CSE/PC/B/T/316
Computer Networks
Topic 6- MAC
Controlled Access and Channelization

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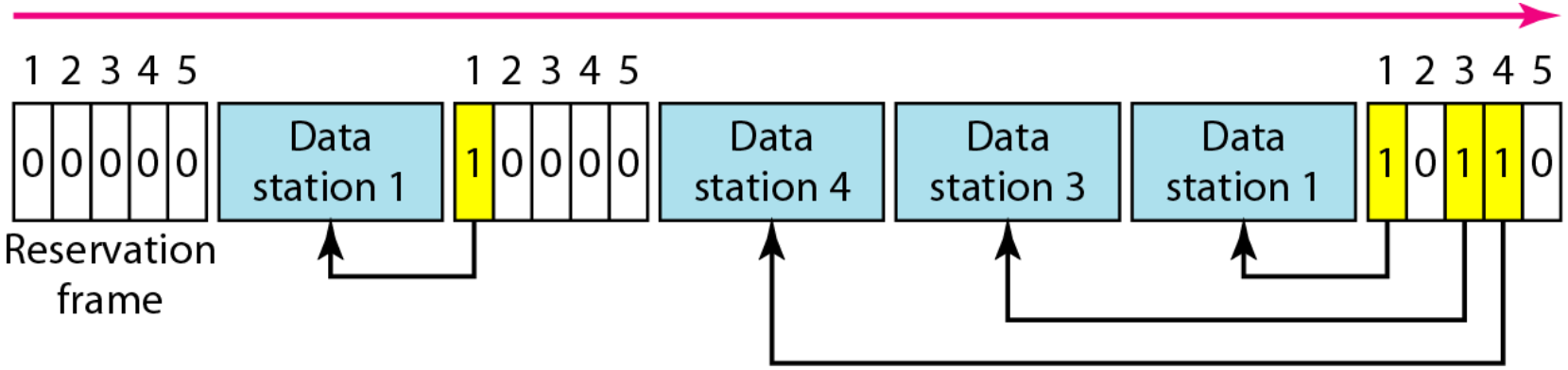
Controlled Access

- In 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. We discuss three popular controlled-access methods.
  - Reservation
  - Polling
  - Token Passing

