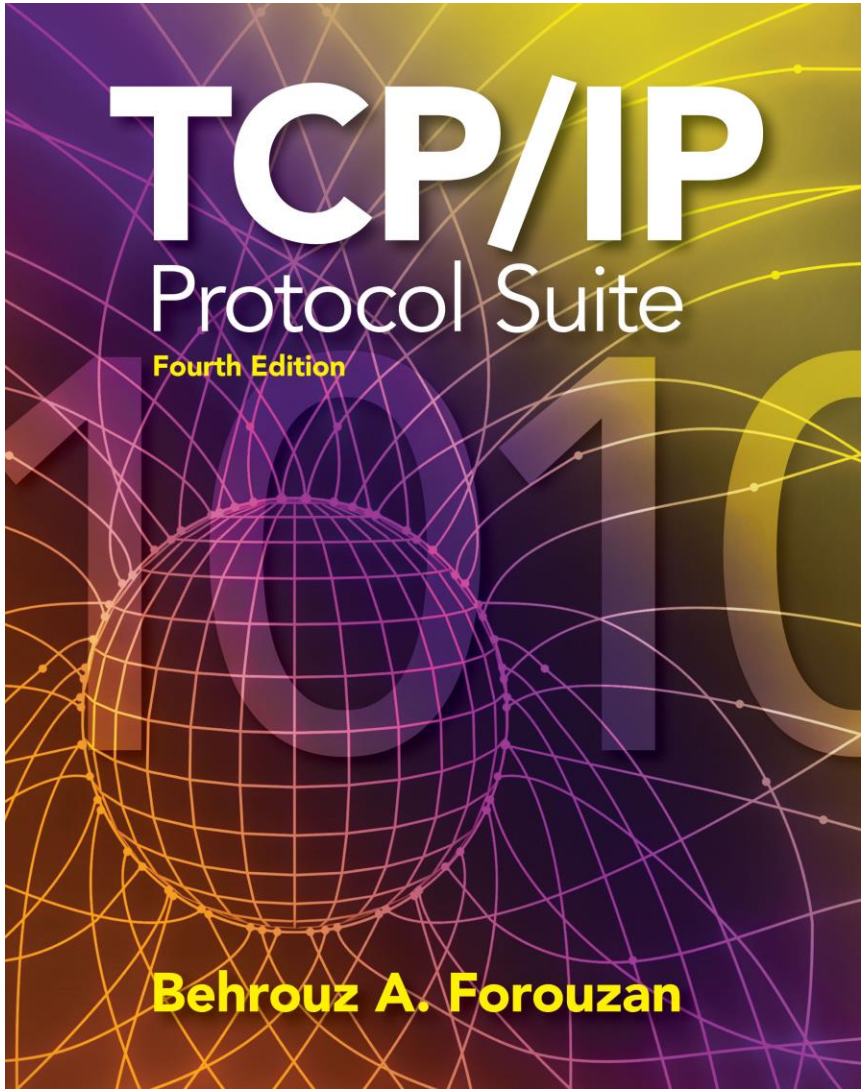
Chapter 3

Underlying Technology



Chapter Outline

3.1 Wired Local Area Network

3.2 Wireless LANs

3.3 Point-to-Point WANs

3.4 Switched WANs

3.5 Connecting Devices

3-1 WIRED LOCAL AREA NETWORKS

A local area network (LAN) is a computer network that is designed for a limited geographic area such as a building or a campus. Although a LAN can be used as an isolated network to connect computers in an organization for the sole purpose of sharing resources, most LANs today are also linked to a wide area network (WAN) or the Internet.

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Figure 3.6 *Ethernet evolution through four generations*

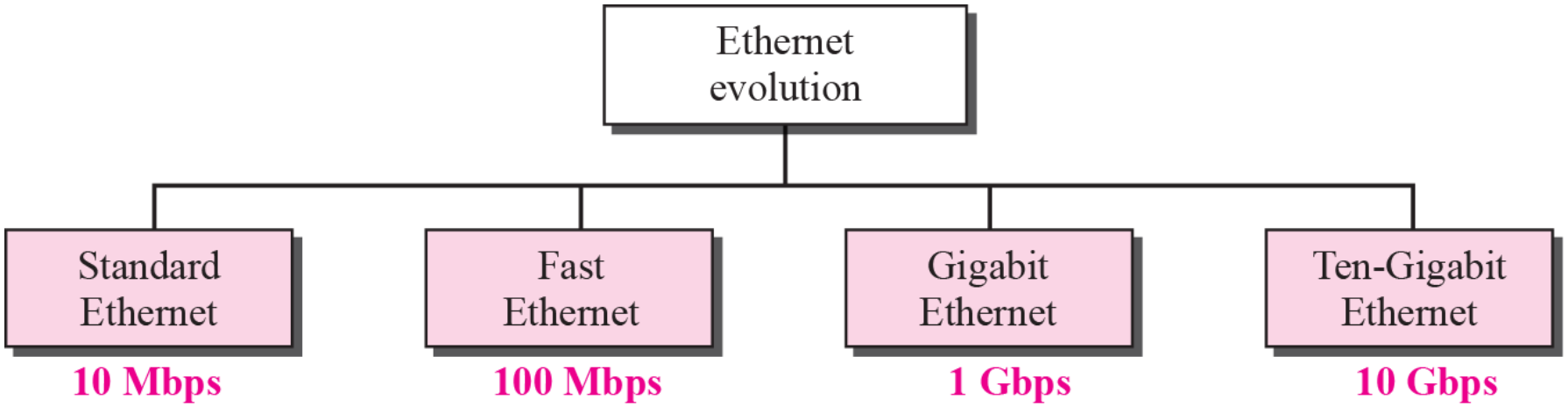


Figure 3.2 *Ethernet Frame*

Preamble: 56 bits of alternating 1s and 0s.

