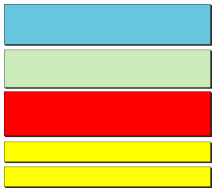


Chapter 11

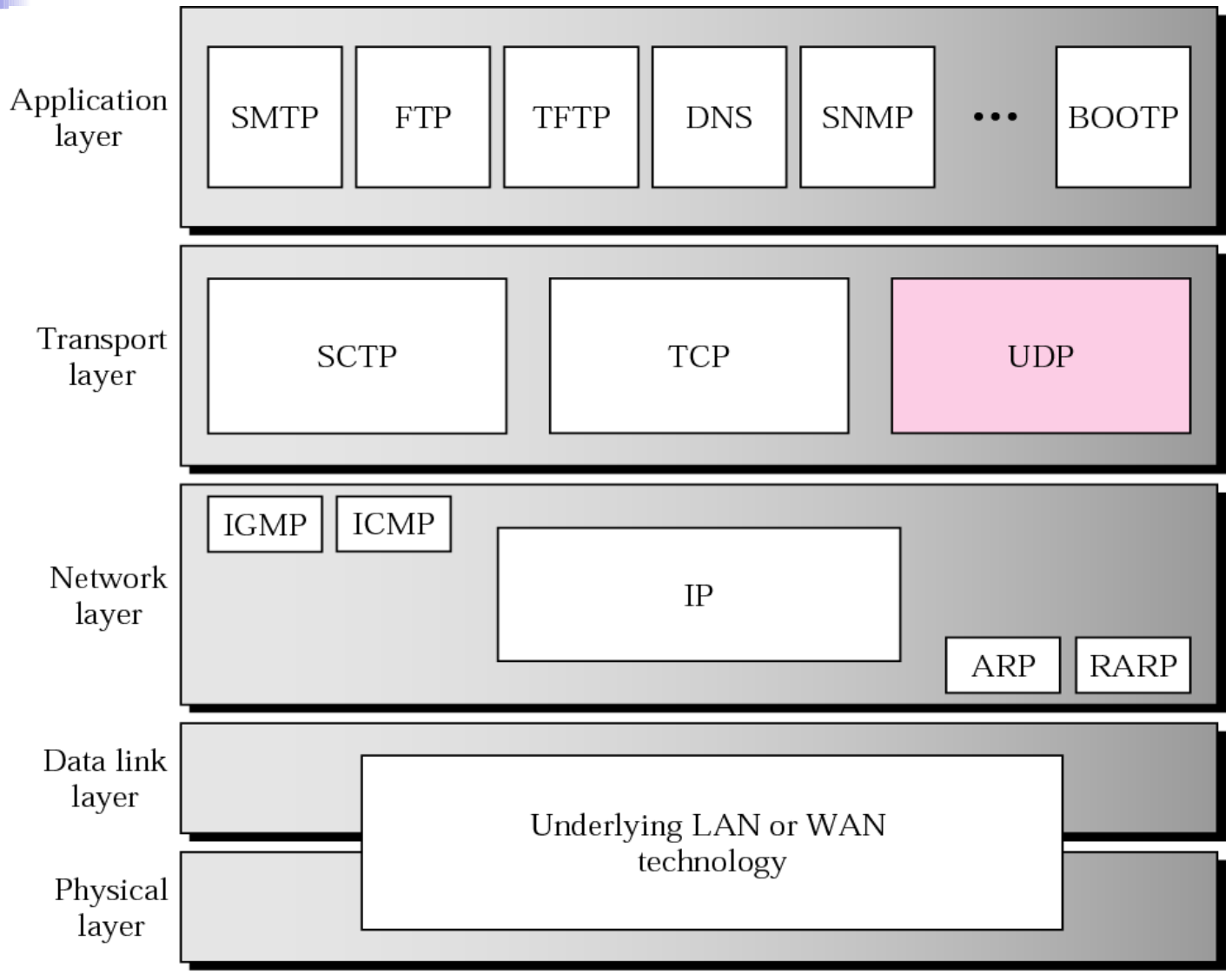
User Datagram Protocol

Objectives

Upon completion you will be able to:

- *Be able to explain process-to-process communication*
- *Know the format of a UDP user datagram*
- *Be able to calculate a UDP checksum*
- *Understand the operation of UDP*
- *Know when it is appropriate to use UDP*
- *Understand the modules in a UDP package*

Figure 11.1 *Position of UDP in the TCP/IP protocol suite*



11.1 PROCESS-TO-PROCESS COMMUNICATION

Before we examine UDP, we must first understand host-to-host communication and process-to-process communication and the difference between them.