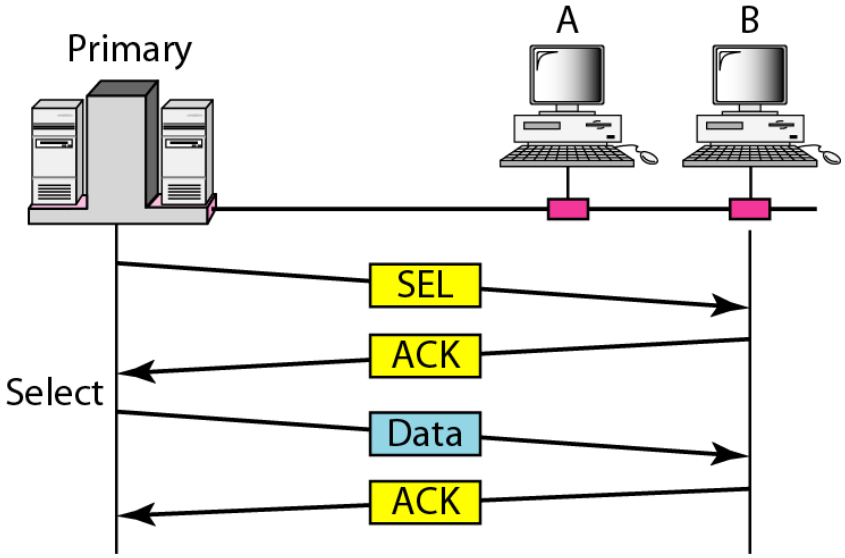
Reservation

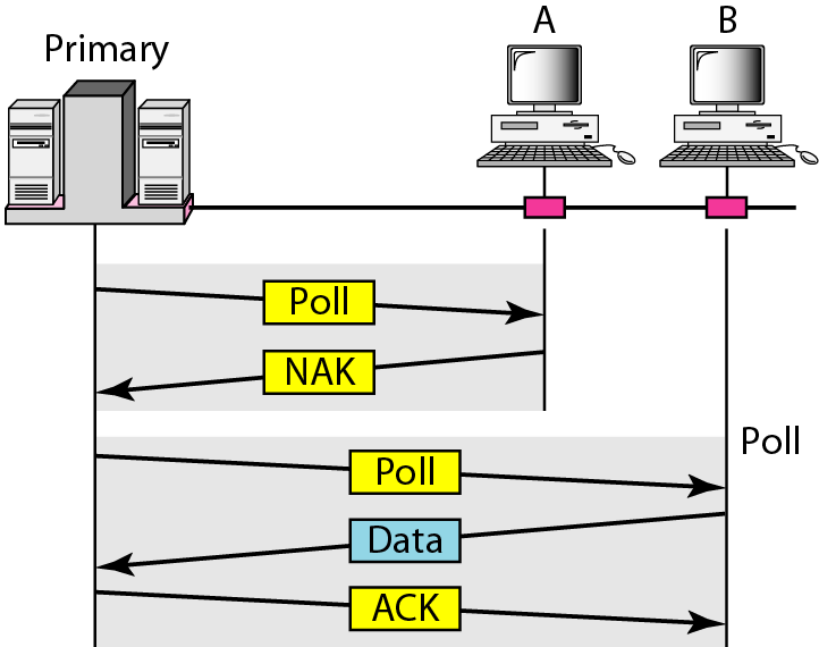
- In reservation method, a station needs to make a reservation before sending data. Time is divided into intervals. In each interval, a reservation frame precedes the data frames sent in that interval.
- If there are N stations in the system, there are exactly N reservation minislots in the reservation frame. Each minislot belongs to a station. When a station needs to send a data frame, it makes a reservation in its own minislot. The station that have made reservations can send their data frames after the reservation frame.



Polling

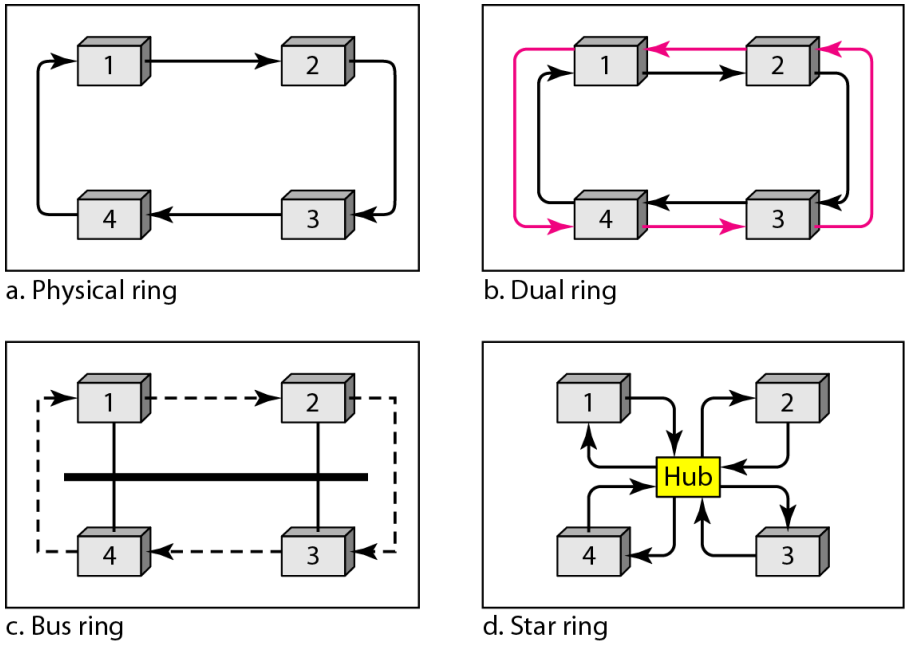
- Polling work with topologies in which one device is designated as a primary station and the other devices are secondary stations.
- All data exchanges must be made through the primary device; the primary device controls the link, therefore, it is always the initiator of a session.
- Poll: If the primary wants to receive data, it asks the secondary nodes if they have anything to send.
- Select: If the primary wants to send data, it tells the secondary nodes to get ready to receive.





Token passing

- In the token passing method, the station in a network are organized in a logical ring.
- A special packet called a token circulates through the ring. The possession of the token gives the station the right to access the channel and send its data.
- Token management is needed for this access method.

