Internet Protocol

Objectives

Upon completion you will be able to:

- *Understand the format and fields of a datagram*
- *Understand the need for fragmentation and the fields involved*
- *Understand the options available in an IP datagram*
- *Be able to perform a checksum calculation*
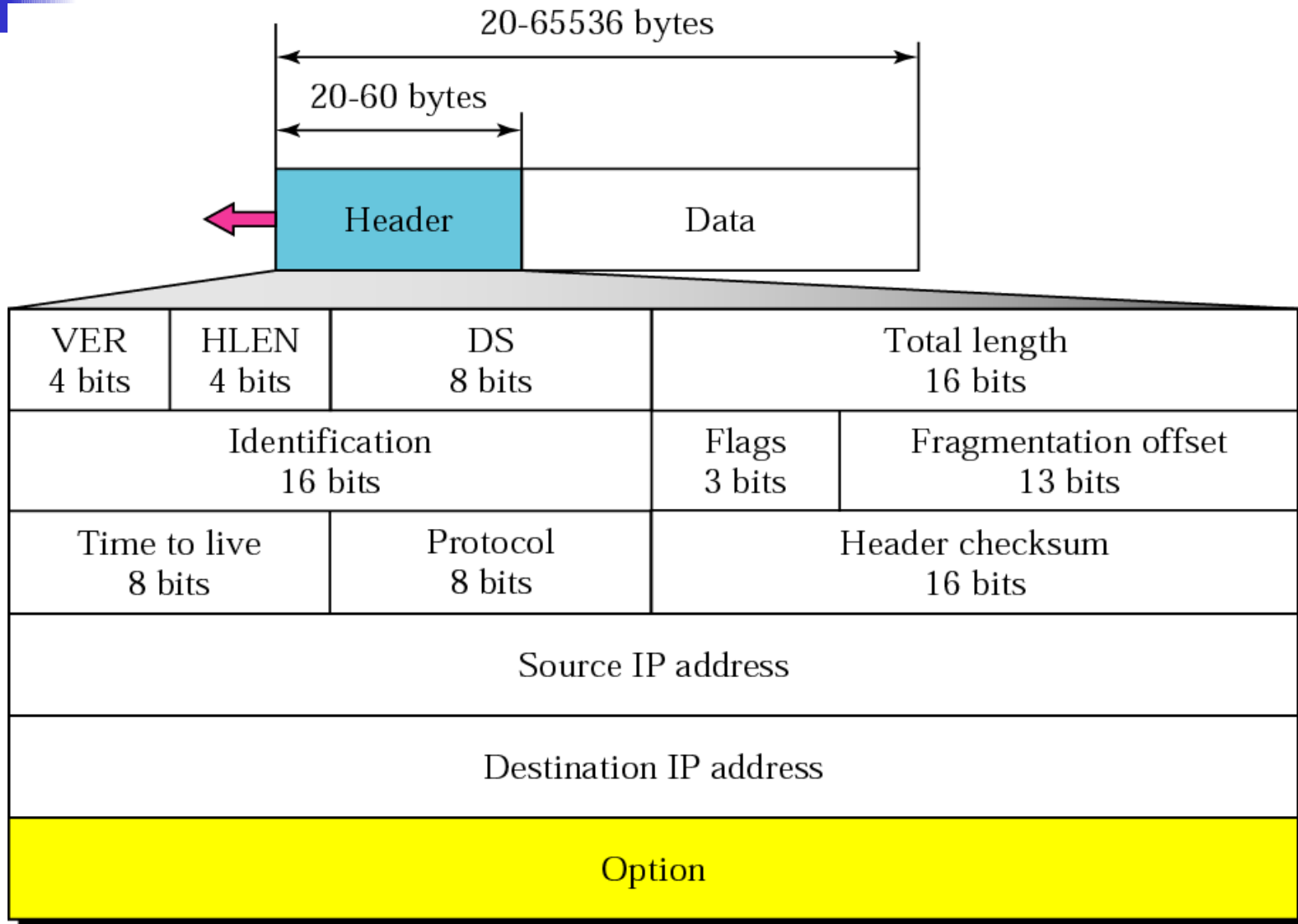- *Understand the components and interactions of an IP package*