The topics discussed in this section include:

Port Numbers
Socket Addresses

Figure 11.2 *UDP versus IP*

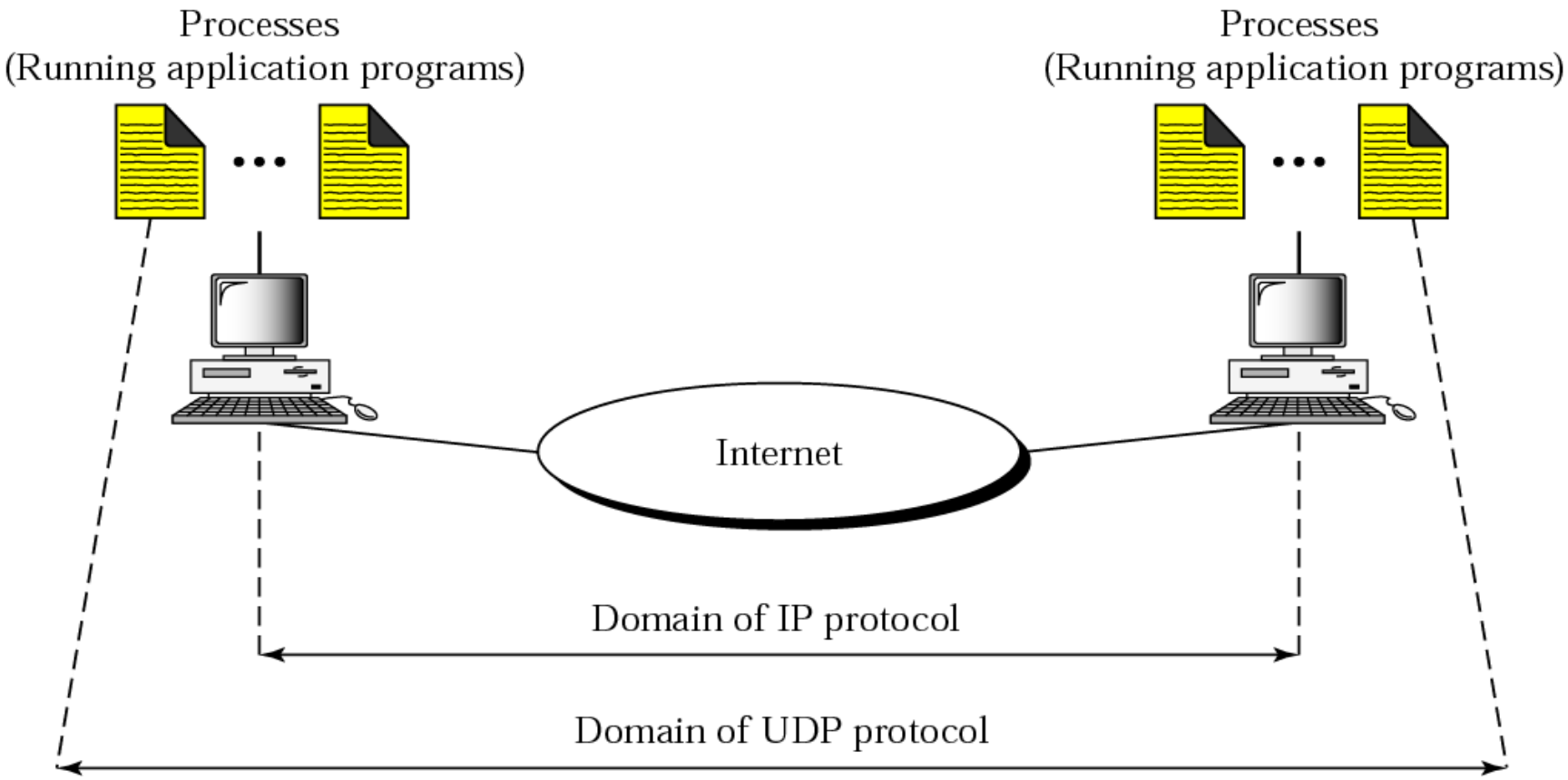


