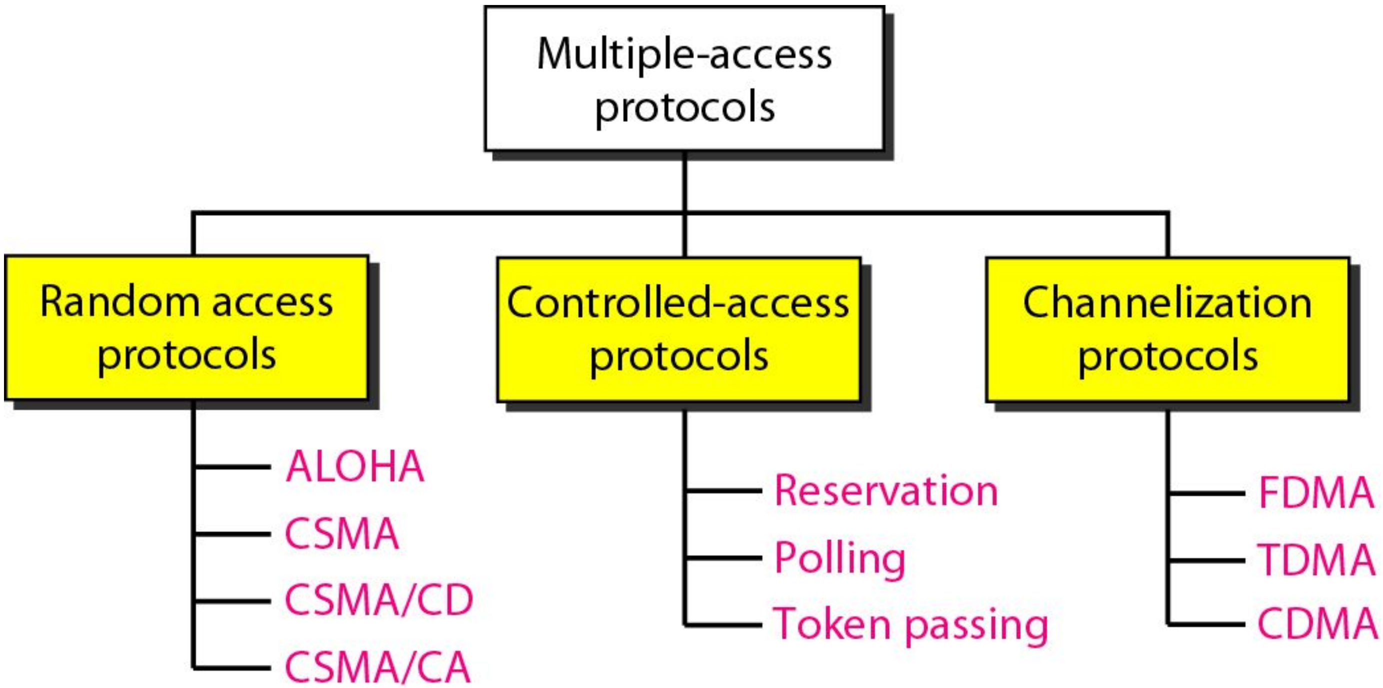
Chapter 12

Multiple Access

Figure 12.2 *Taxonomy of multiple-access protocols discussed in this chapter*



12-1 RANDOM ACCESS

In random access or contention methods, no station is superior to another station and none is assigned the control over another. No station permits, or does not permit, another station to send. At each instance, a station that has data to send uses a procedure defined by the protocol to make a decision on whether or not to send.

