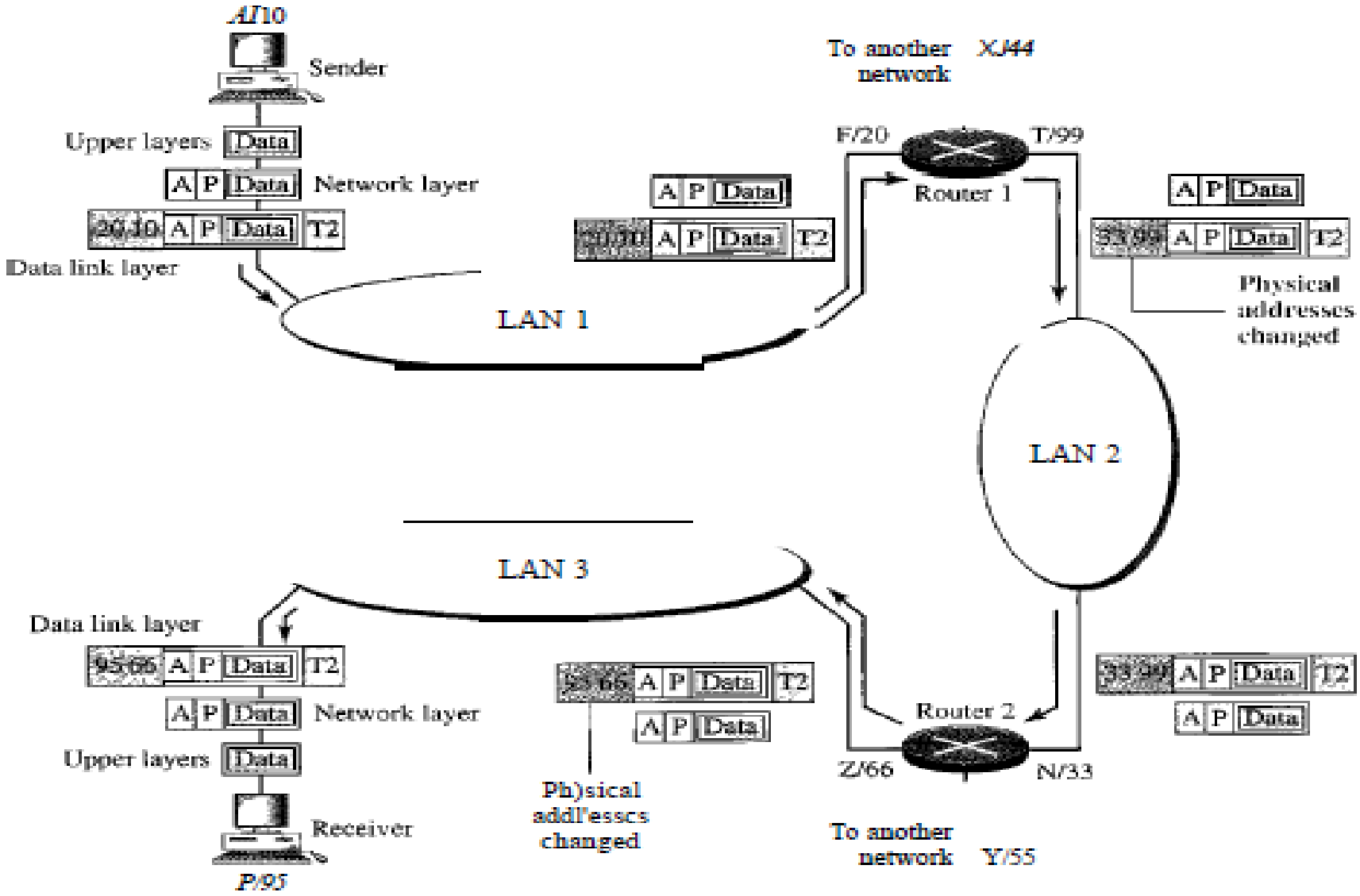