Figure 11.3 *Port numbers*

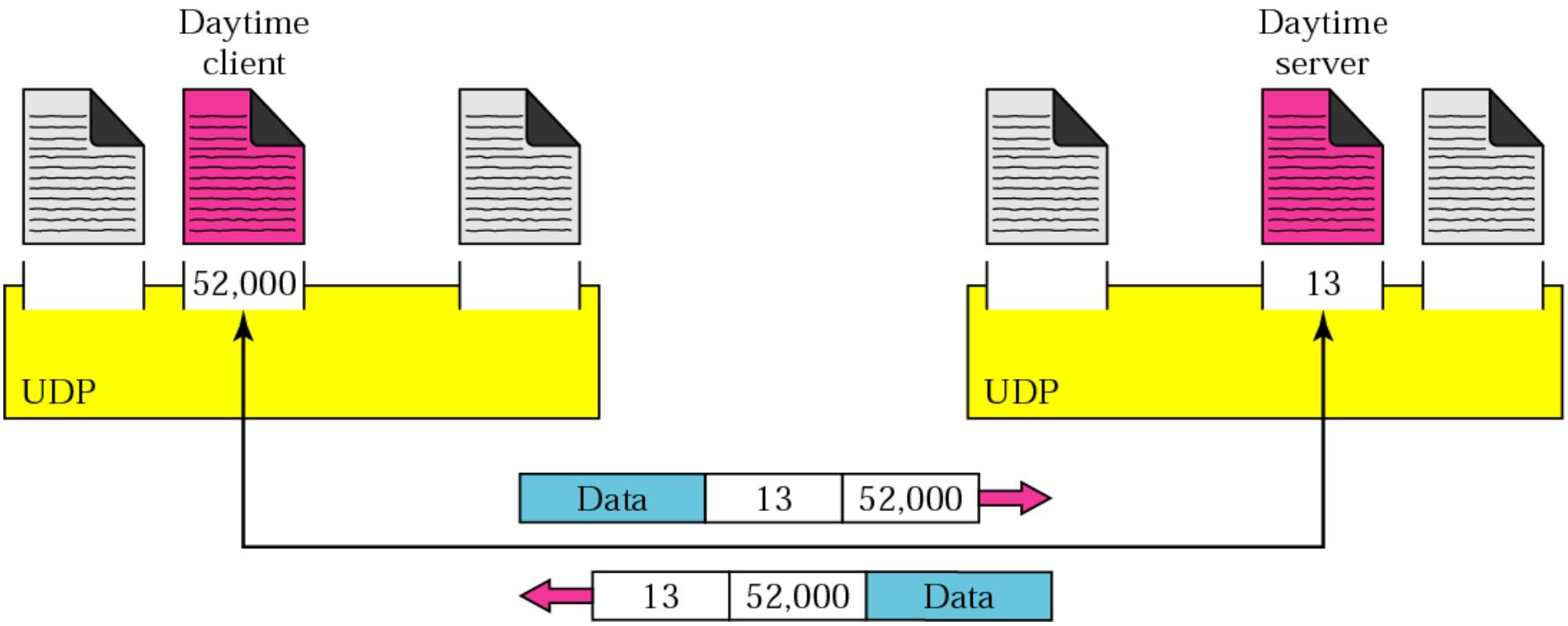


Figure 11.4 *IP addresses versus port numbers*

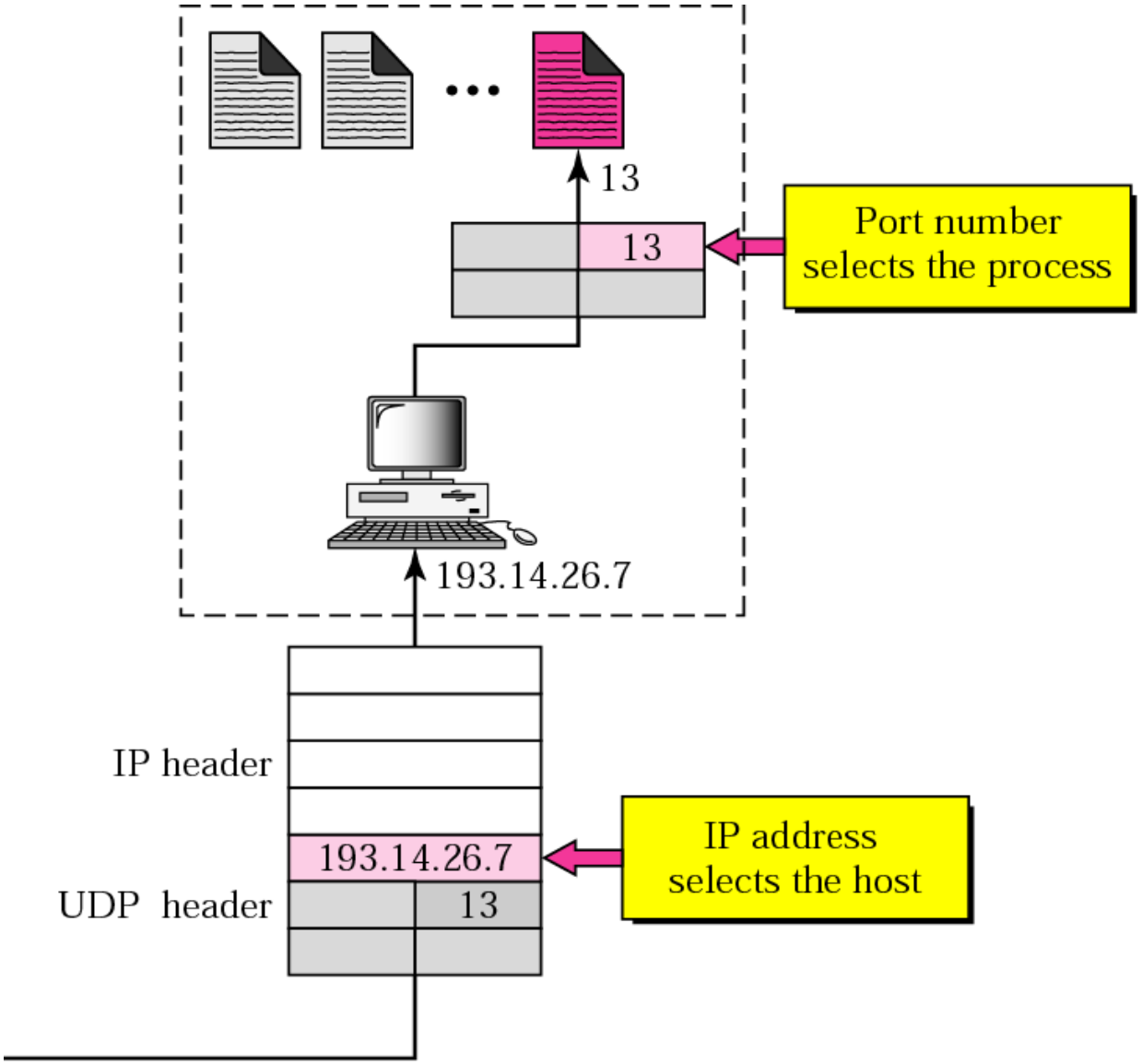