Figure 8.1   *Position of IP in TCP/IP protocol suite*

TCP/IP Protocol Suite   2
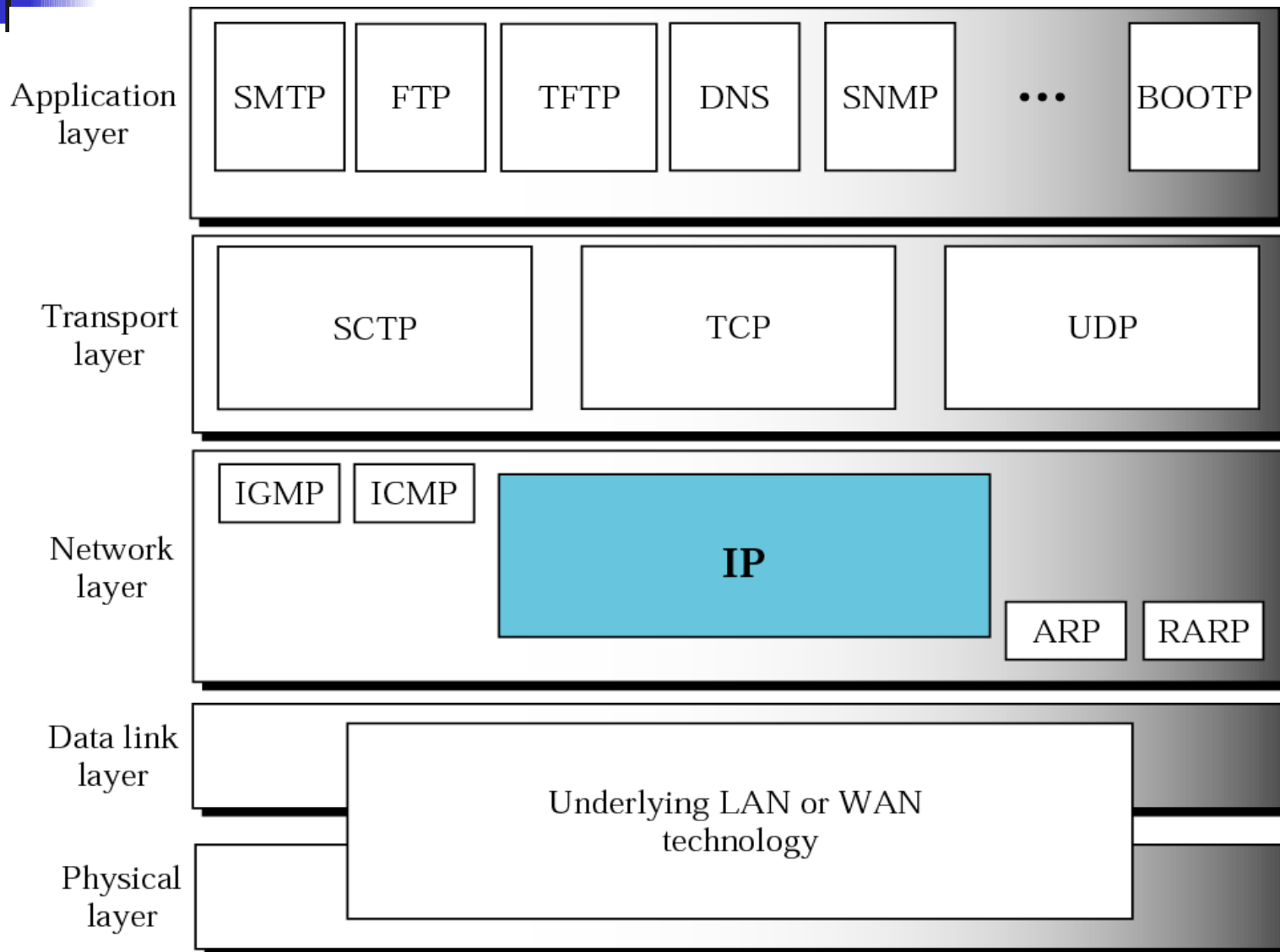
8.1 DATAGRAM

A packet in the IP layer is called a datagram, a variable-length packet consisting of two parts: header and data. The header is 20 to 60 bytes in length and contains information essential to routing and delivery.

Figure 8.2   *IP datagram*

20-65536 bytes

20-60 bytes

Header	Data

VER 4 bits	HLEN 4 bits	DS 8 bits	Total length 16 bits	
Identification 16 bits			Flags 3 bits	Fragmentation offset 13 bits
Time to live 8 bits		Protocol 8 bits	Header checksum 16 bits	
Source IP address				
Destination IP address				
Option				