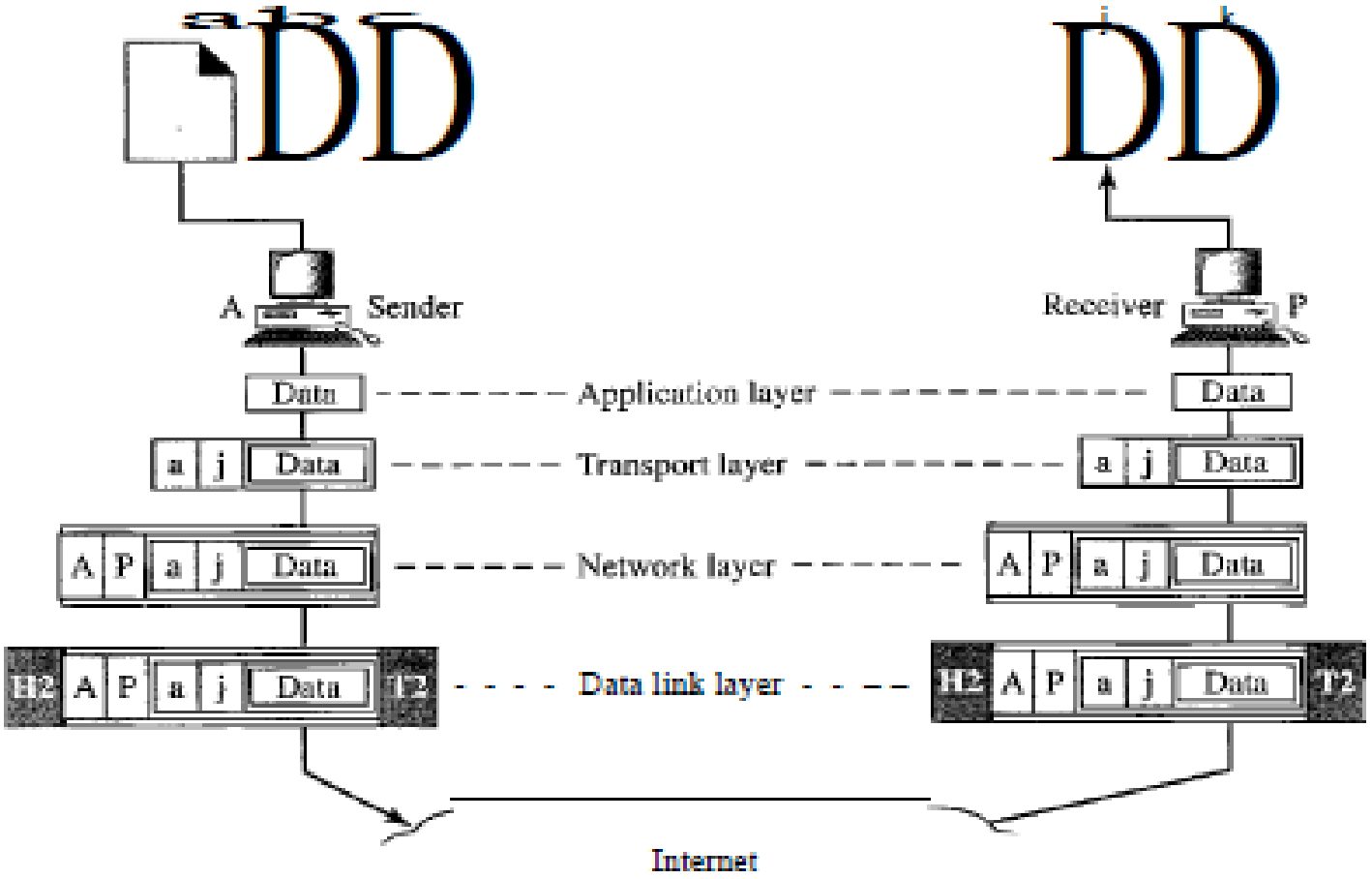