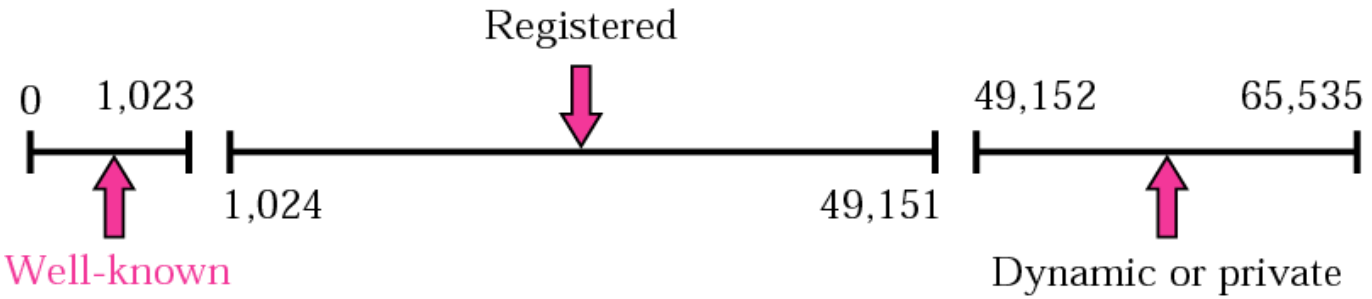


Figure 11.5 *ICANN ranges*

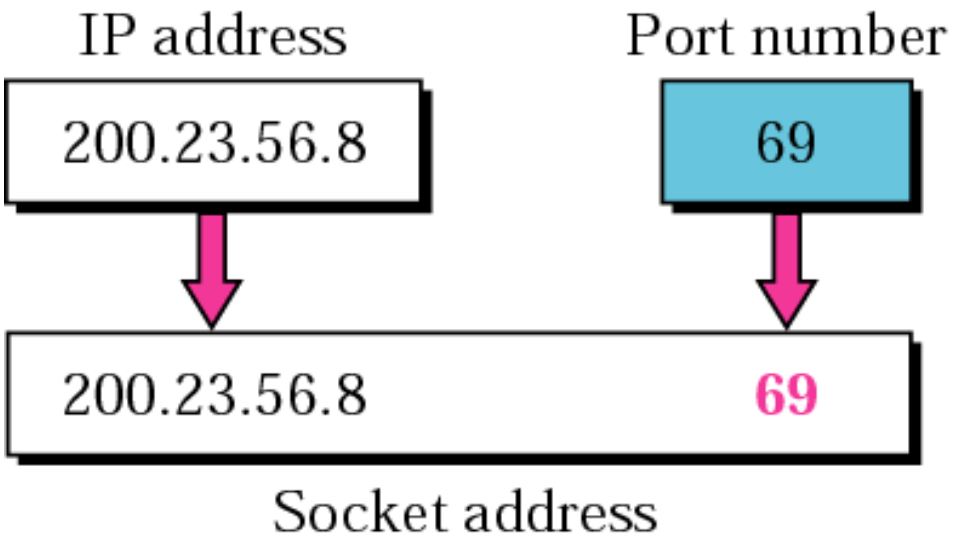


The well-known port numbers are less than 1024.

