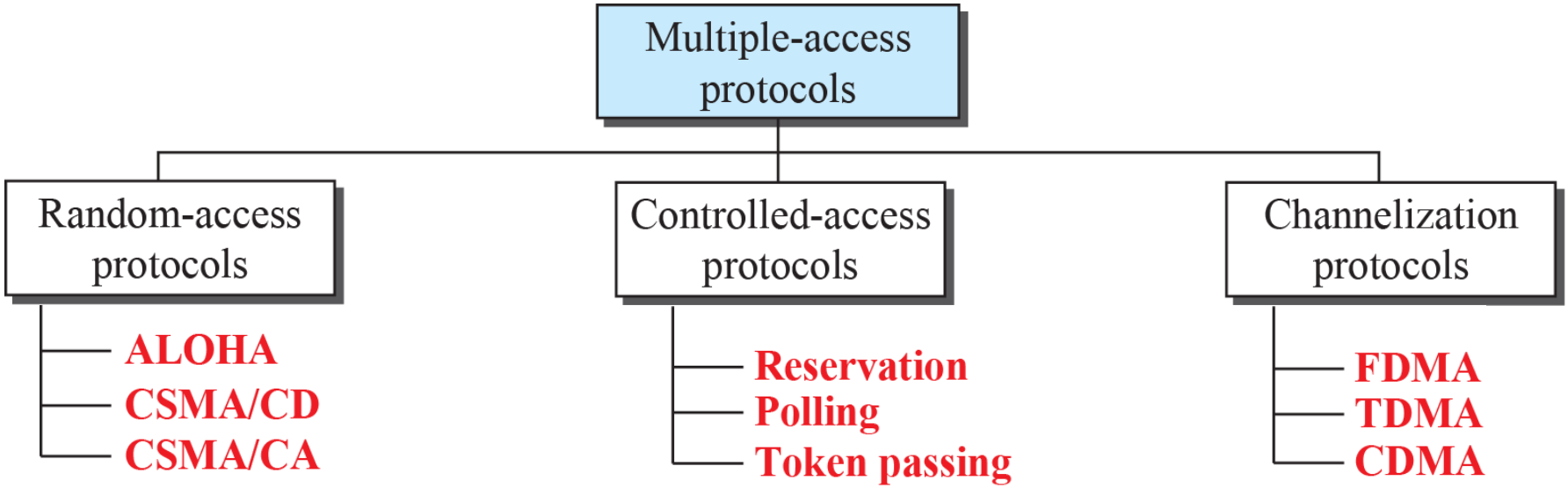
Chapter 12

Media Access Control (MAC)

Taxonomy of multiple-access protocols



RANDOM ACCESS

- or contention

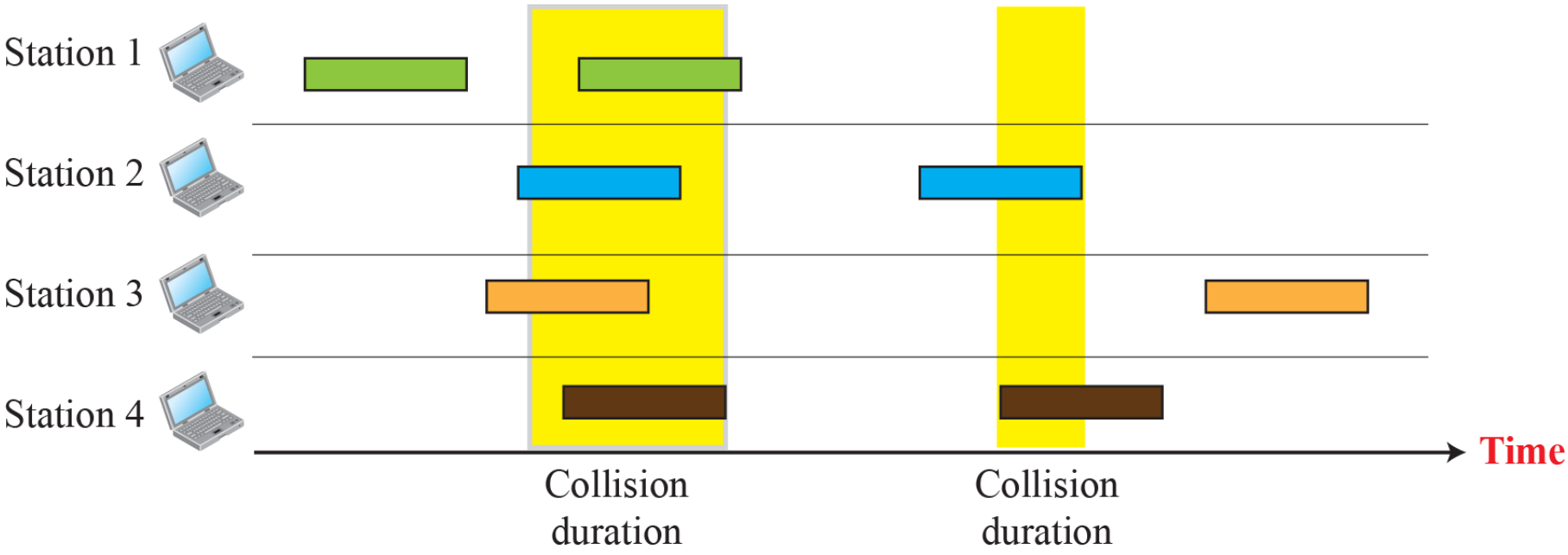
- at each instance, a station that has data to send uses a procedure defined by the protocol to make a decision on whether or not to send.

- this decision depends on the state of the medium (idle or busy).