Topics discussed in this section:

ALOHA
Carrier Sense Multiple Access
Carrier Sense Multiple Access with Collision Detection
Carrier Sense Multiple Access with Collision Avoidance

Figure 12.8 *Space/time model of the collision in CSMA*

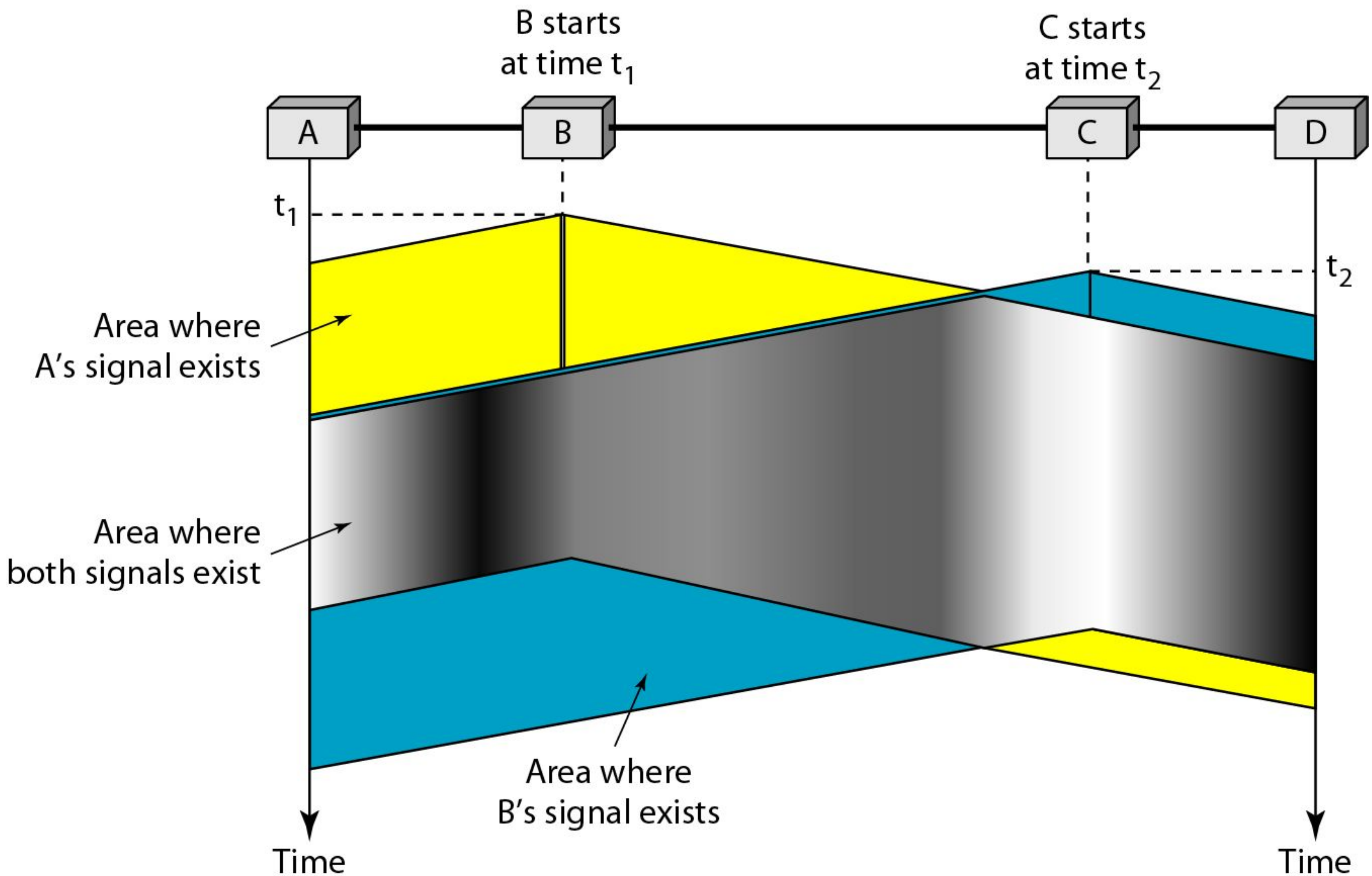