SFD: Start frame delimiter, flag (10101011)

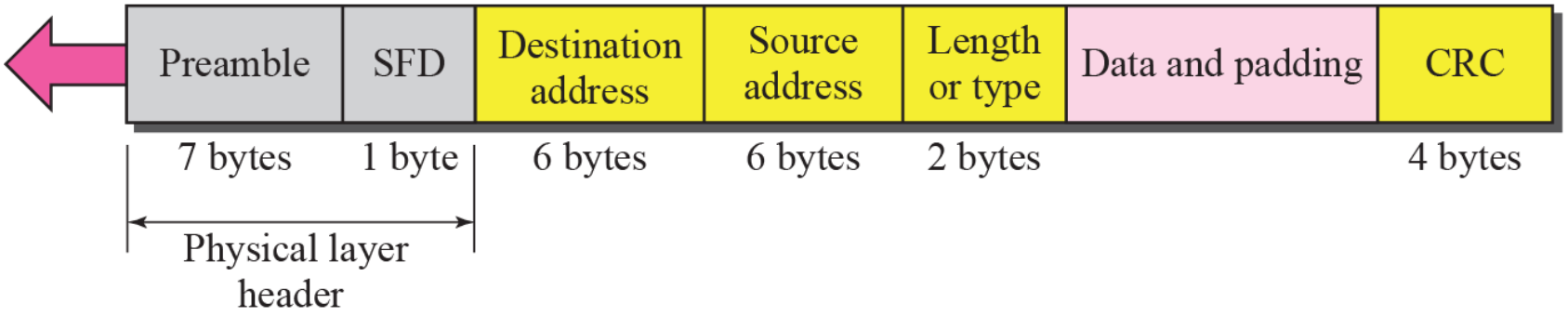
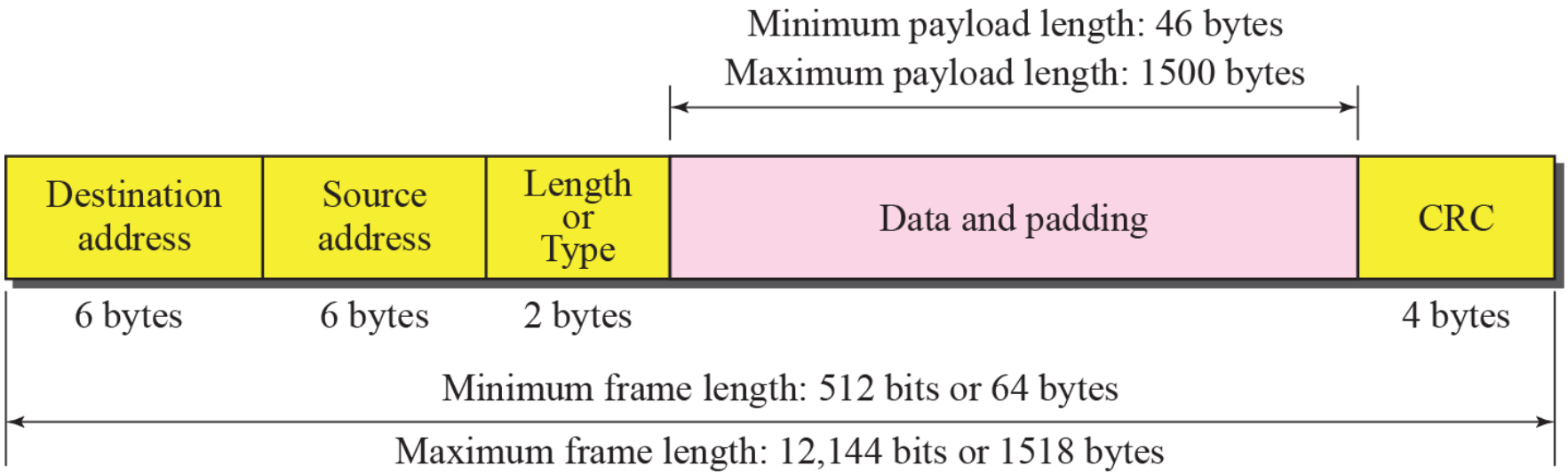


Figure 3.3 *Maximum and minimum lengths*



Note

Minimum length: 64 bytes (512 bits)

Maximum length: 1518 bytes (12,144 bits)

Figure 3.4 *Ethernet address in hexadecimal notation*

d: Hexadecimal digit

$$d_1d_2 : d_3d_4 : d_5d_6 : d_7d_8 : d_9d_{10} : d_{11}d_{12}$$

6 bytes = 12 hexadecimal digits = 48 bits

Note

The broadcast destination address is a special case of the multicast address in which all bits are 1s.