Figure 2.21 *Port addresses*



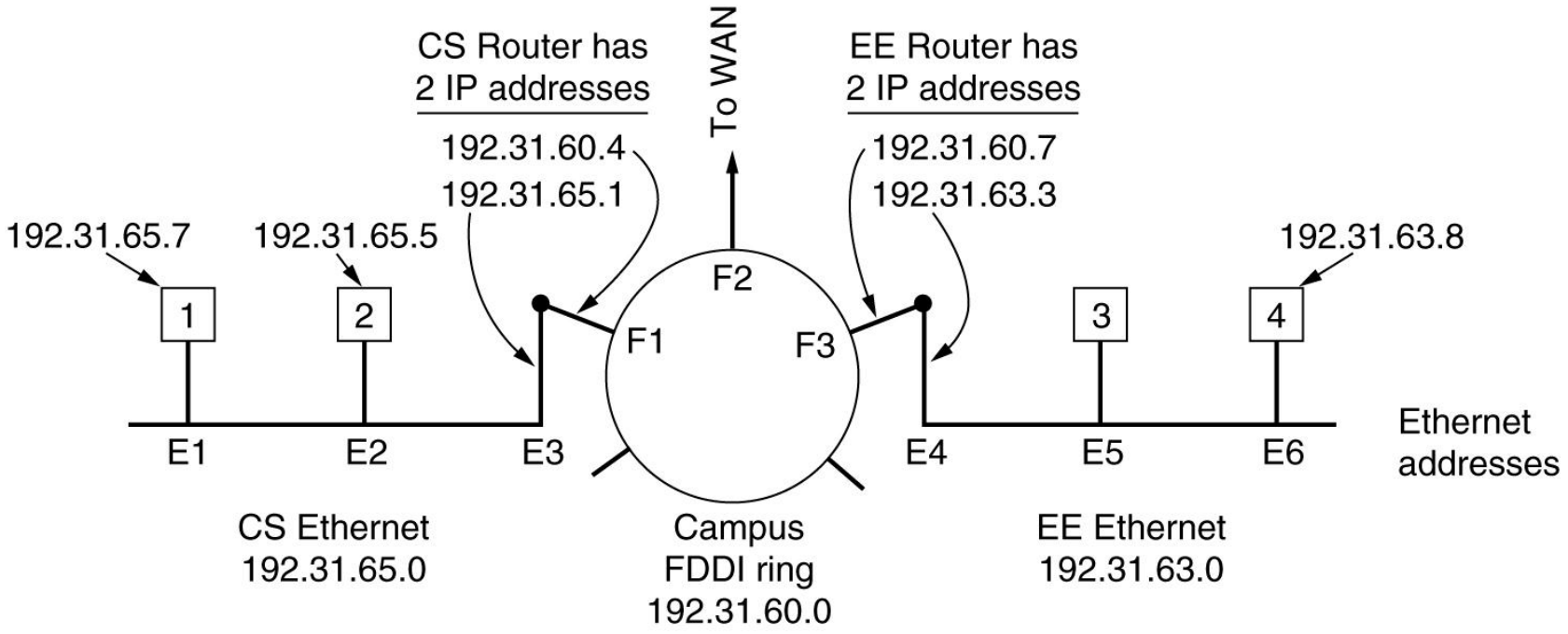
The physical addresses change from hop to hop, but the logical and port addresses usually remain the same.

SPECIFIC ADDRESSES

- www.google.com

- User friendly addresses these addresses changes its corresponding addresses.