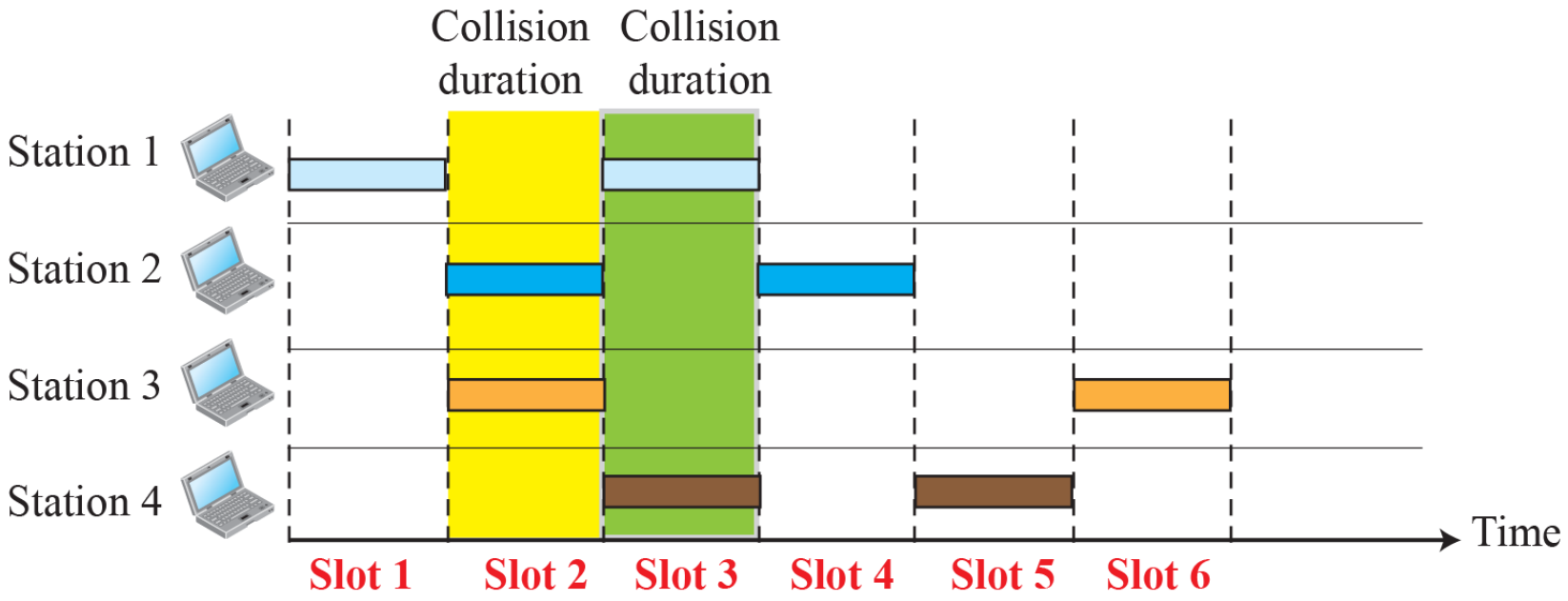
ALOHA

- the earliest random access method
- was developed at the University of Hawaii in early 1970.
- It was designed for a radio (wireless) LAN, but it can be used on any shared medium.
- It is obvious that there are potential collisions in this arrangement.
- The medium is shared between the stations. When a station sends data, another station may attempt to do so at the same time.
- The data from the two stations collide and become garbled.