Figure 3.7 *Space/time model of a collision in CSMA*

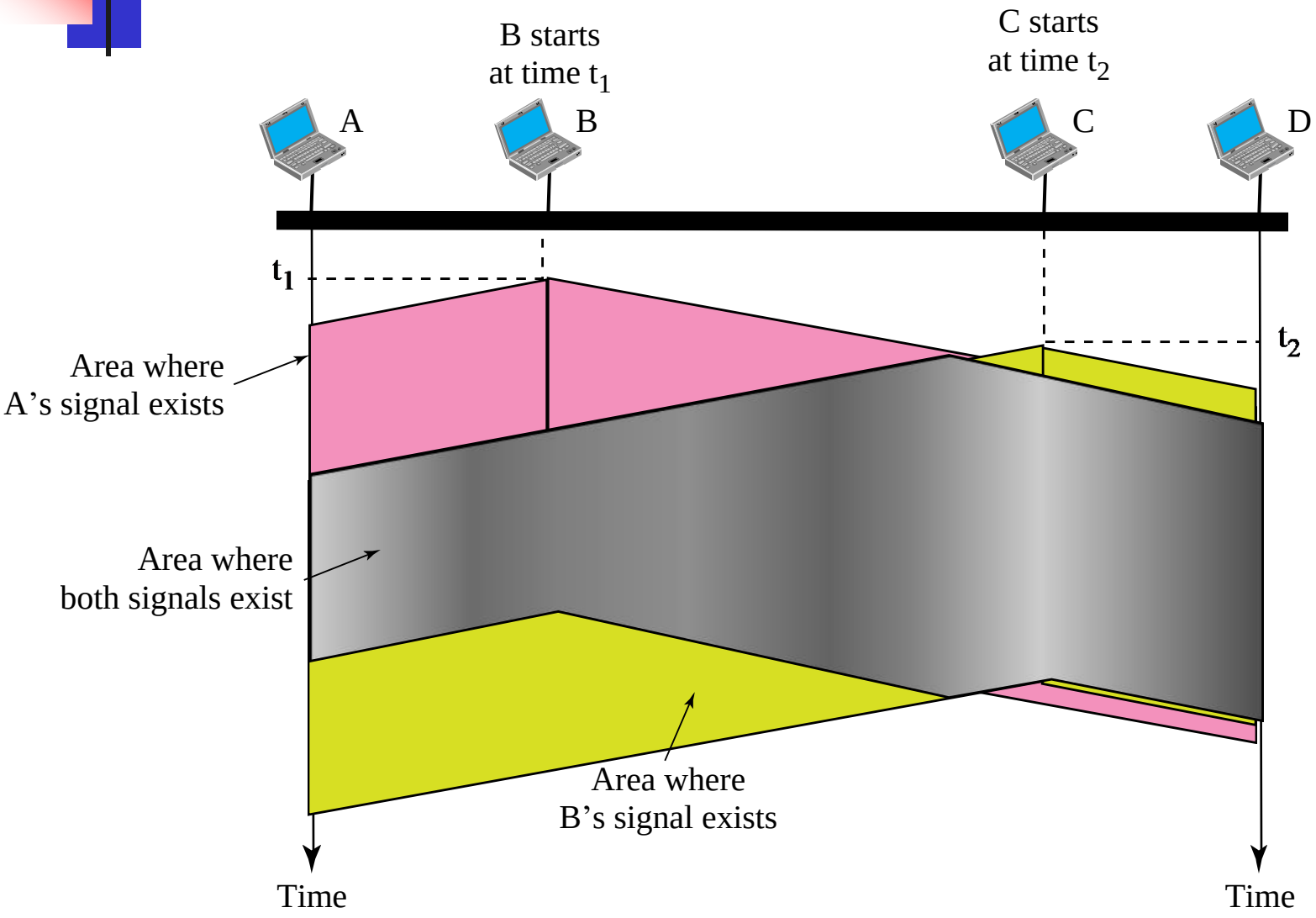
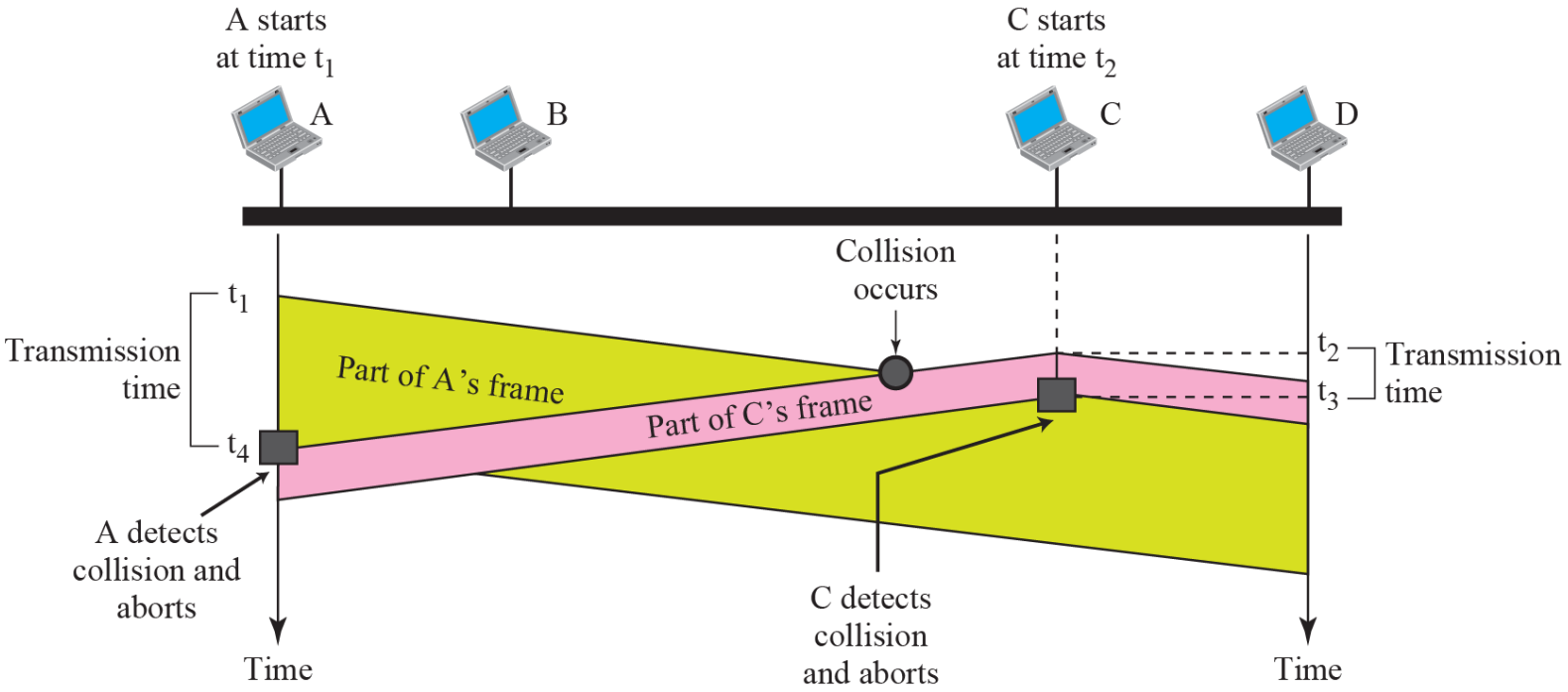