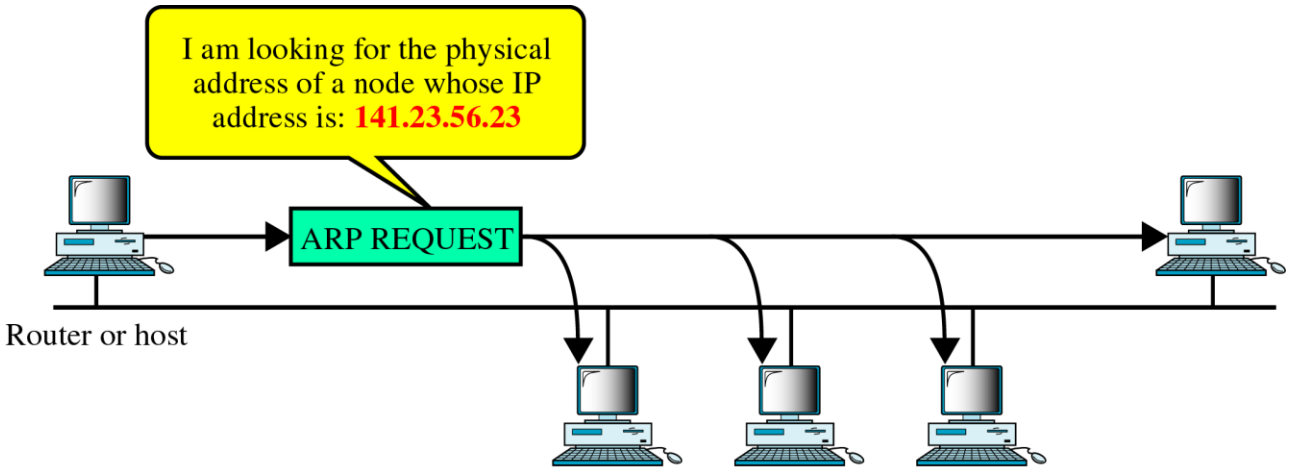
ARP– The Address Resolution Protocol



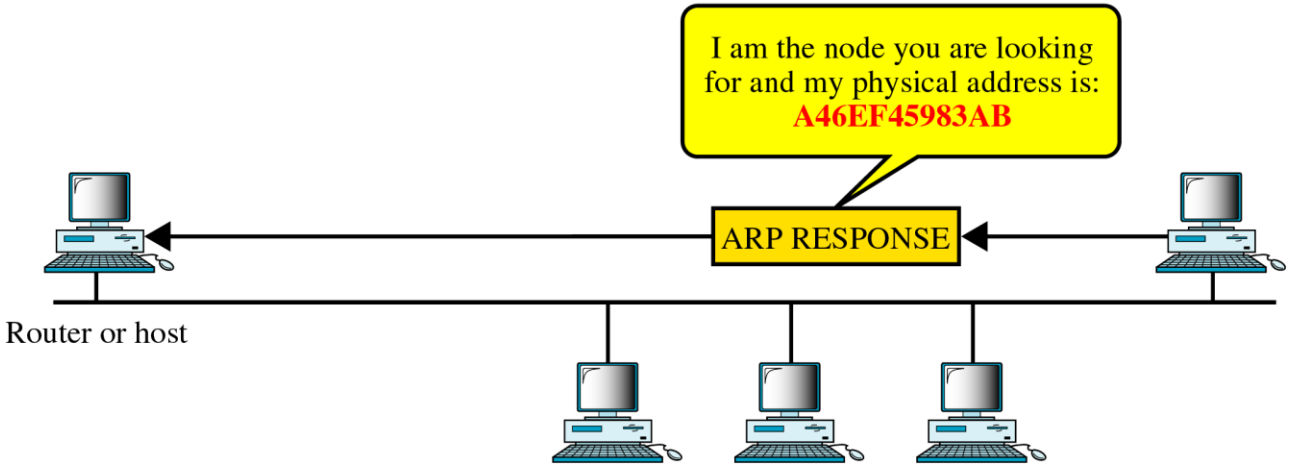
Three interconnected /24 networks: two Ethernets and an FDDI ring.