Frames in a pure ALOHA network



Frames in a slotted ALOHA network

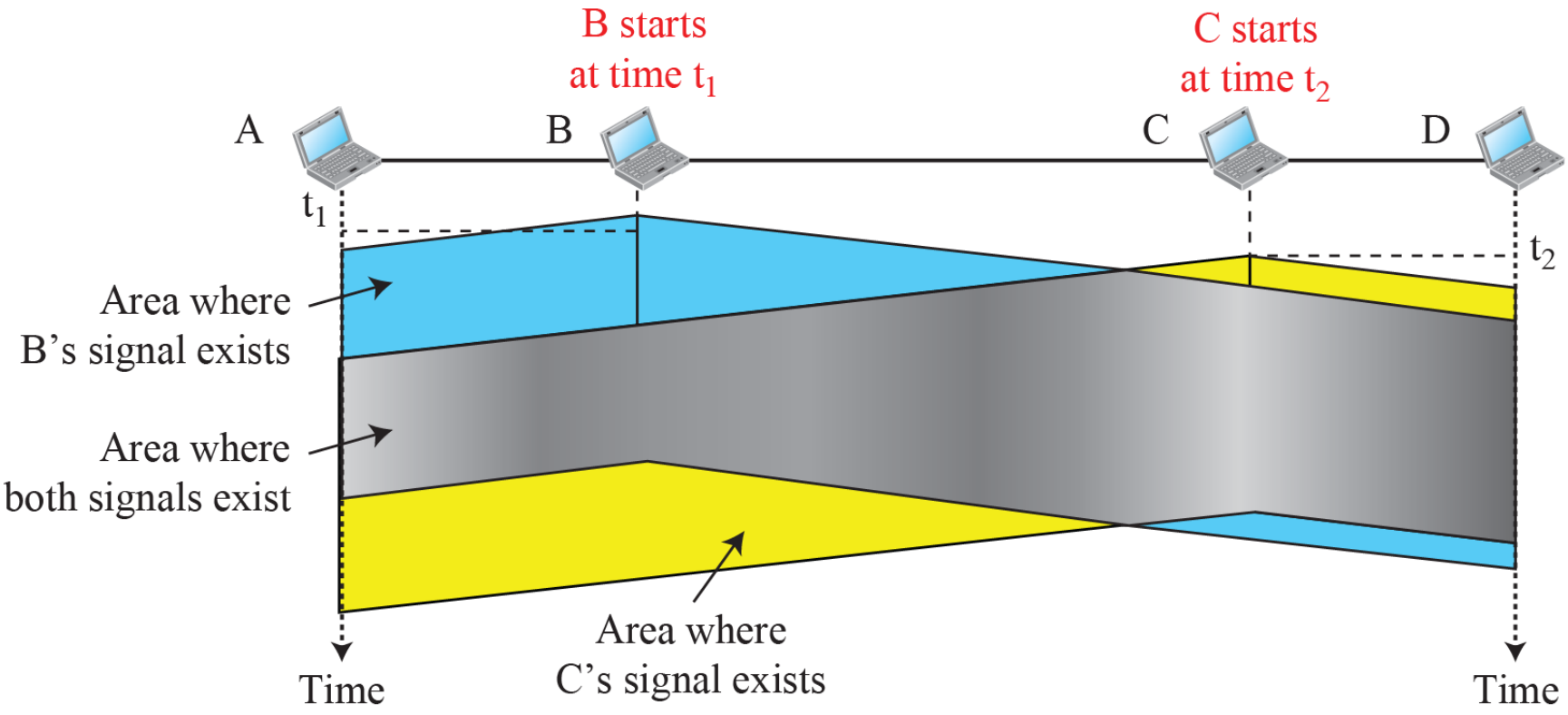


CSMA

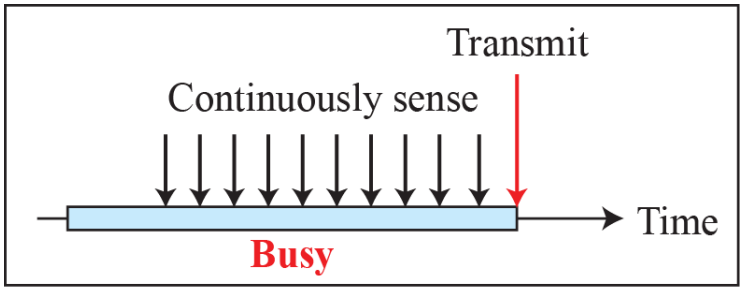
- **The chance of collision can be reduced if a station senses the medium before trying to use it.**
- **Carrier sense multiple access (CSMA) requires that each station first listen to the medium (or check the state of the medium) before sending.**

- **In other words, CSMA is based on the principle "sense before transmit" or "listen before talk."**