Figure 3.8 *Collision of the first bit in CSMA/CD*



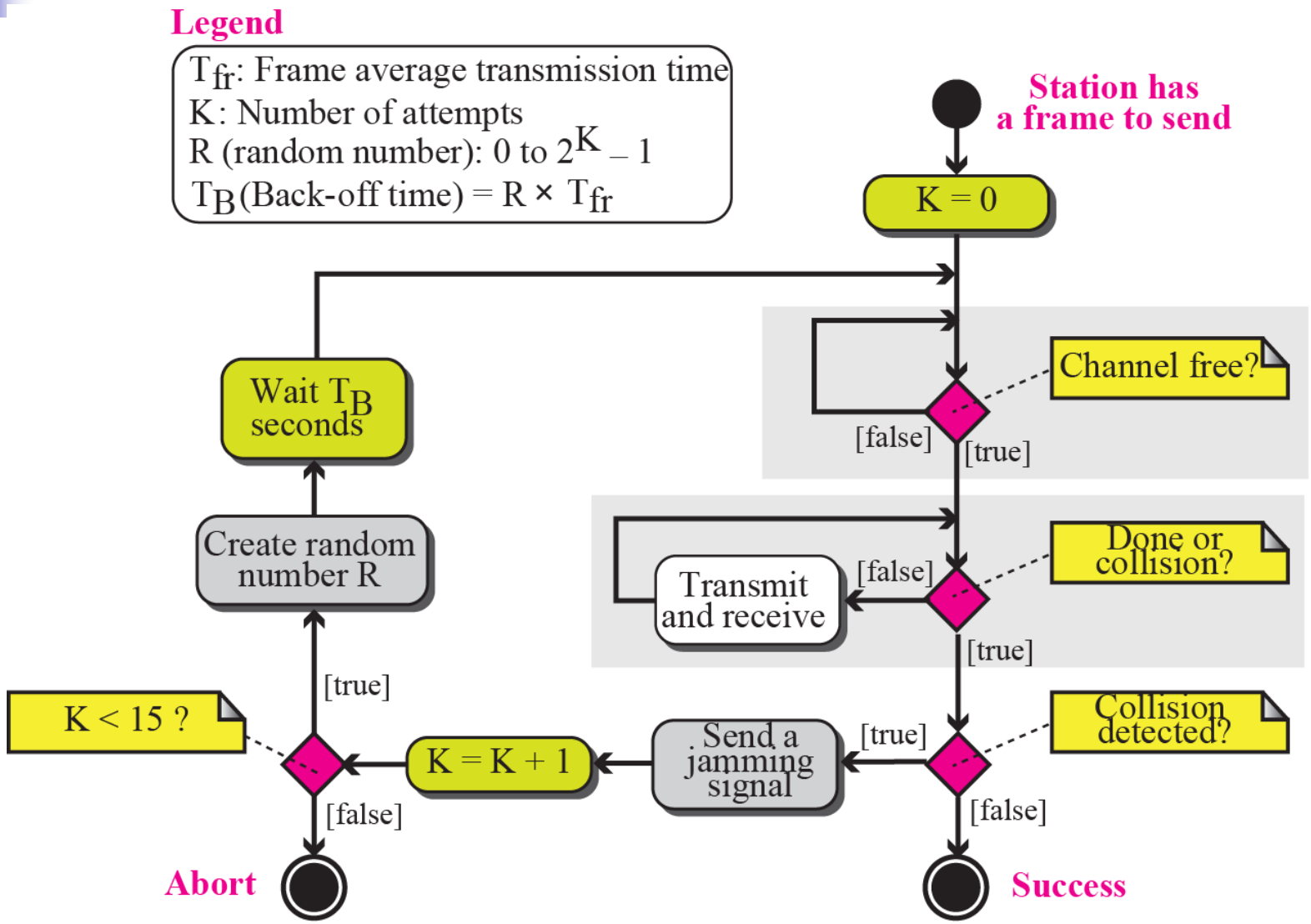
Example 3.3

In the standard Ethernet, if the maximum propagation time is 25.6 μs, what is the minimum size of the frame?

Solution

The frame transmission time is $T_{fr} = 2 \times T_p = 51.2$ μs. This means, in the worst case, a station needs to transmit for a period of 51.2 μs to detect the collision. The minimum size of the frame is 10 Mbps × 51.2 μs = 512 bits or 64 bytes. This is actually the minimum size of the frame for Standard Ethernet, as we discussed before.

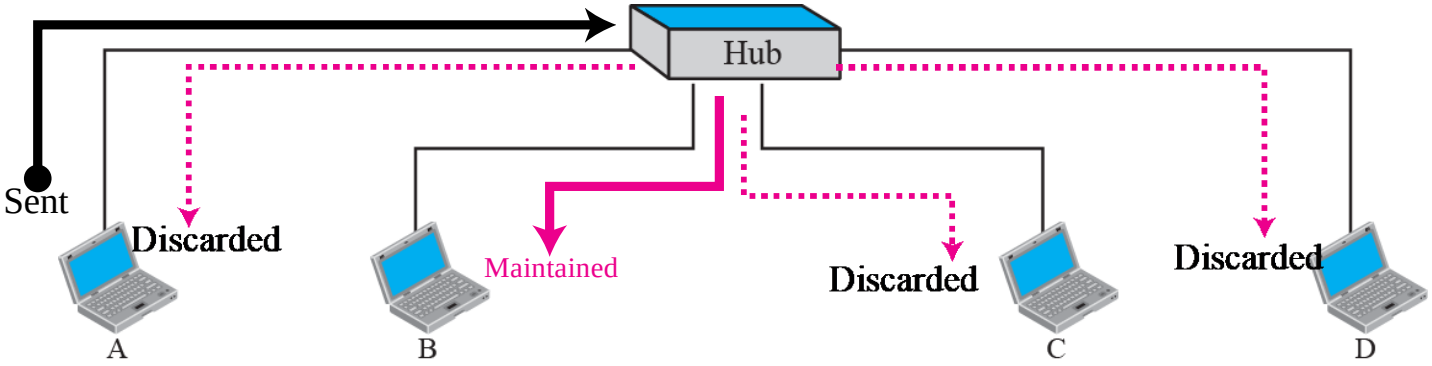
Figure 3.9 *CSMA/CD flow diagram*



3-5 CONNECTING DEVICES

LANs or WANs do not normally operate in isolation. They are connected to one another or to the Internet. To connect LANs and WANs together we use connecting devices. Connecting devices can operate in different layers of the Internet model. We discuss three kinds of connecting devices: repeaters (or hubs), bridges (or two-layer switches), and routers (or three-layer switches).