Table 11.1 Well-known ports used with UDP

Port	*Protocol*	*Description*
7	Echo	Echoes a received datagram back to the sender
9	Discard	Discards any datagram that is received
11	Users	Active users
13	Daytime	Returns the date and the time
17	Quote	Returns a quote of the day
19	Chargen	Returns a string of characters
53	Nameserver	Domain Name Service
67	Bootps	Server port to download bootstrap information
68	Bootpc	Client port to download bootstrap information
69	TFTP	Trivial File Transfer Protocol
111	RPC	Remote Procedure Call
123	NTP	Network Time Protocol
161	SNMP	Simple Network Management Protocol
162	SNMP	Simple Network Management Protocol (trap)

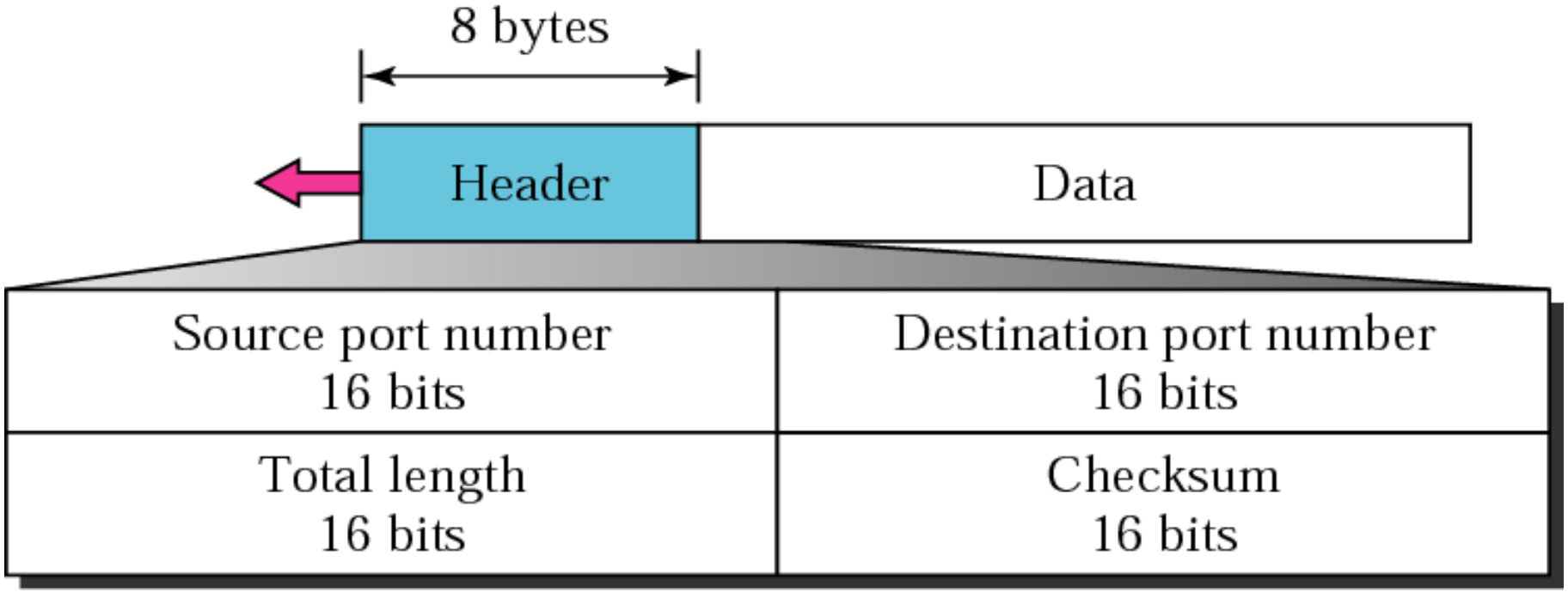
Figure 11.6 *Socket address*



11.2 USER DATAGRAM

UDP packets are called user datagrams and have a fixed-size header of 8 bytes.

Figure 11.7 *User datagram format*



UDP length =
IP length − IP header's length

11.4 UDP OPERATION

UDP uses concepts common to the transport layer. These concepts will be discussed here briefly, and then expanded in the next chapter on the TCP protocol.