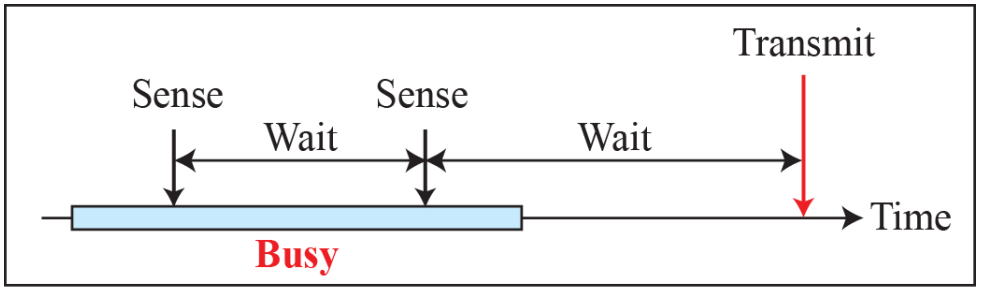
Space/time model of a collision in CSMA



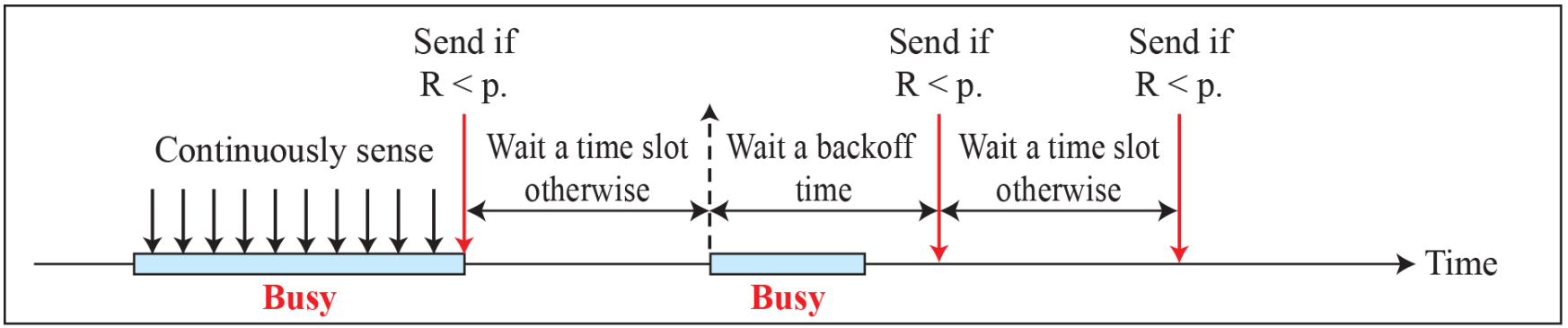
Behavior of three persistence methods



a. 1-persistent



b. Nonpersistent



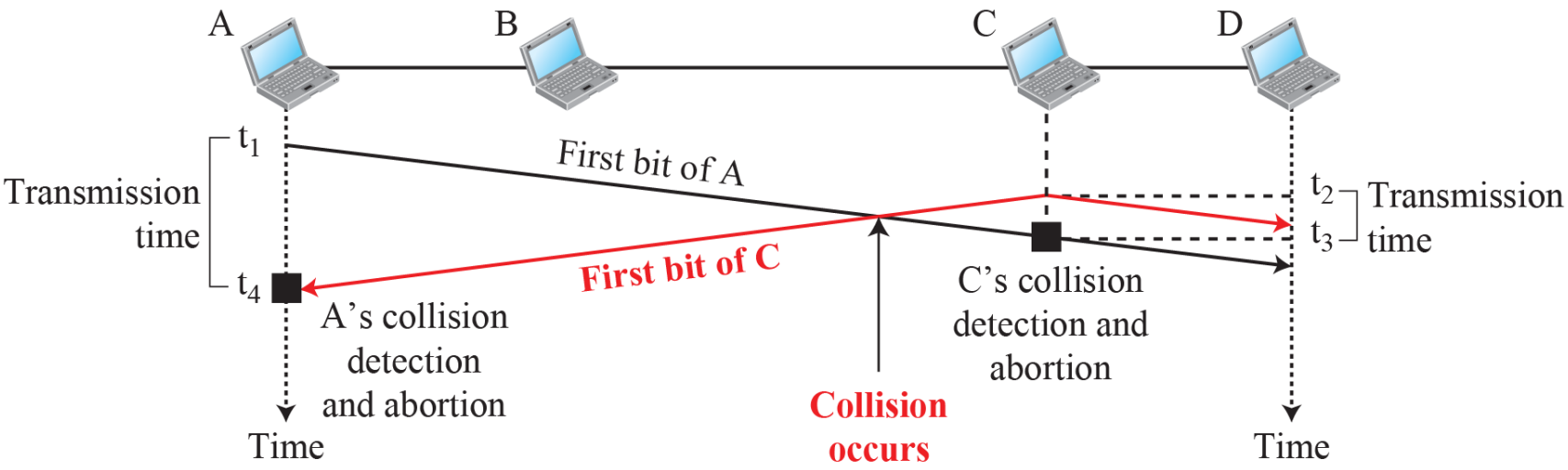
c. *p*-persistent

CSMA/CD

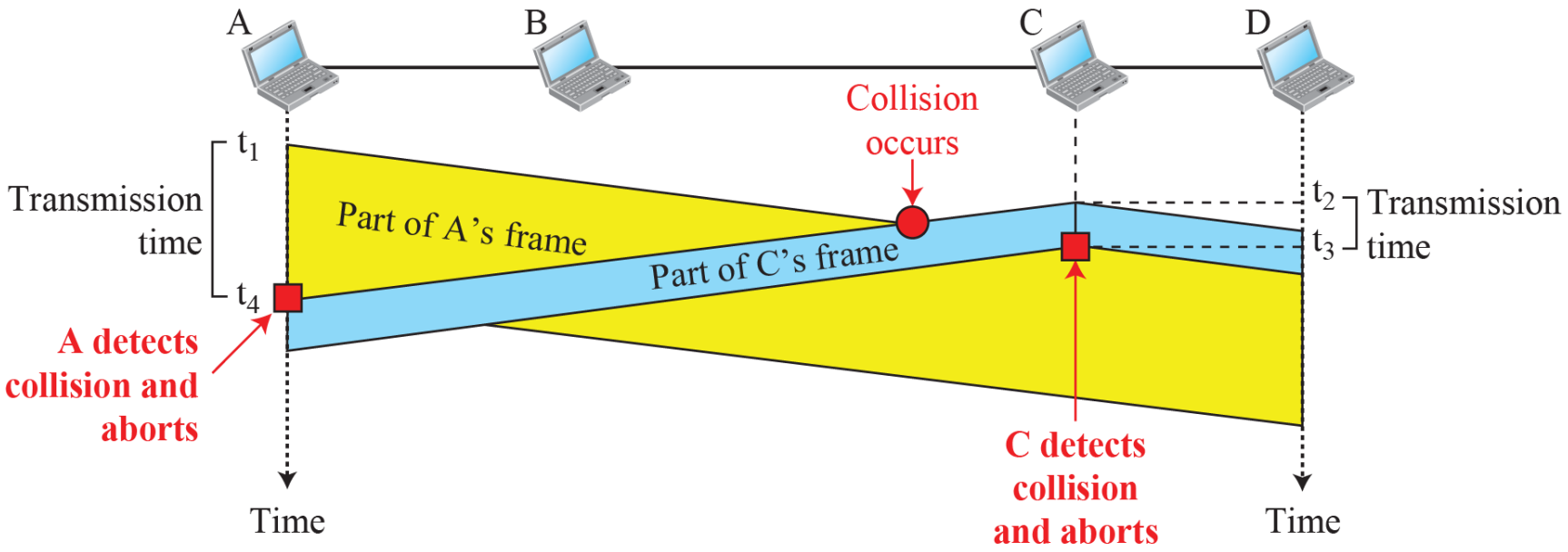
- a station monitors the medium after it sends a frame to see if the transmission was successful.

- If so, the station is finished. If, however, there is a collision, the frame is sent again.