Figure 3.41 *Repeater or hub*



Note

A repeater forwards every bit; it has no filtering capability.

Note

A bridge has a table used in filtering decisions.

Note

A bridge does not change the physical (MAC) addresses in a frame.

Figure 3.42 *Bridge*

Bridge table

Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	2
64:2B:13:45:61:12	3
64:2B:13:45:61:13	4

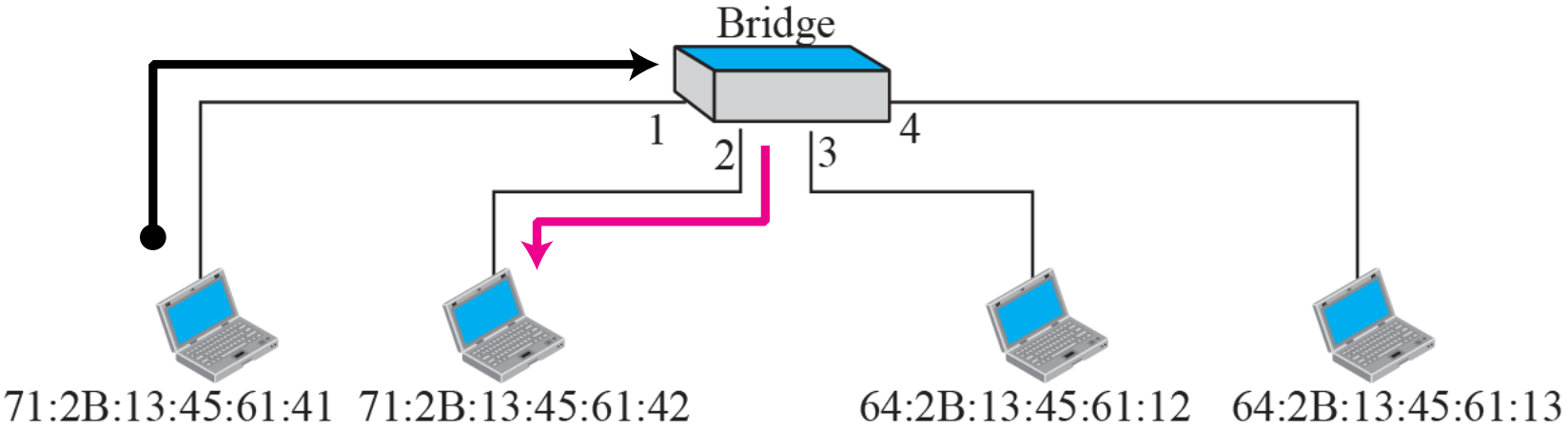


Figure 3.43 *Learning bridge*

Gradual building of Table

Address	Port

a. Original

Address	Port
71:2B:13:45:61:41	1

b. After A sends a frame to D

Address	Port
71:2B:13:45:61:41	1
64:2B:13:45:61:13	4

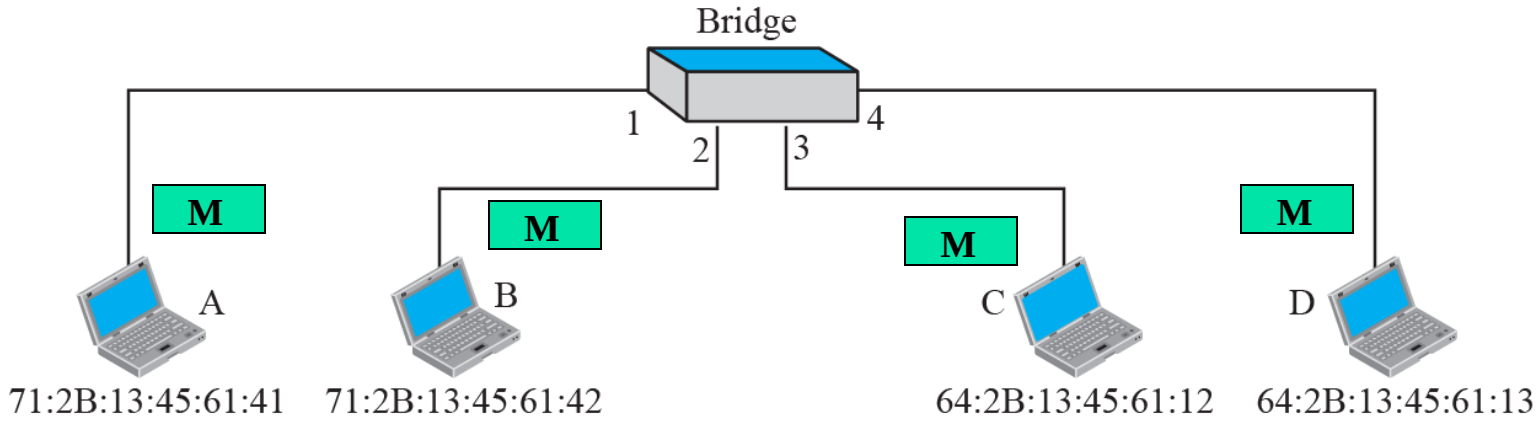
c. After D sends a frame to B

Address	Port
71:2B:13:45:61:41	1
64:2B:13:45:61:13	4
71:2B:13:45:61:42	2

d. After B sends a frame to A

Address	Port
71:2B:13:45:61:41	1
64:2B:13:45:61:13	4
71:2B:13:45:61:42	2
64:2B:13:45:61:12	3