Figure 24-13

ARP



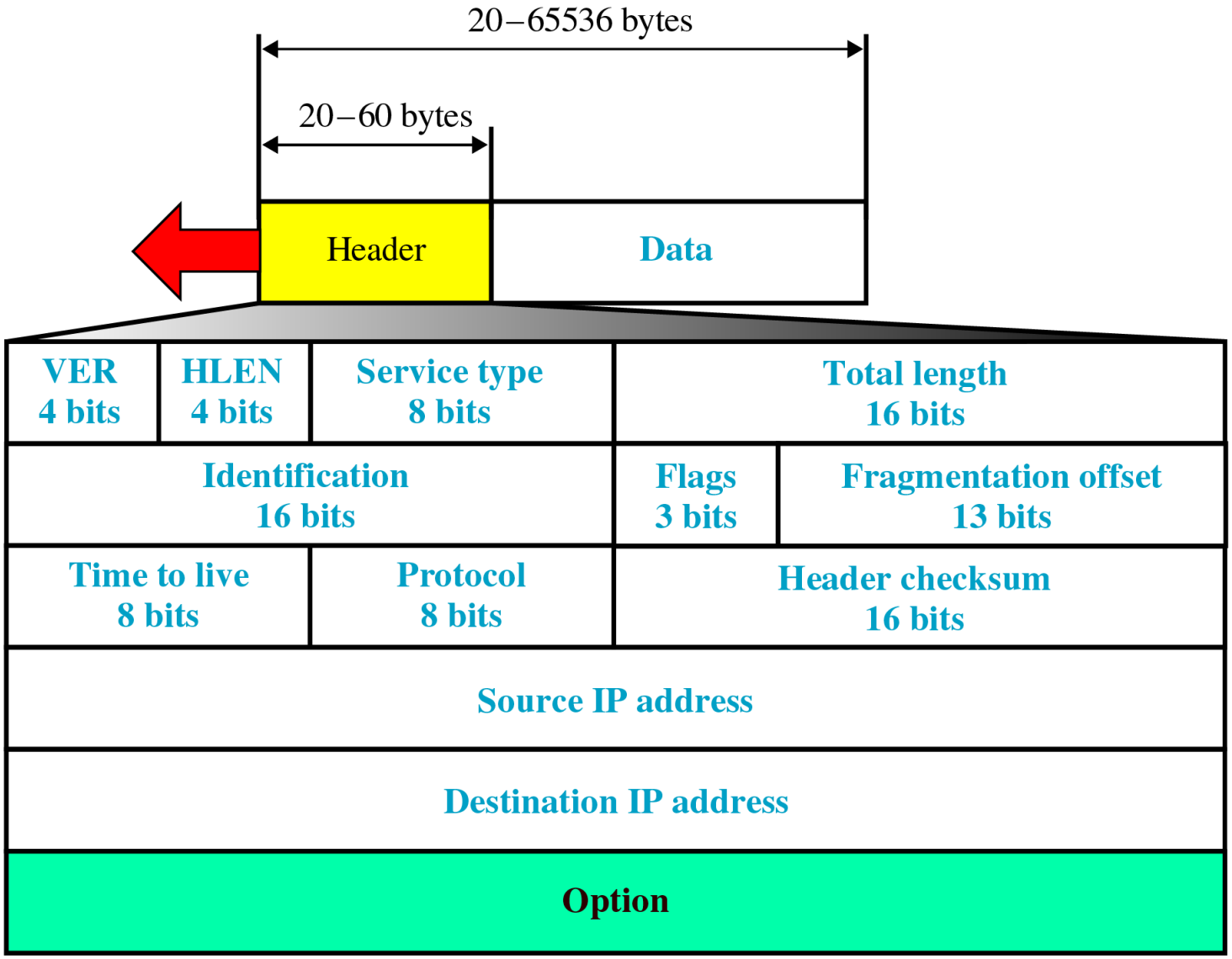
a. ARP request



b. ARP response

Figure 24-3

IP Datagram



The IP Protocol (2)

Option	Description
Security	Specifies how secret the datagram is
Strict source routing	Gives the complete path to be followed
Loose source routing	Gives a list of routers not to be missed
Record route	Makes each router append its IP address
Timestamp	Makes each router append its address and timestamp

Some of the IP options.

Internet Control Message Protocol

Message type	Description
Destination unreachable	Packet could not be delivered
Time exceeded	Time to live field hit 0
Parameter problem	Invalid header field
Source quench	Choke packet
Redirect	Teach a router about geography
Echo request	Ask a machine if it is alive
Echo reply	Yes, I am alive
Timestamp request	Same as Echo request, but with timestamp
Timestamp reply	Same as Echo reply, but with timestamp

The principal ICMP message types.