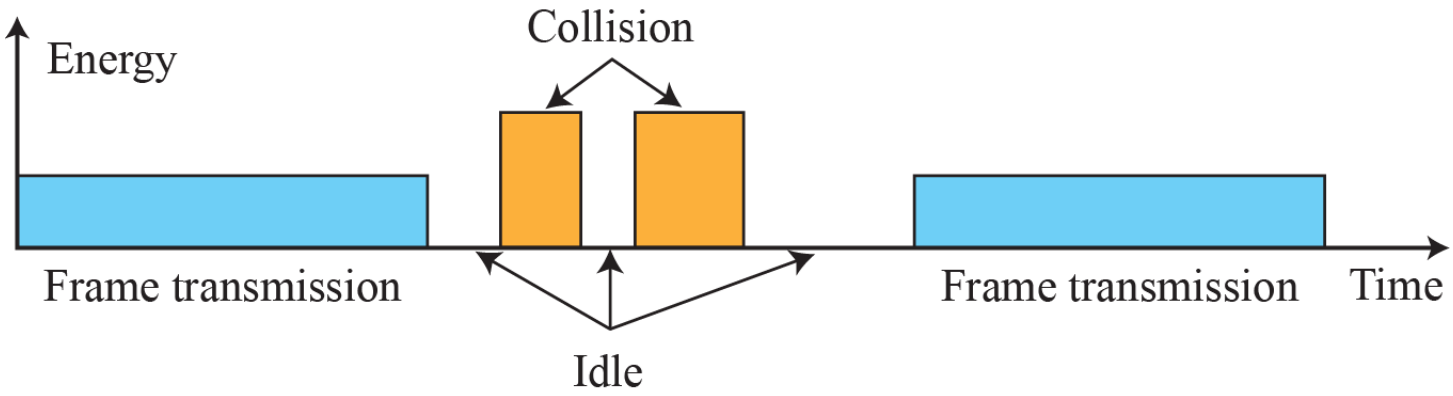
Collision of the first bits in CSMA/CD



Collision and abortion in CSMA/CD



Energy level during transmission, idleness, or collision

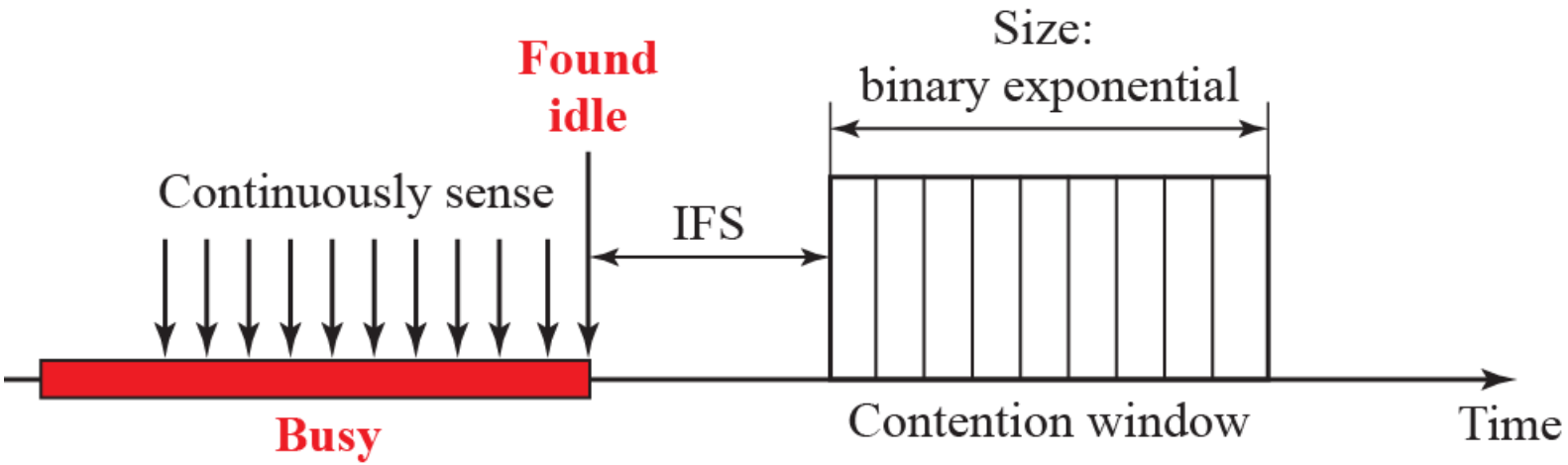


CSMA/CA

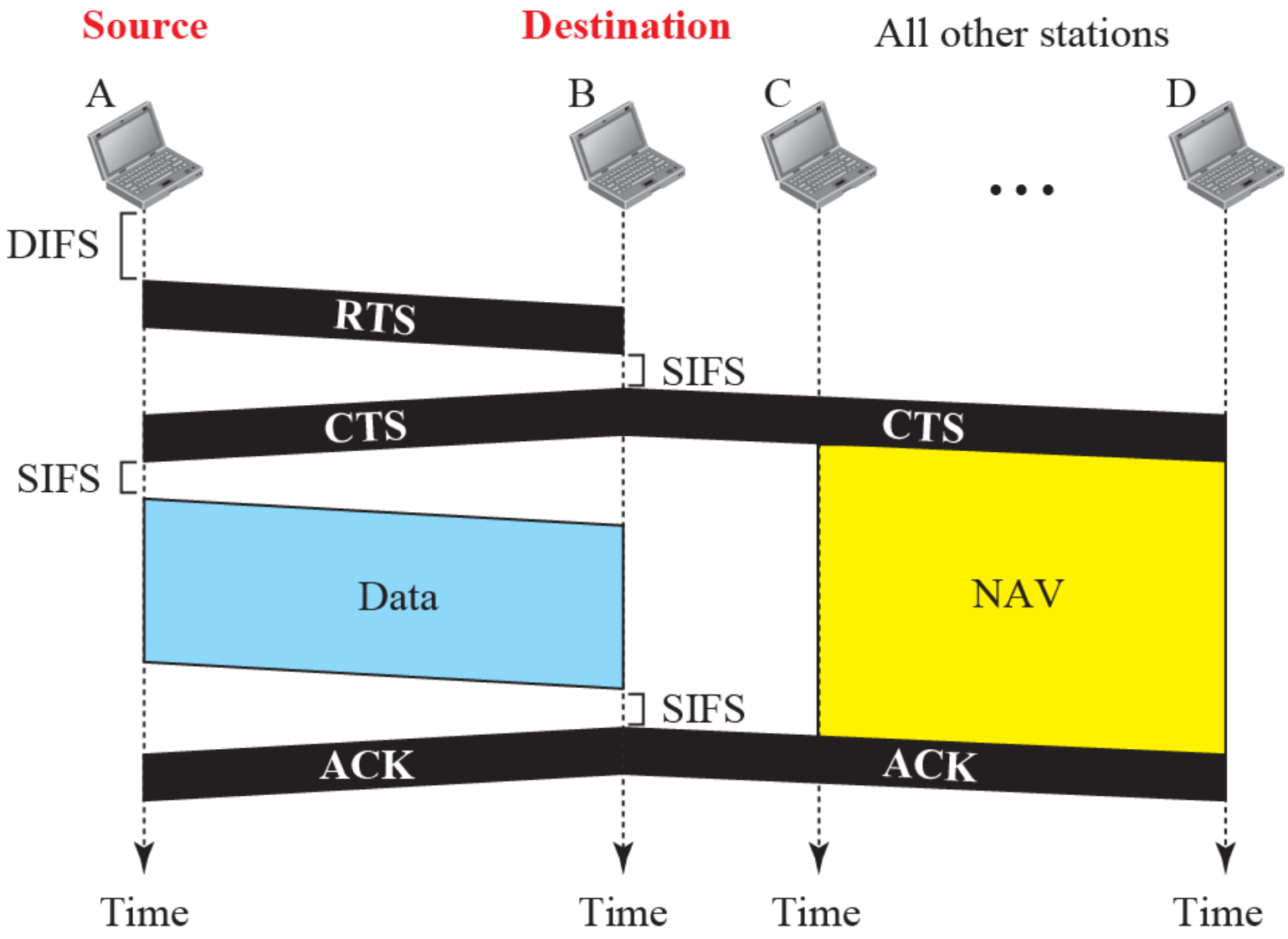
- was invented for wireless networks.

- Collisions are avoided through the use of CSMA/CA's three strategies:
  - the interframe space
  - the contention window
  - acknowledgments

Contention window



CMACA and NAV



CONTROLLED ACCESS

- the stations consult one another to find which station has the right to send.

- a station cannot send unless it has been authorized by other stations.