e. After C sends a frame to D

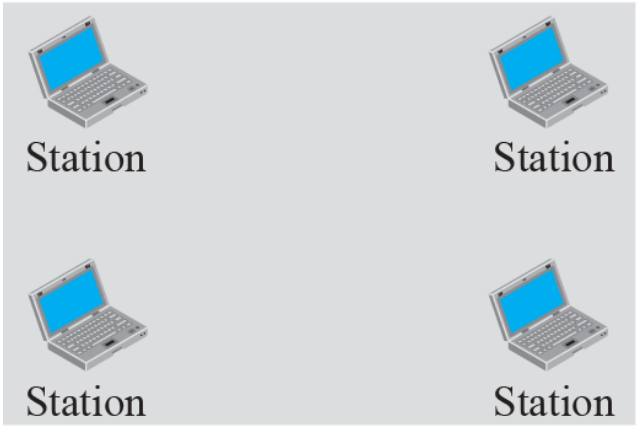


3-2 WIRELESS LANS

Wireless communication is one of the fastest growing technologies. The demand for connecting devices without the use of cables is increasing everywhere. Wireless LANs can be found on college campuses, in office buildings, and in many public areas. In this section, we concentrate on two wireless technologies for LANs: IEEE 802.11 wireless LANs

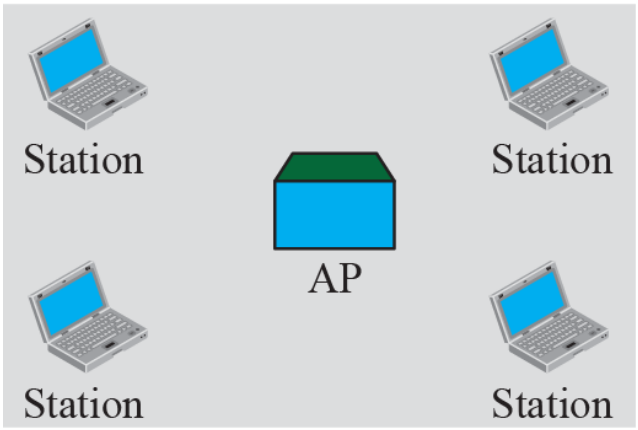
Figure 3.13 *Basic service sets (BSSs)*

BSS: Basic service set



Ad hoc network (BSS without an AP)

AP: Access point



Infrastructure (BSS with an AP)