Figure 12.9 *Vulnerable time in CSMA*

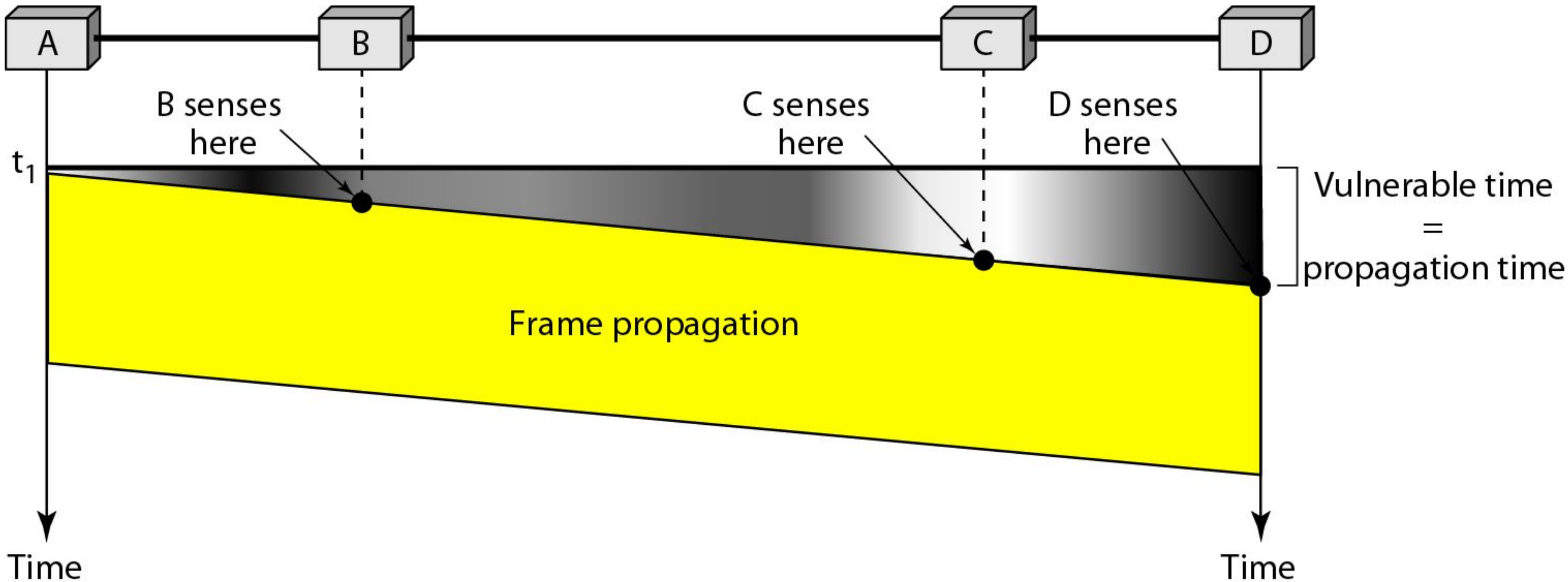


Figure 12.10 *Behavior of three persistence methods*