- three controlled-access methods.

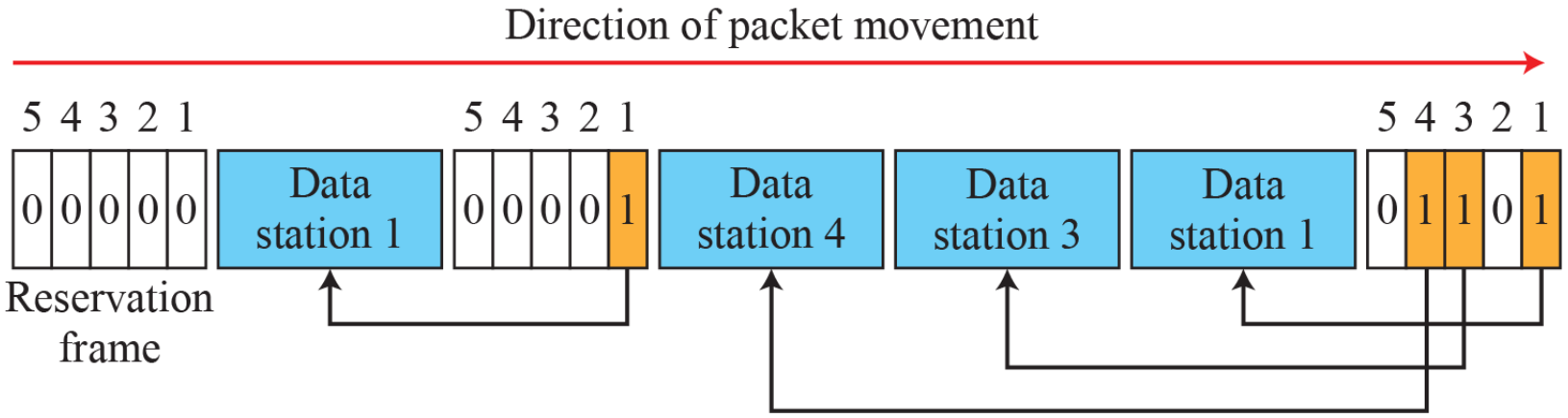
Reservation

- a station needs to make a reservation before sending data.

- Time is divided into intervals.

- In each interval, a reservation frame precedes the data frames sent in that interval.

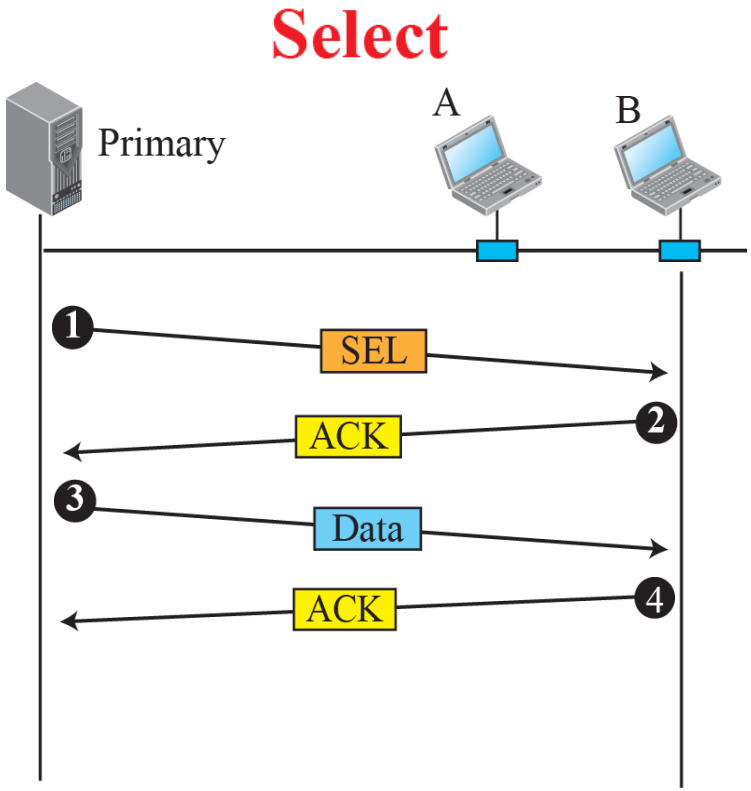
Reservation access method

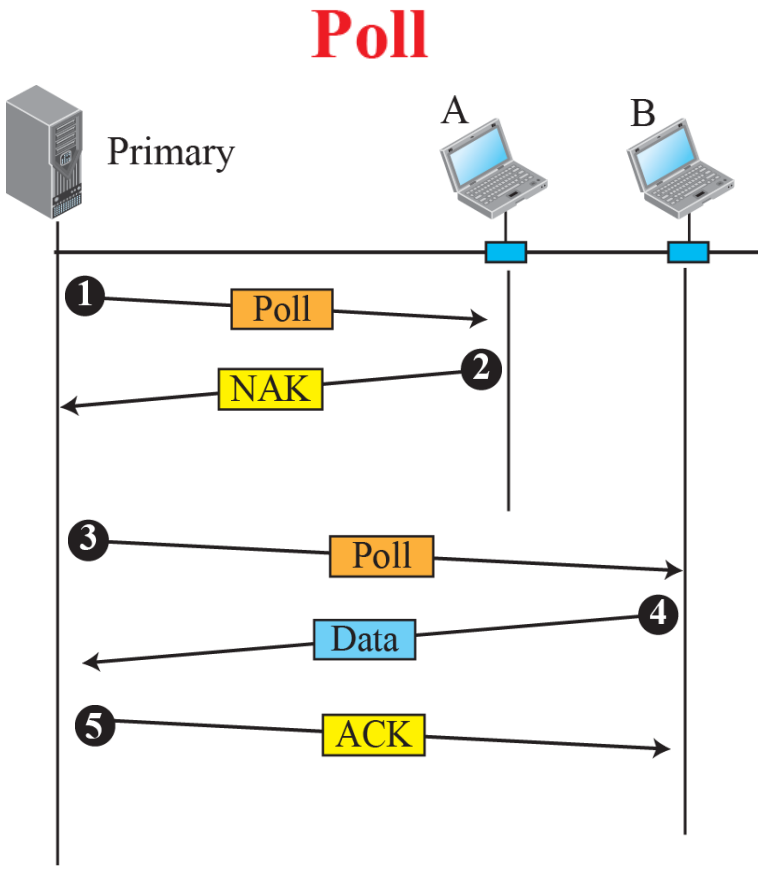


Polling

- Polling works with topologies in which one device is designated as a primary station and the other devices are secondary stations.
- All data exchanges must be made through the primary device even when the ultimate destination is a secondary device.
- The primary device controls the link; the secondary devices follow its instructions.
- It is up to the primary device to determine which device is allowed to use the channel at a given time.