The topics discussed in this section include:

Connectionless Services
Flow and Error Control
Encapsulation and Decapsulation
Queuing
Multiplexing and Demultiplexing

Figure 11.10 *Encapsulation and decapsulation*

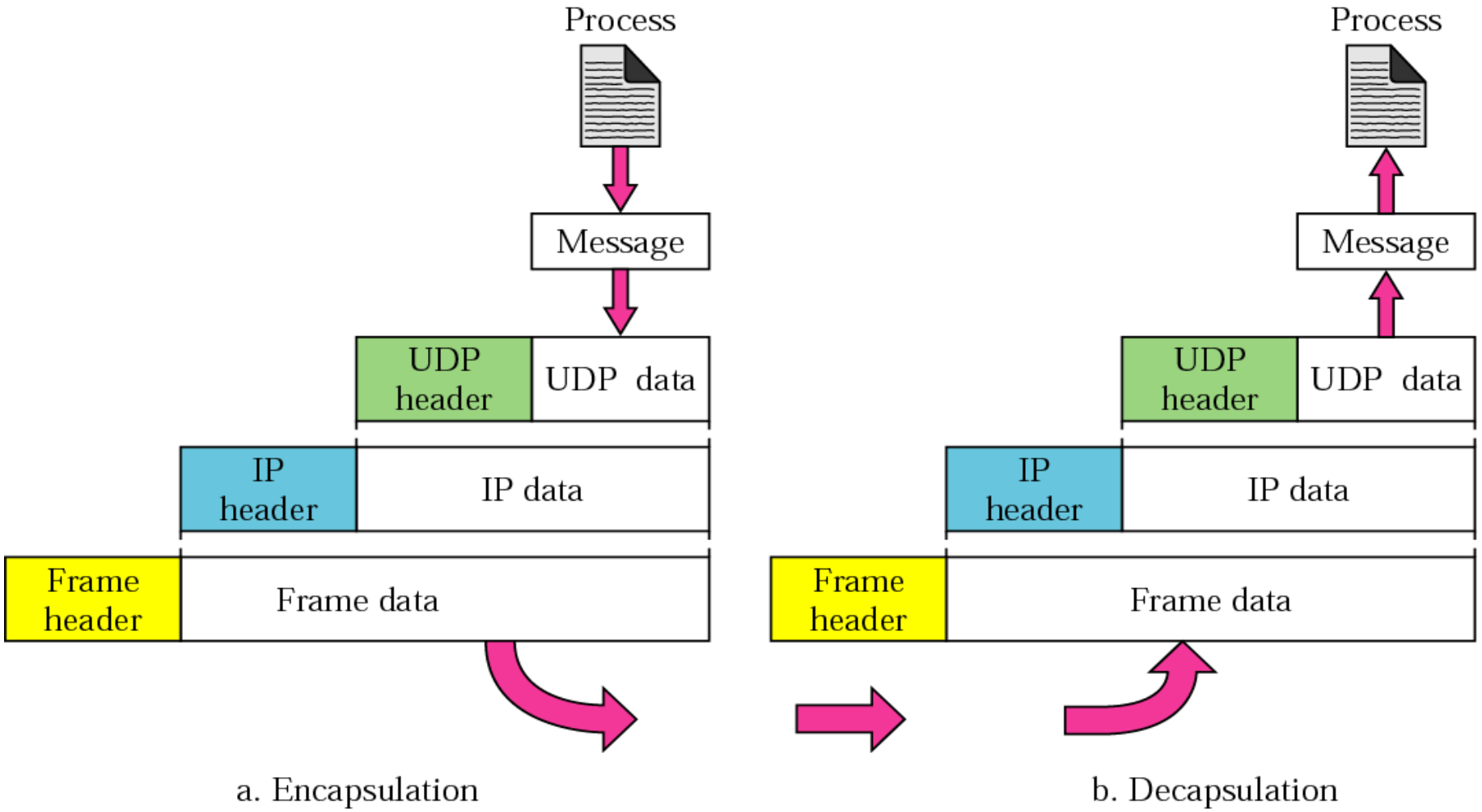
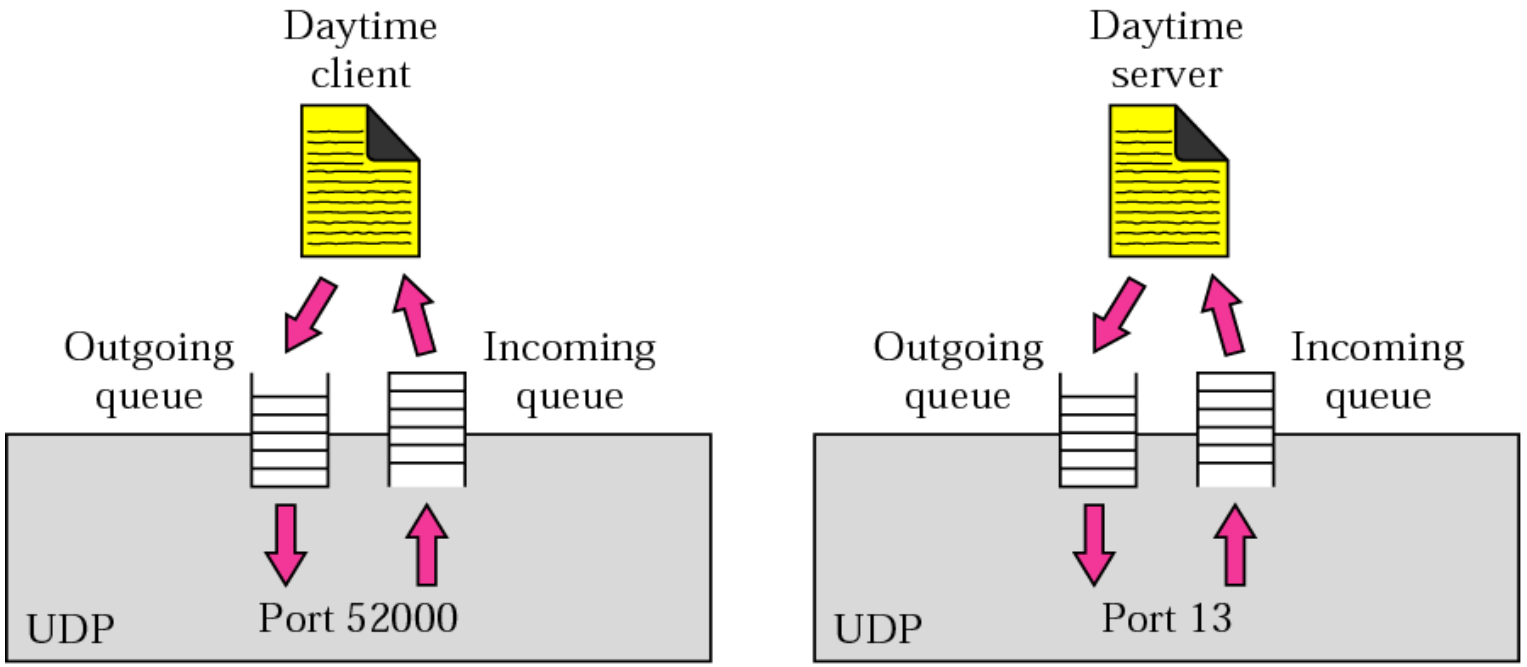