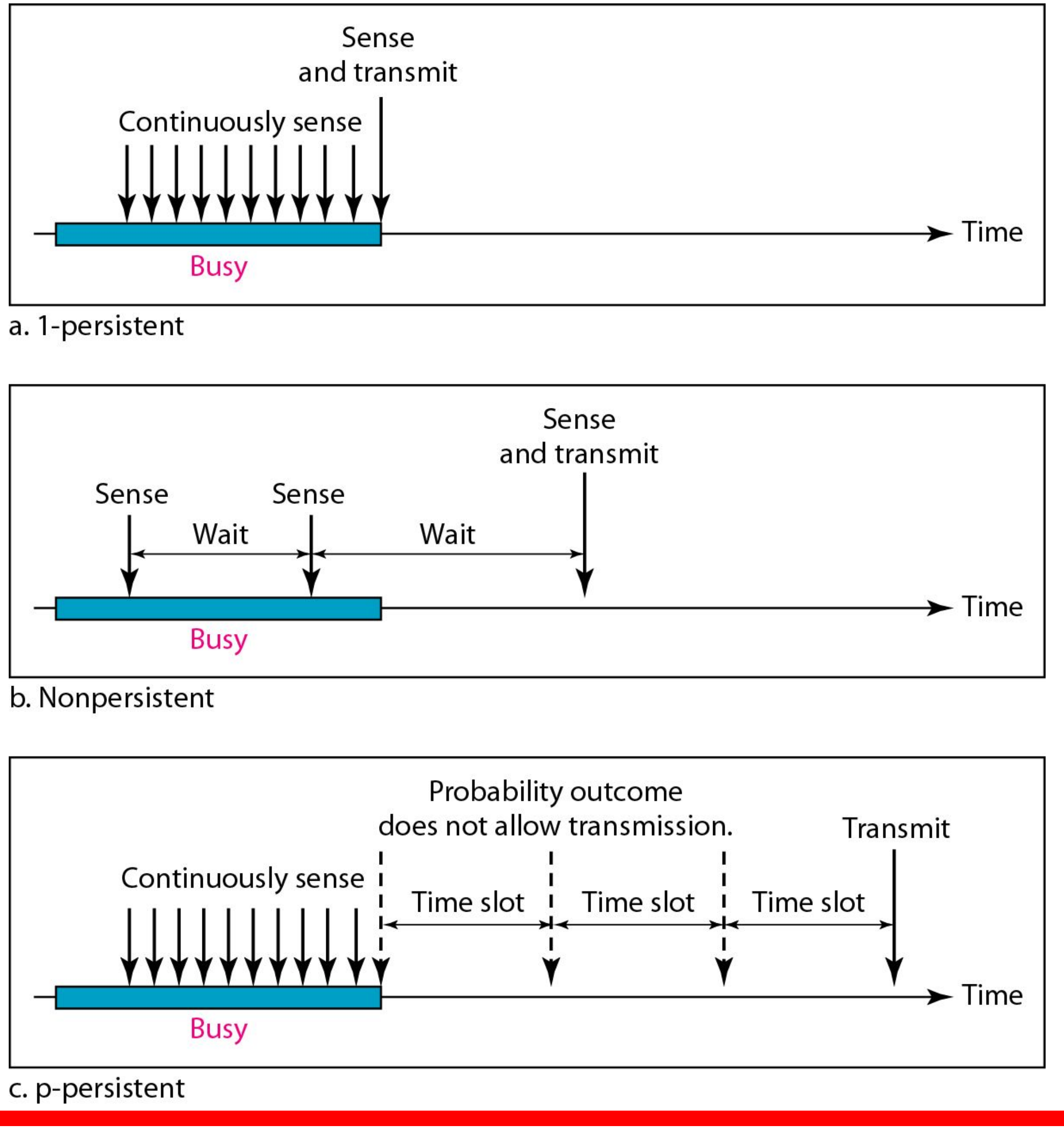


Figure 12.11 *Flow diagram for three persistence methods*

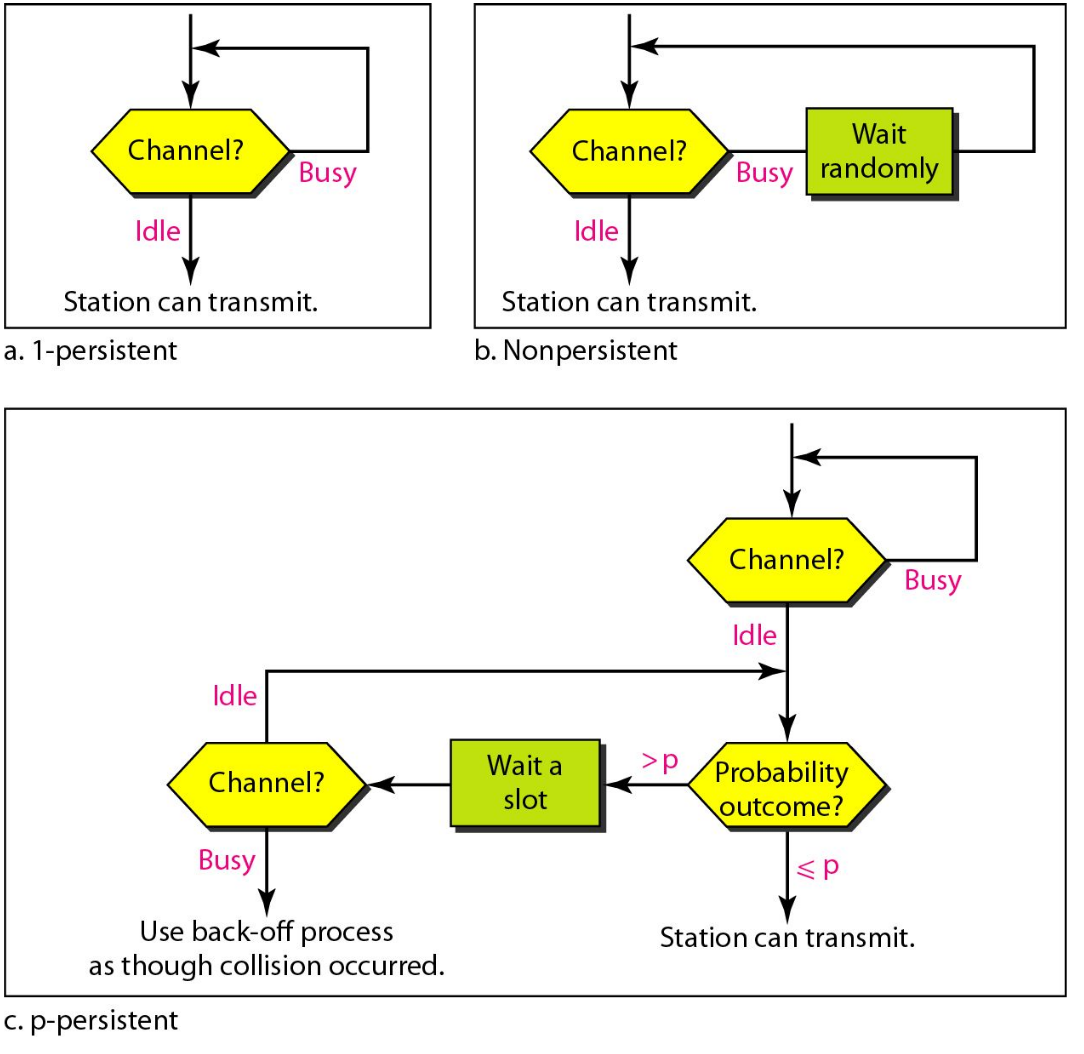