Select and poll functions in polling-access method





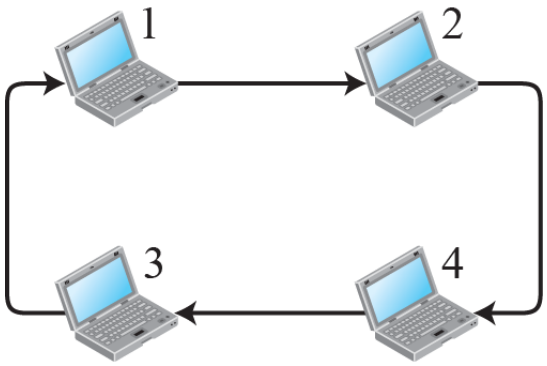
Token Passing

- the stations in a network are organized in a logical ring.

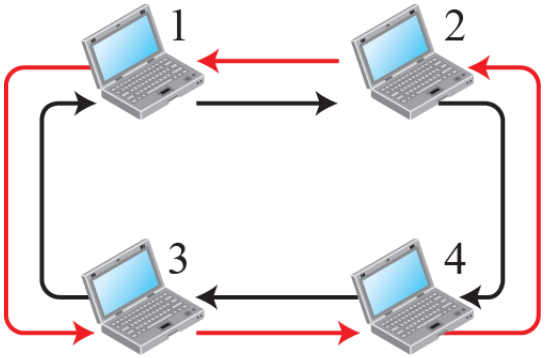
- In other words, for each station, there is a predecessor and a successor

- The predecessor is the station which is logically before the station in the ring; the successor is the station which is after the station in the ring.

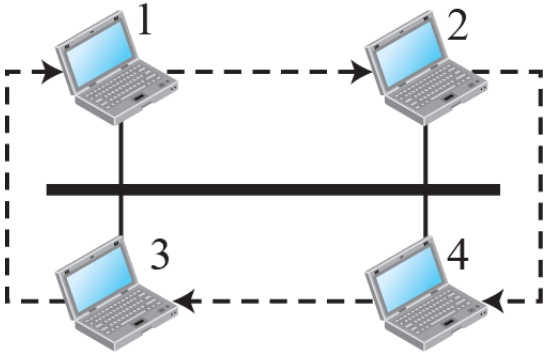
Logical ring and physical topology in token-passing access method



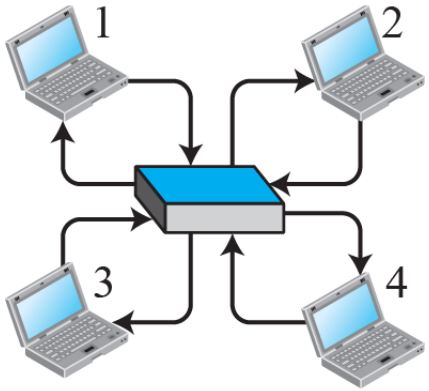
a. Physical ring



b. Dual ring



c. Bus ring



d. Star ring

CHANNELIZATION

- **Channelization (or channel partition, as it is sometimes called) is a multiple-access method in which the available bandwidth of a link is shared in time, frequency, or through code, among different stations.**

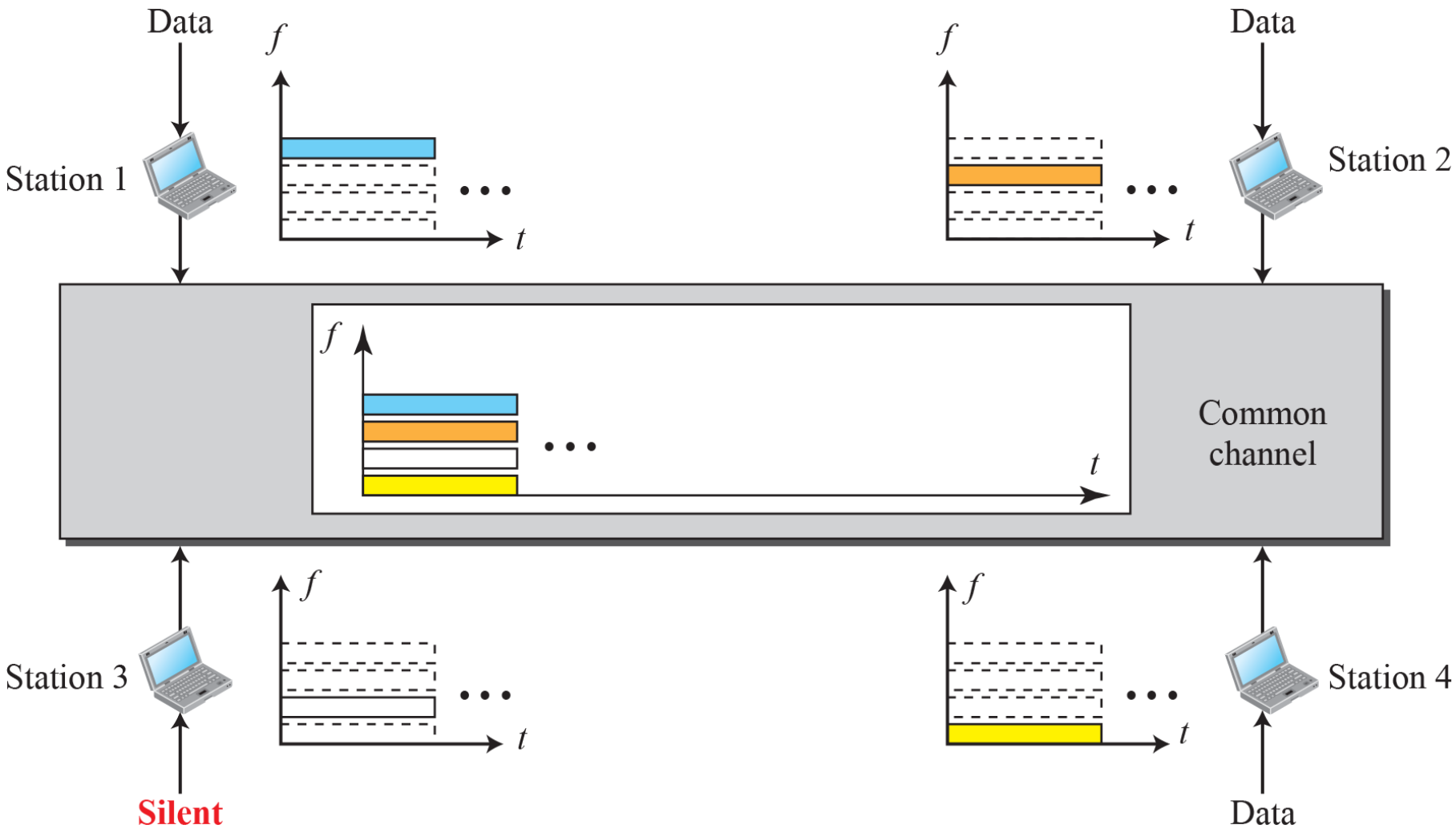
- **three protocols: FDMA, TDMA, and CDMA.**