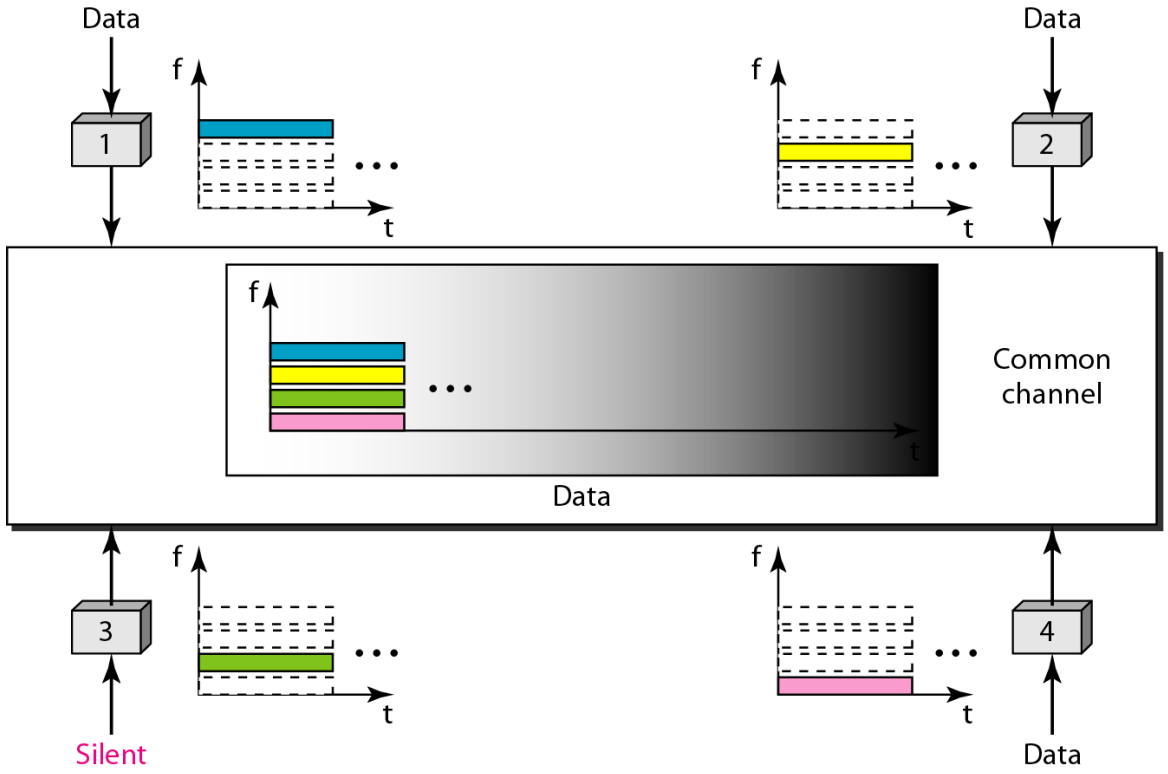


Channelization

- Channelization is a multiple-access method in which the available bandwidth of a link is shared in time, frequency, or through code, between different stations. In this section, we discuss three channelization protocols.
  - Frequency-Division Multiple Access (FDMA)
  - Time-Division Multiple Access (TDMA)
  - Code-Division Multiple Access (CDMA)