Figure 12.12 *Collision of the first bit in CSMA/CD*

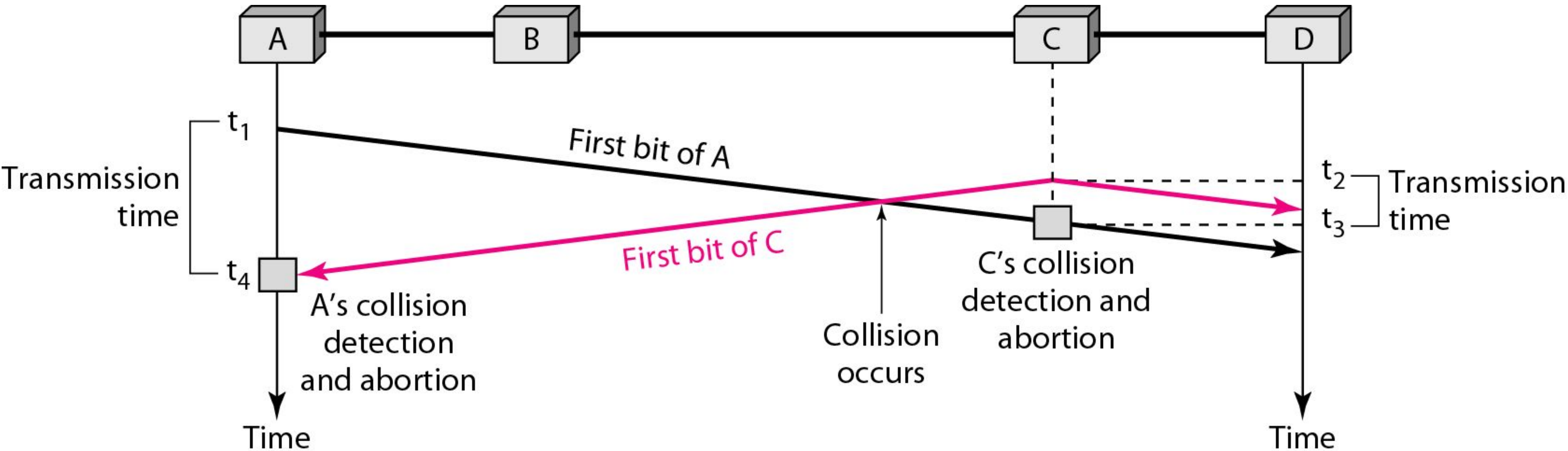
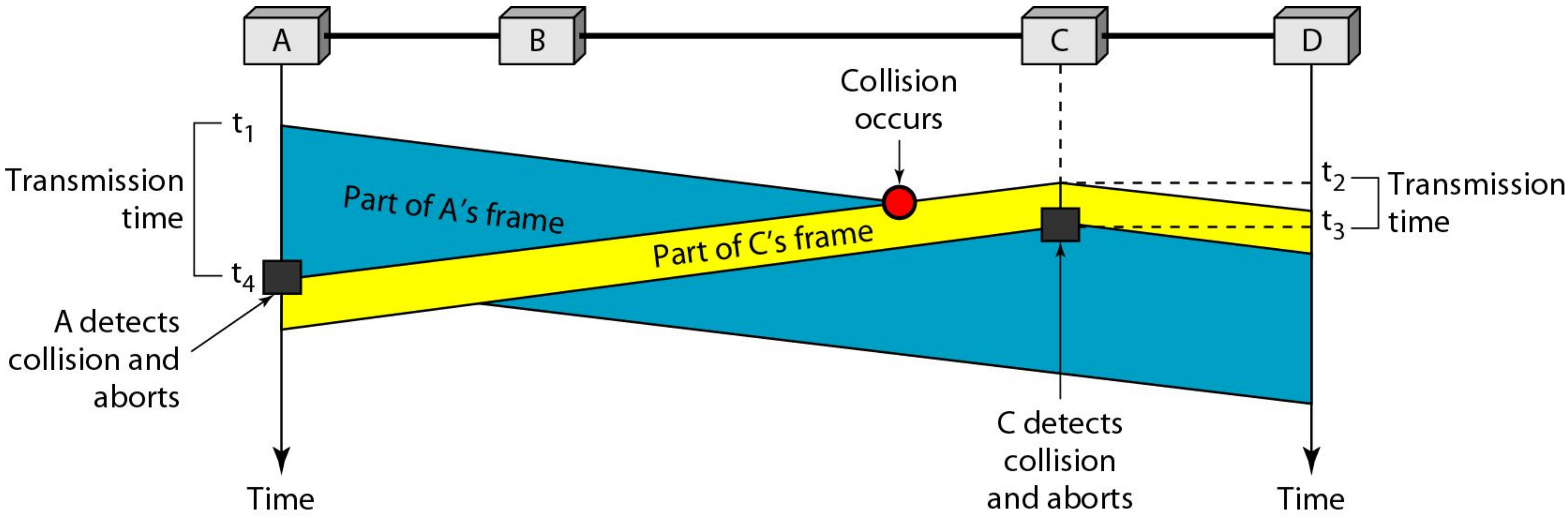