TCP/IP Protocol Suite   4

Figure 8.3 *Service type or differentiated services*

Service type

Differentiated services

TCP/IP Protocol Suite 5
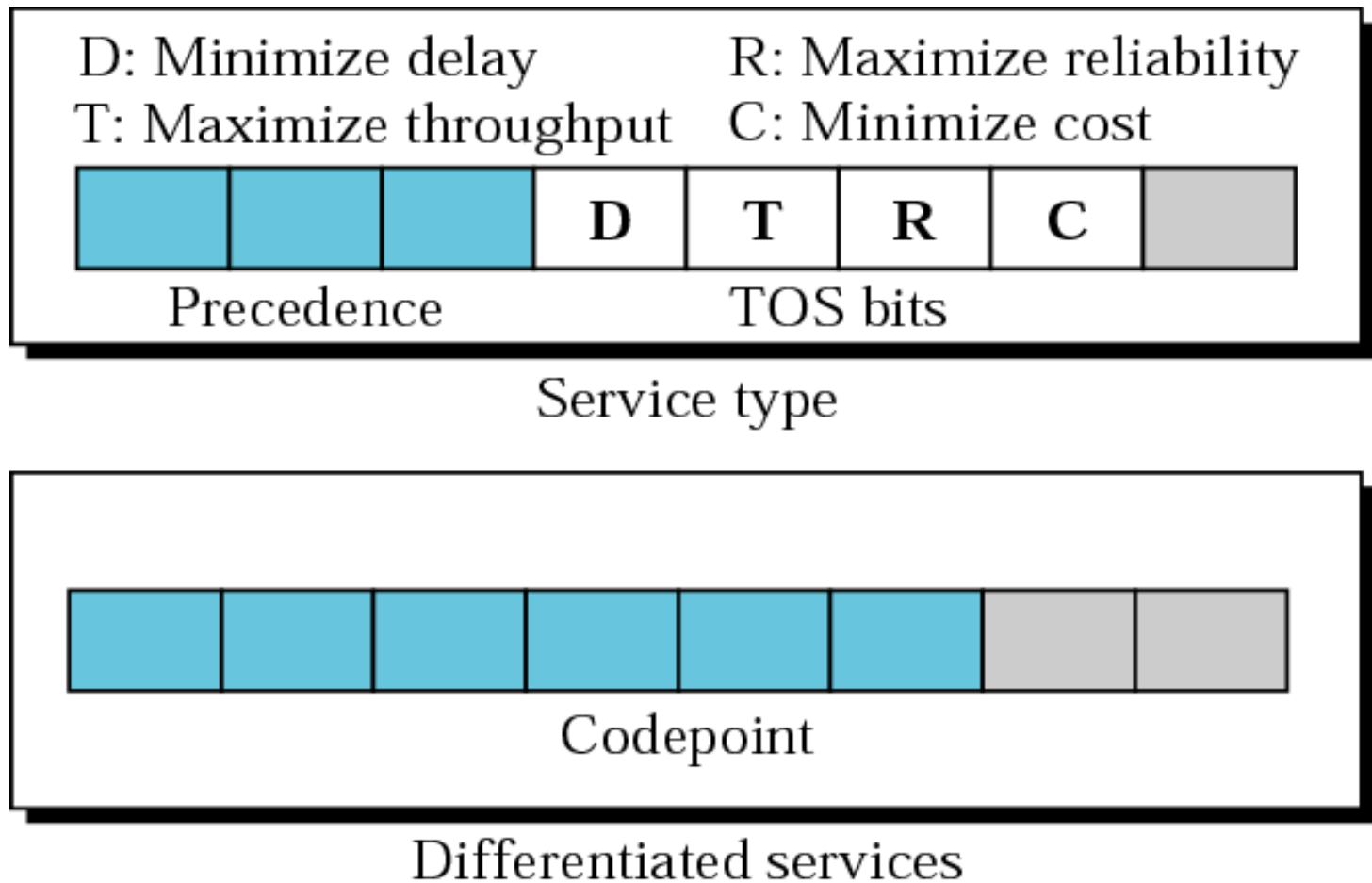
Table 8.1 Types of service

TOS Bits	Description
0000	Normal (default)
0001	Minimize cost
0010	Maximize reliability
0100	Maximize throughput
1000	Minimize delay

TCP/IP Protocol Suite

Table 8.2 Default types of service

Protocol	TOS Bits	Description
ICMP	0000	Normal
BOOTP	0000	Normal
NNTP	0001	Minimize cost
IGP	0010	Maximize reliability
SNMP	0010	Maximize reliability
TELNET	1000	Minimize delay
FTP (data)	0100	Maximize throughput
FTP (control)	1000	Minimize delay
TFTP	1000	Minimize delay
SMTP (command)	1000	Minimize delay
SMTP (data)	0100	Maximize throughput
DNS (UDP query)	1000	Minimize delay
DNS (TCP query)	0000	Normal
DNS (zone)	0100	Maximize throughput

Note:

The total length field defines the total length of the datagram including the header.

Table 8.4 Protocols

Value	Protocol
1	ICMP
2	IGMP
6	TCP
17	UDP
89	OSPF

TCP/IP Protocol Suite

Example 1

An IP packet has arrived with the first 8 bits as shown:

← 01000010

The receiver discards the packet. Why?

Solution

There is an error in this packet. The 4 left-most bits (0100) show the version, which is correct. The next 4 bits (0010) show the header length; which means (2 × 4 = 8), which is wrong. The minimum number of bytes in the header must be 20. The packet has been corrupted in transmission.

Example 2

In an IP packet, the value of HLEN is 1000 in binary. How many bytes of options are being carried by this packet?

Solution

The HLEN value is 8, which means the total number of bytes in the header is 8 × 4 or 32 bytes. The first 20 bytes are the base header, the next 12 bytes are the options.

Example 3

In an IP packet, the value of HLEN is 5_{16} and the value of the total length field is 0028_{16} . How many bytes of data are being carried by this packet?

Solution
The HLEN value is 5, which means the total number of bytes in the header is 5 × 4 or 20 bytes (no options). The total length is 40 bytes, which means the packet is carrying 20 bytes of data (40 − 20).