Figure 3.14 *Extended service sets (ESSs)*

ESS: Extended service set
BSS: Basic service set
AP: Access point

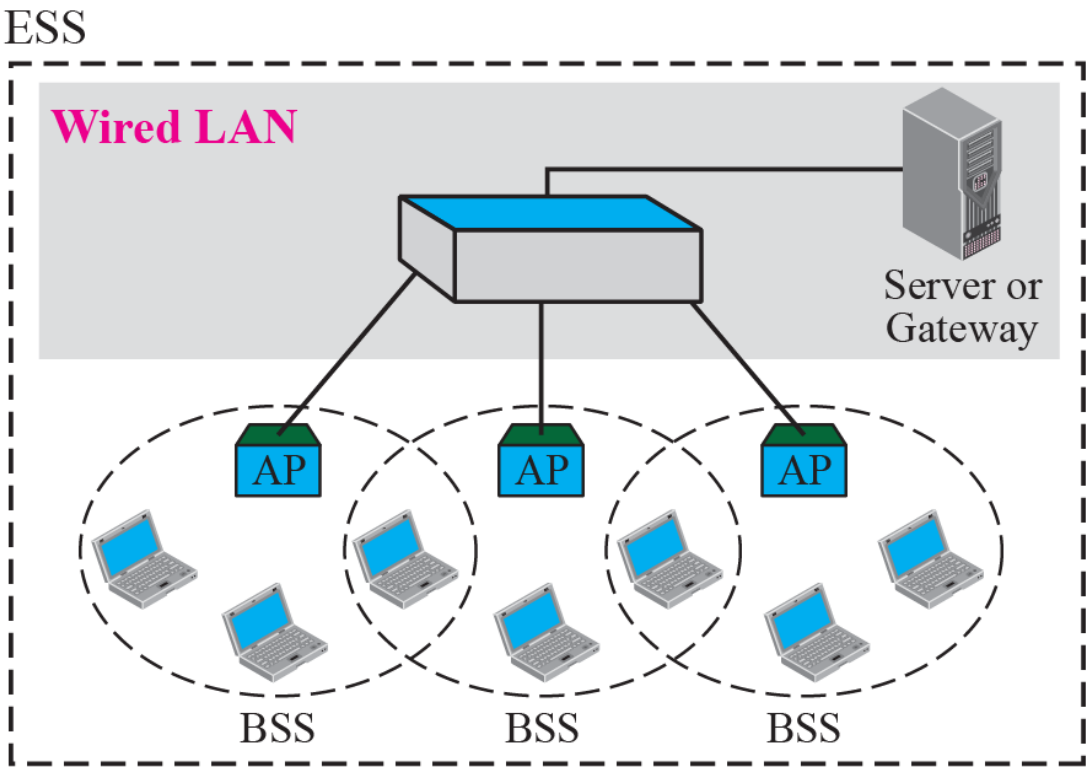


Figure 3.17 *Frame format*

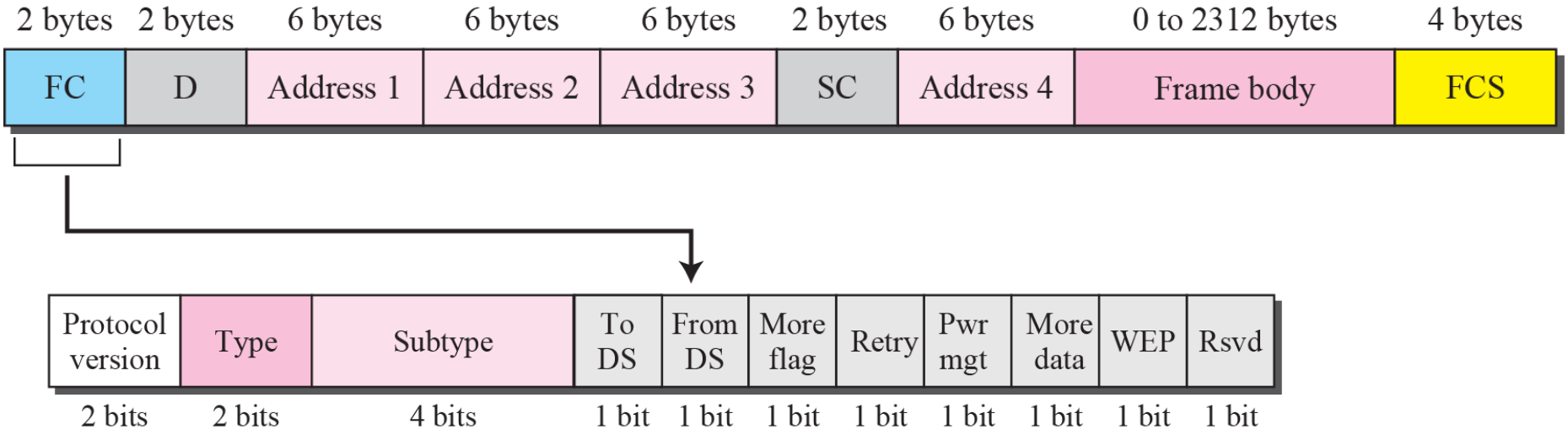
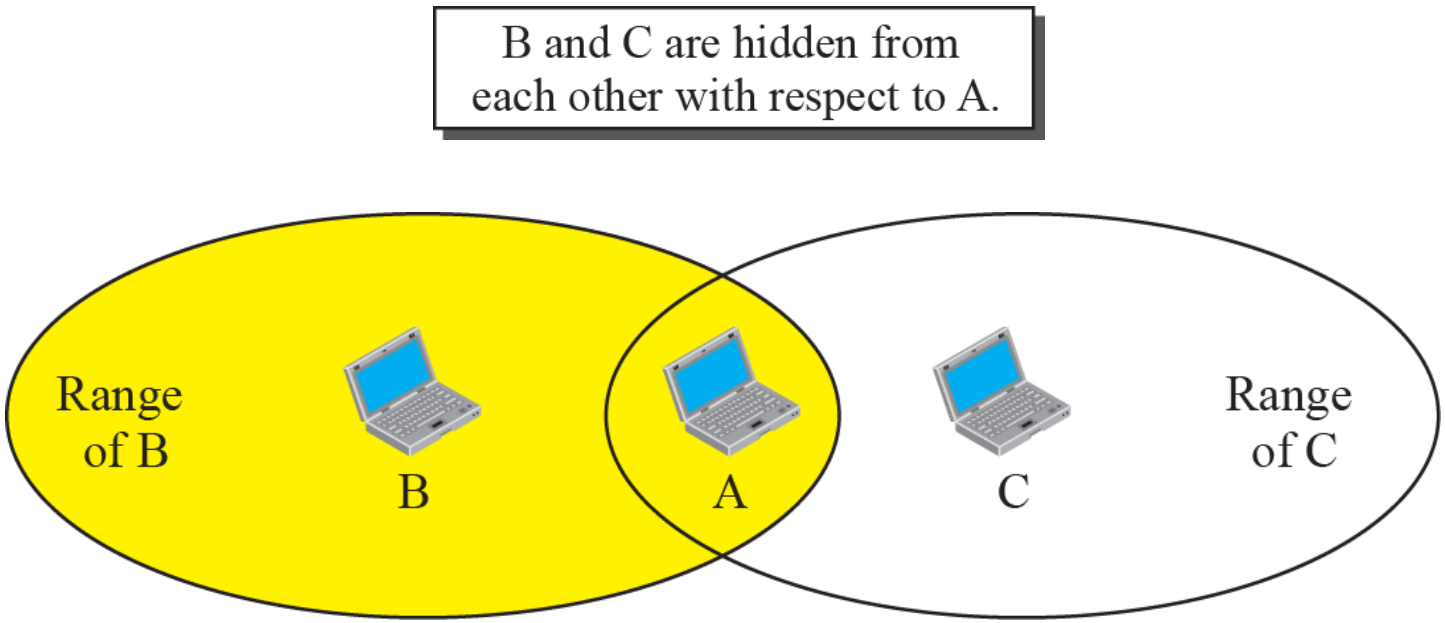


Table 3.7 *Addresses*

To DS	*From DS*	*Address 1*	*Address 2*	*Address 3*	*Address 4*
0	0	Destination	Source	BSS ID	N/A
0	1	Destination	Sending AP	Source	N/A
1	0	Receiving AP	Source	Destination	N/A
1	1	Receiving AP	Sending AP	Destination	Source

Figure 3.19 *Hidden station problem*



Note

The CTS frame in CSMA/CA handshake can prevent collision from a hidden station.