Figure 12.13 *Collision and abortion in CSMA/CD*



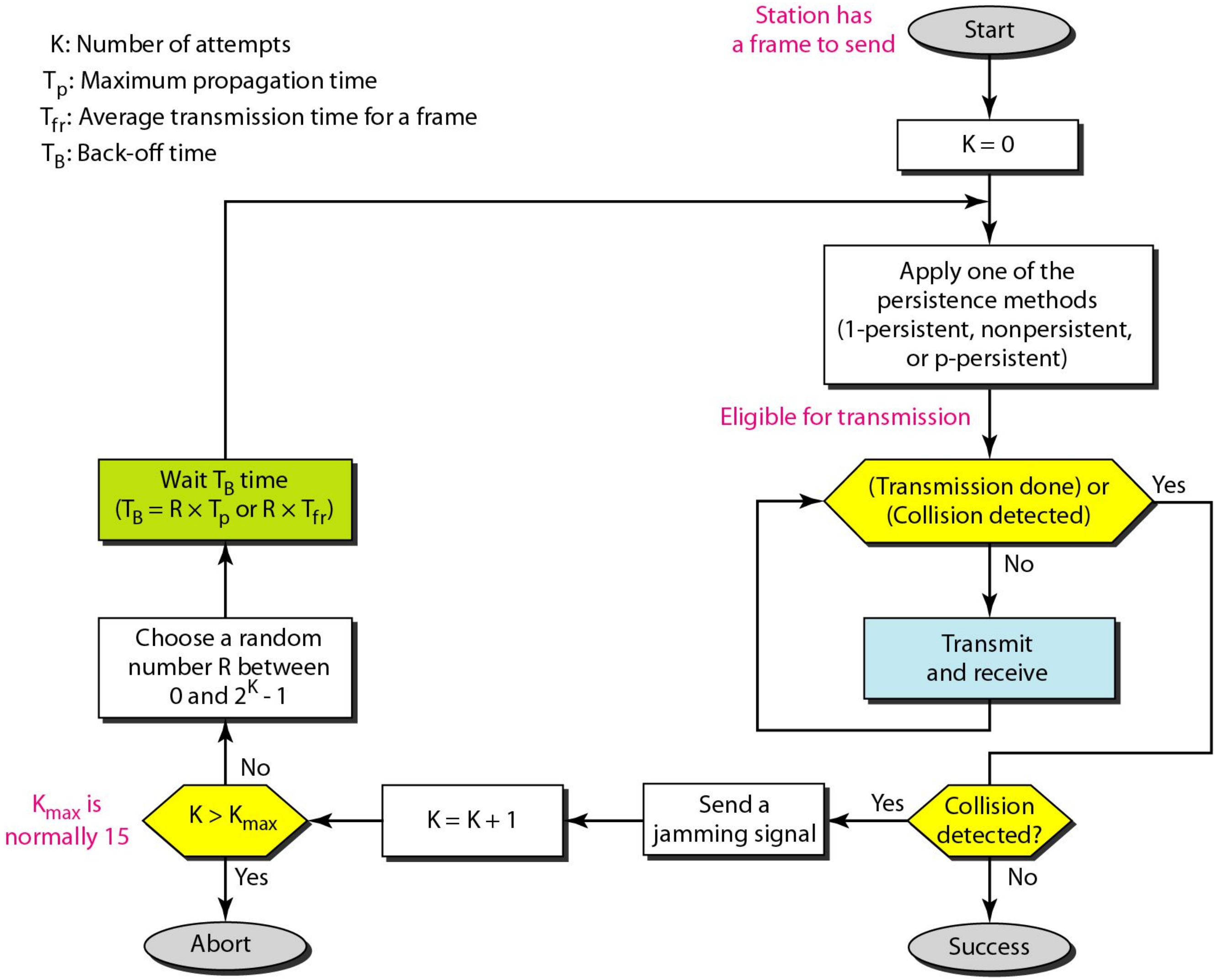
Example 12.5

A network using CSMA/CD has a bandwidth of 10 Mbps. If the maximum propagation time (including the delays in the devices and ignoring the time needed to send a jamming signal, as we see later) is 25.6 μs, what is the minimum size of the frame?

Solution

The frame transmission time is $T_{fr} = 2 \times T_p = 51.2\ \mu s$. 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.