Figure 11.11 *Queues in UDP*



11.6 UDP PACKAGE

To show how UDP handles the sending and receiving of UDP packets, we present a simple version of the UDP package. The UDP package involves five components: a control-block table, input queues, a control-block module, an input module, and an output module.

The topics discussed in this section include:

Control-Block Table
Input Queues
Control-Block Module
Input Module
Output Module

Figure 11.13 *UDP design*

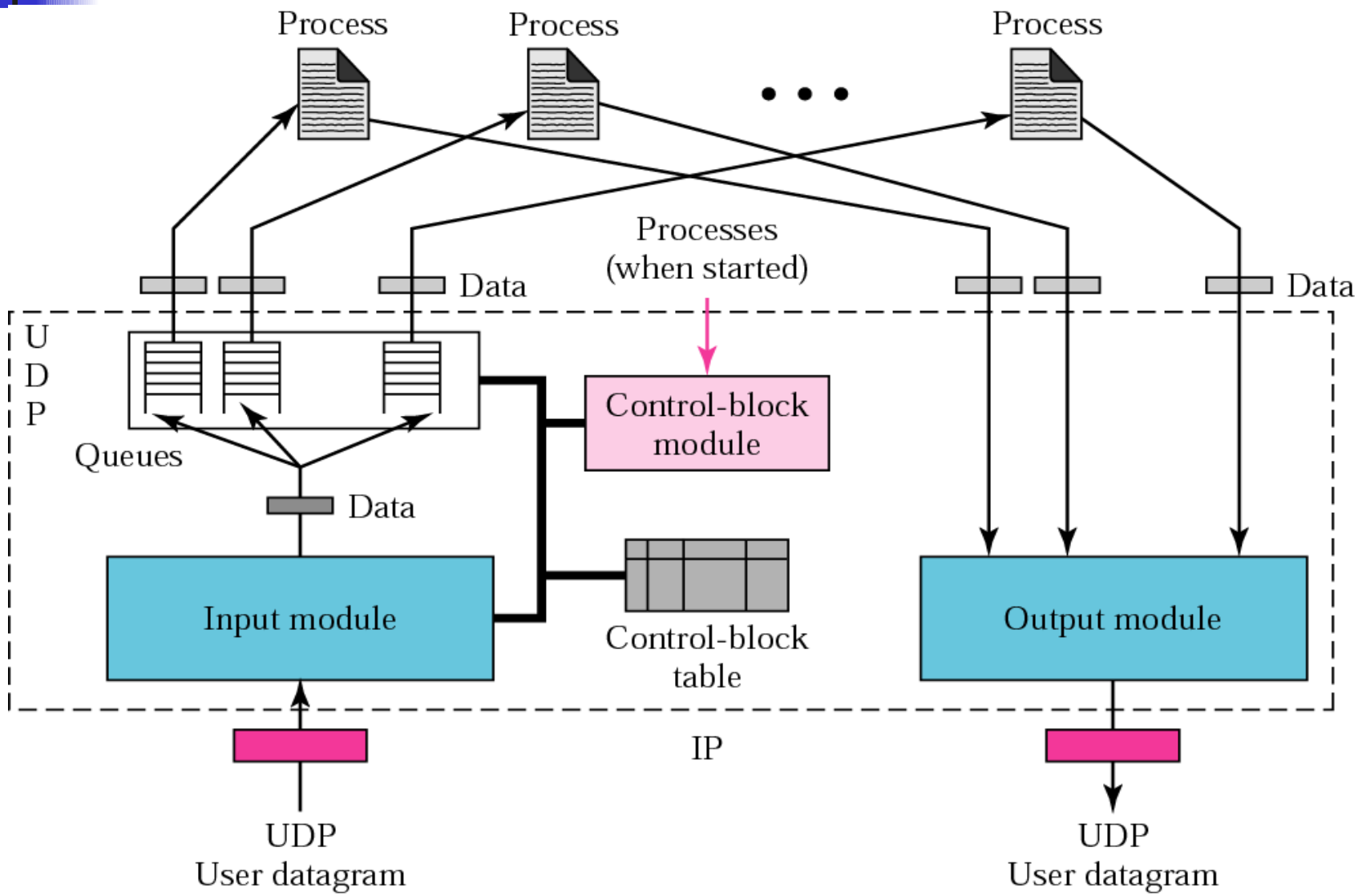
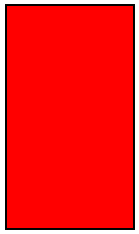


Table 11.2 ***The control-block table at the beginning of examples***

State	*Process ID*	*Port Number*	*Queue Number*
IN-USE	2,345	52,010	34
IN-USE	3,422	52,011	
FREE			
IN-USE	4,652	52,012	38
FREE			



Example 2

The first activity is the arrival of a user datagram with destination port number 52,012. The input module searches for this port number and finds it. Queue number 38 has been assigned to this port, which means that the port has been previously used. The input module sends the data to queue 38. The control-block table does not change.

Example 3

After a few seconds, a process starts. It asks the operating system for a port number and is granted port number 52,014. Now the process sends its ID (4,978) and the port number to the control-block module to create an entry in the table. The module takes the first FREE entry and inserts the information received. The module does not allocate a queue at this moment because no user datagrams have arrived for this destination (see Table 11.3).

See Next Slide

Table 11.3 Control-block table after Example 3

State	*Process ID*	*Port Number*	*Queue Number*
IN-USE	2,345	52,010	34
IN-USE	3,422	52,011	
IN-USE	**4,978**	**52,014**	
IN-USE	4,652	52,012	38
FREE			

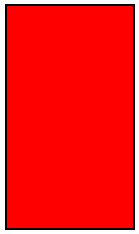
Example 4

A user datagram now arrives for port 52,011. The input module checks the table and finds that no queue has been allocated for this destination since this is the first time a user datagram has arrived for this destination. The module creates a queue and gives it a number (43). See Table 11.4.

See Next Slide

Table 11.4 Control-block after Example 4

State	*Process ID*	*Port Number*	*Queue Number*
IN-USE	2,345	52,010	34
IN-USE	3,422	52,011	**43**
IN-USE	4,978	52,014	
IN-USE	4,652	52,012	38
FREE			



Example 5

After a few seconds, a user datagram arrives for port 52,222. The input module checks the table and cannot find an entry for this destination. The user datagram is dropped and a request is made to ICMP to send an "unreachable port" message to the source.