Figure 3.15 *CSMA/CA flow diagram*

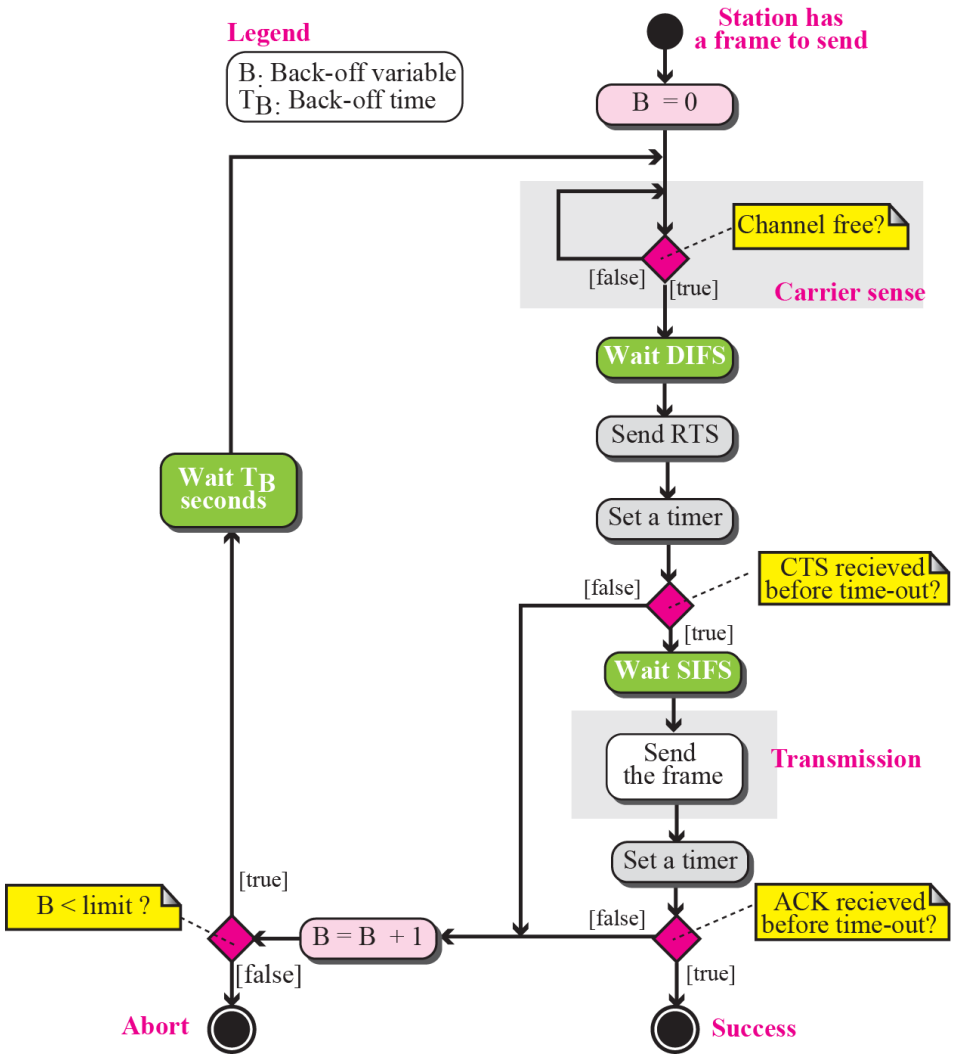


Figure 3.16 *CSMA/CA and NAV*

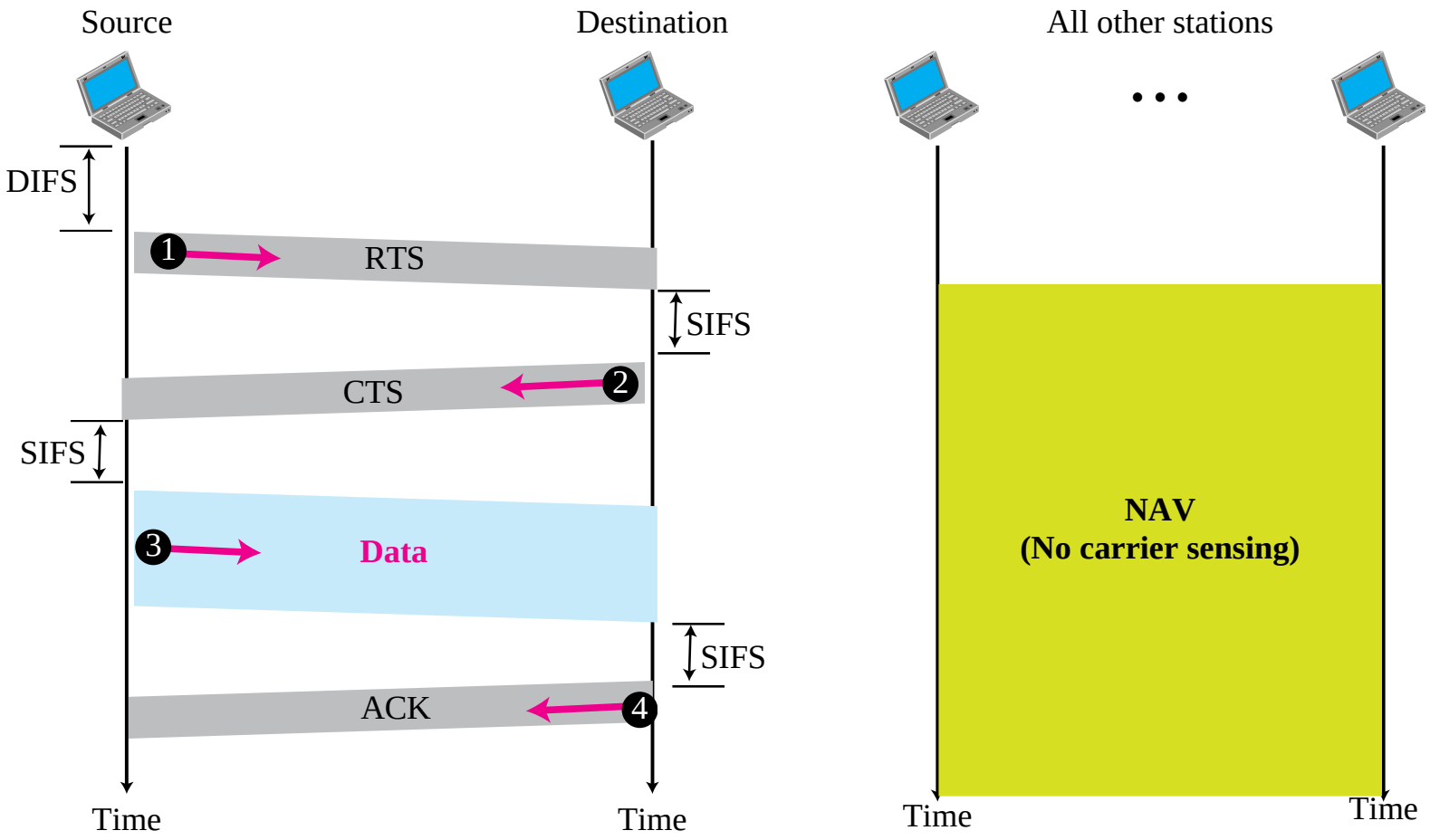


Figure 3.20 *Use of handshaking to prevent hidden station problem*