FDMA

- **the available bandwidth is divided into frequency bands**

- **Each station is allocated a band to send its data. In other words, each band is reserved for a specific station, and it belongs to the station all the time**

Frequency-division multiple access (FDMA)



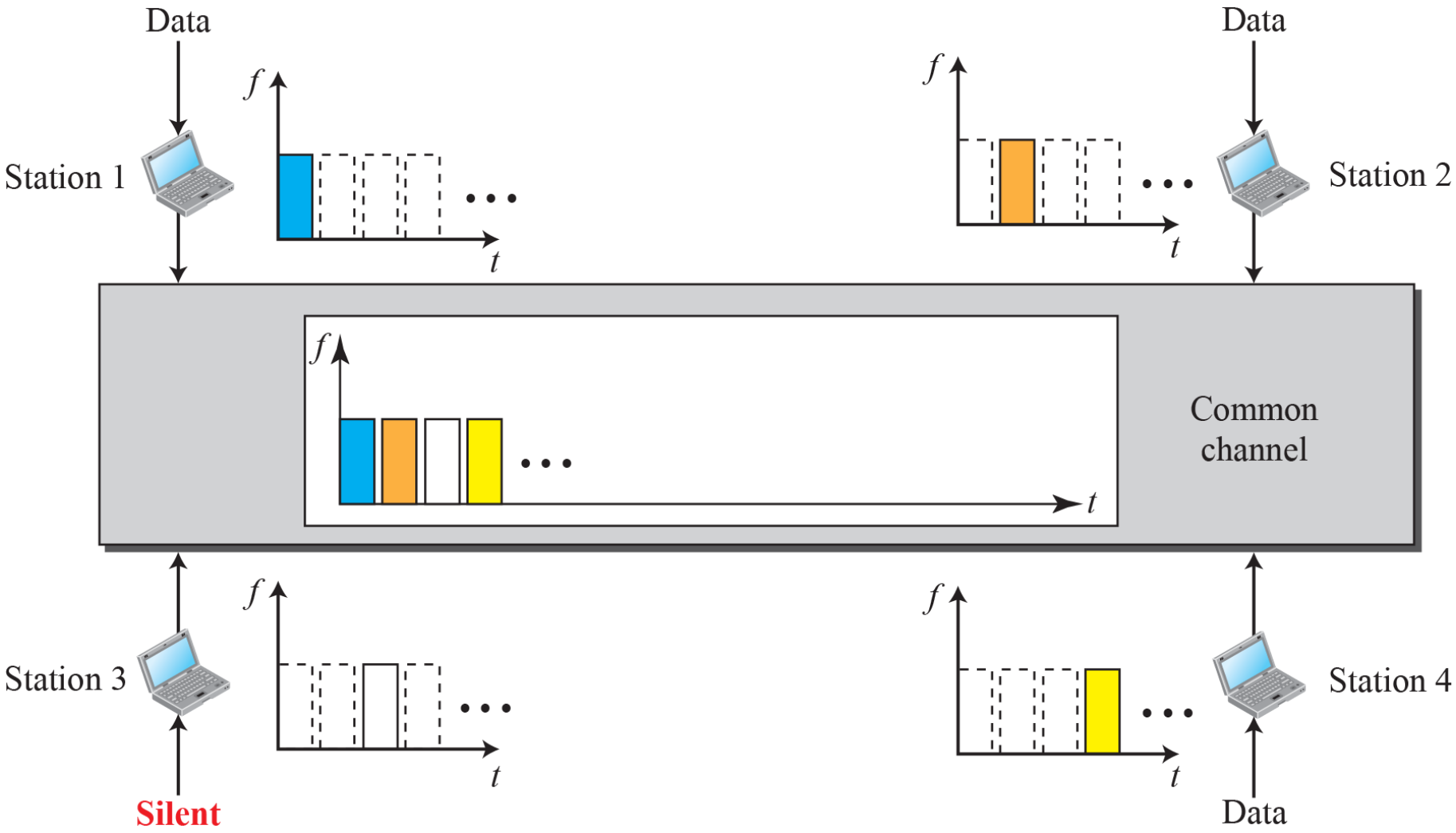
TDMA

- the stations share the bandwidth of the channel in time

- Each station is allocated a time slot during which it can send data

- Each station transmits its data in its assigned time slot

Time-division multiple access (TDMA)



CDMA

- **CDMA differs from FDMA in that only one channel occupies the entire bandwidth of the link**

- **It differs from TDMA in that all stations can send data simultaneously; there is no timesharing**

Simple idea of communication with code