Figure 12.14 *Flow diagram for the CSMA/CD*

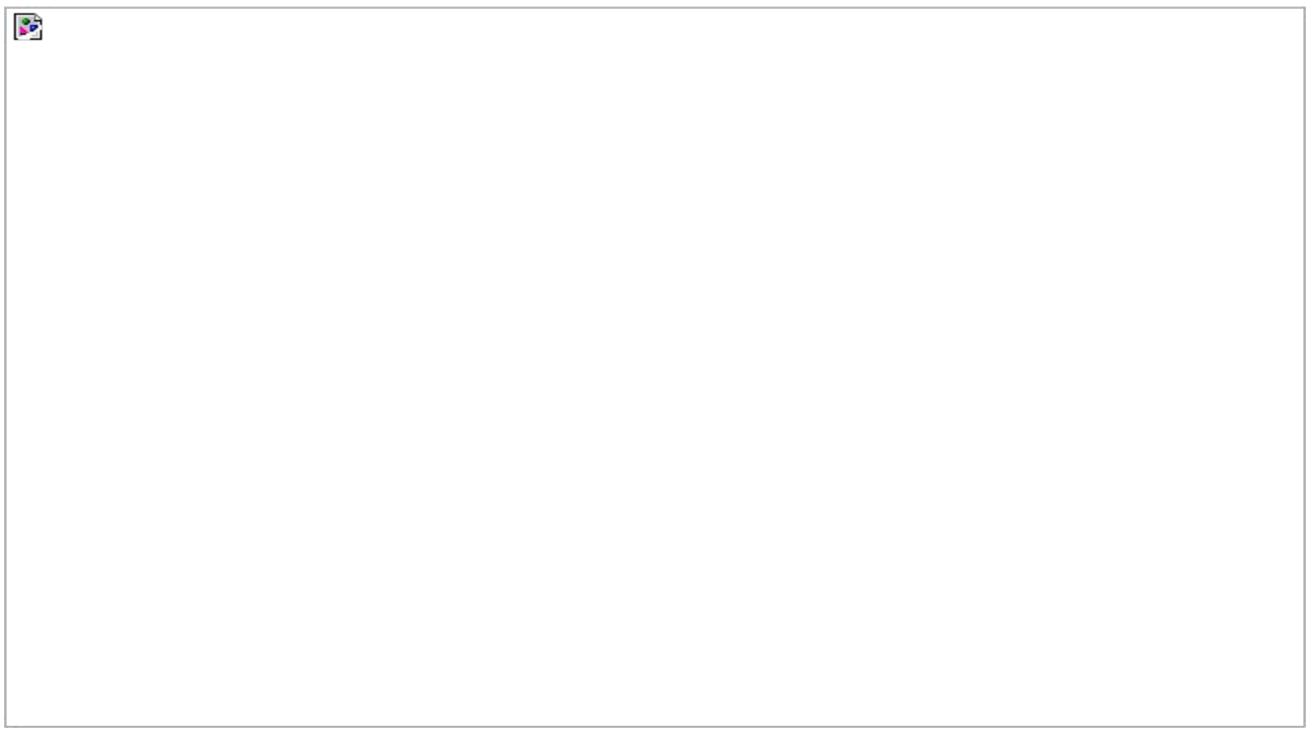


BackOff Algorithm

- Back-off algorithm is a **collision resolution** mechanism which is used in random access MAC protocols (CSMA/CD). This algorithm is generally used in Ethernet to schedule re-transmissions after collisions.

- If a collision takes place between 2 stations, they may restart transmission as soon as they can after the collision. This will always lead to another collision and form an infinite loop of collisions leading to a deadlock. To prevent such scenario back-off algorithm is used.

- Let us consider a scenario of 2 stations A and B transmitting some data:
- After a collision, time is divided into discrete slots (**T**$_{\text{slot}}$) whose length is equal to 2t, where t is the maximum propagation delay in the network.



Algorithm

- Waiting time = back–off time
- Let n = collision number or re-transmission serial number.
- Then,
- Waiting time = K * Tslot
- where K = $[0, 2^n - 1]$

- **Case-1 :**
  Suppose 2 stations A and B start transmitting data (Packet 1) at the same time then, collision occurs. So, the collision number n for both their data (Packet 1) = 1. Now, both the station randomly pick an integer from the set K i.e. {0, 1}.

Probability that A wins = 1/4

Probability that B wins = 1/4

- **Case-2 :**
  Assume that A wins in Case 1 and transmitted its data(Packet 1). Now, as soon as B transmits its packet 1, A transmits its packet 2. Hence, collision occurs. Now collision no. n becomes 1 for packet 2 of A and becomes 2 for packet 1 of B.
  For packet 2 of A, K = {0, 1}
  For packet 1 of B, K = {0, 1, 2, 3}

Probability that A wins = 5/8

Probability that B wins = 1/8

Probability of collision = 2/8

Advantage –

- Collision probability decreases exponentially.

Disadvantages –

- **Capture effect:** Station who wins ones keeps on winning.
- Works only for 2 stations or hosts.