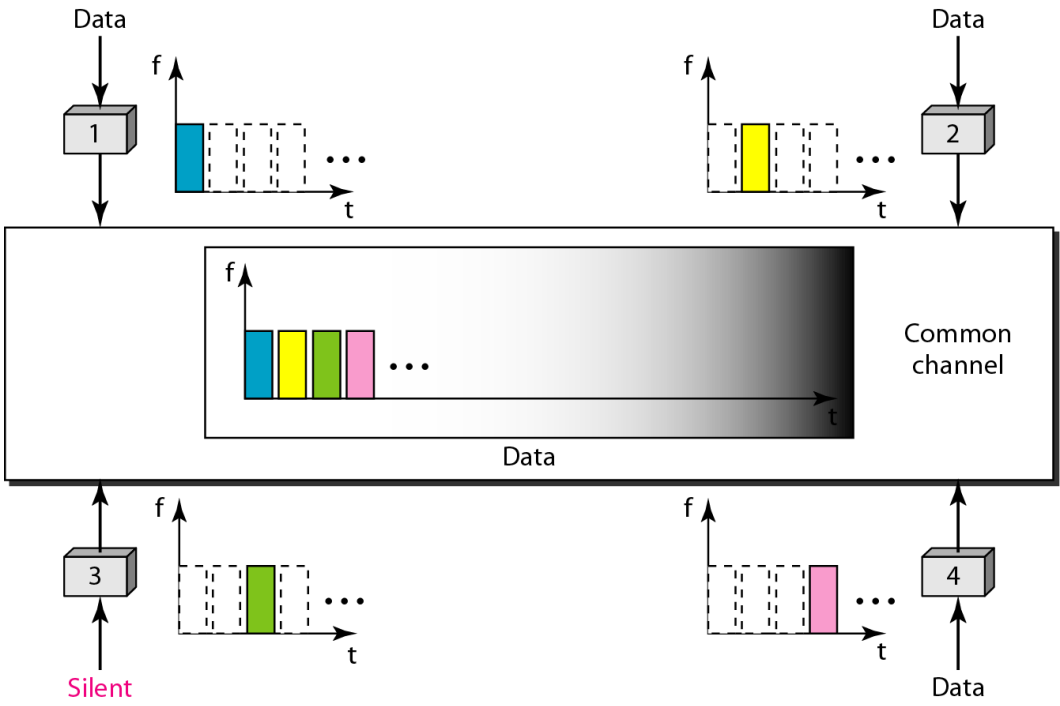
FDMA

- In FDMA, the available bandwidth is divided into frequency bands.
- Each station is allocated a band to send its data.
- Each station uses a bandpass filter to confine the transmitter frequencies.
- To prevent station interferences, the allocated bands are separated from one another by small guard bands.



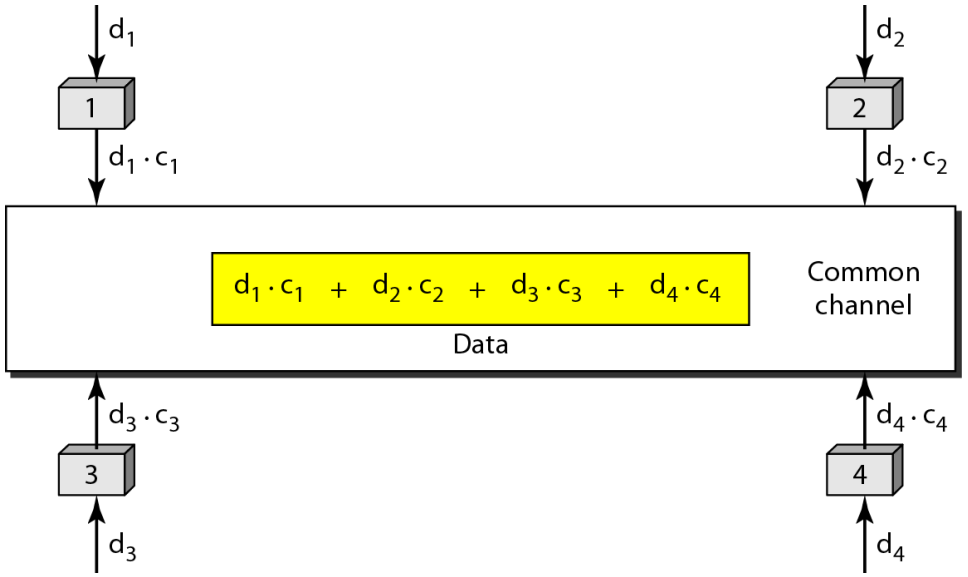
TDMA

- In TDMA, the bandwidth is just one channel that is timeshared between different stations.
- The main problem with TDMA lies in achieving synchronization between the different stations.
- Each node needs to know the beginning of its slot and the location of its slot.
- This may be difficult because of propagation delays if the stations are spread over a large area.

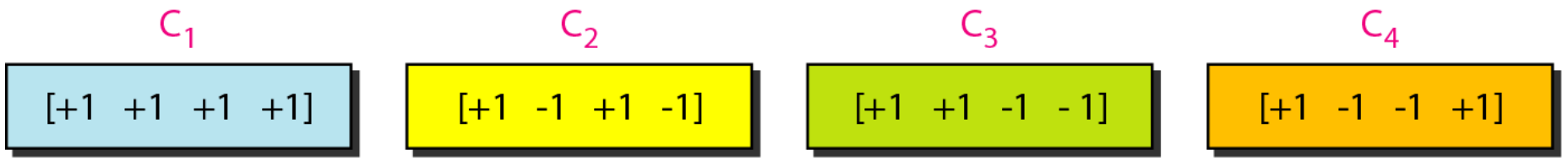


CDMA

- CDMA was conceived several decades ago..with advancement on electronic technology recently implemented .
- In CDMA, one channel carries all transmissions simultaneously.

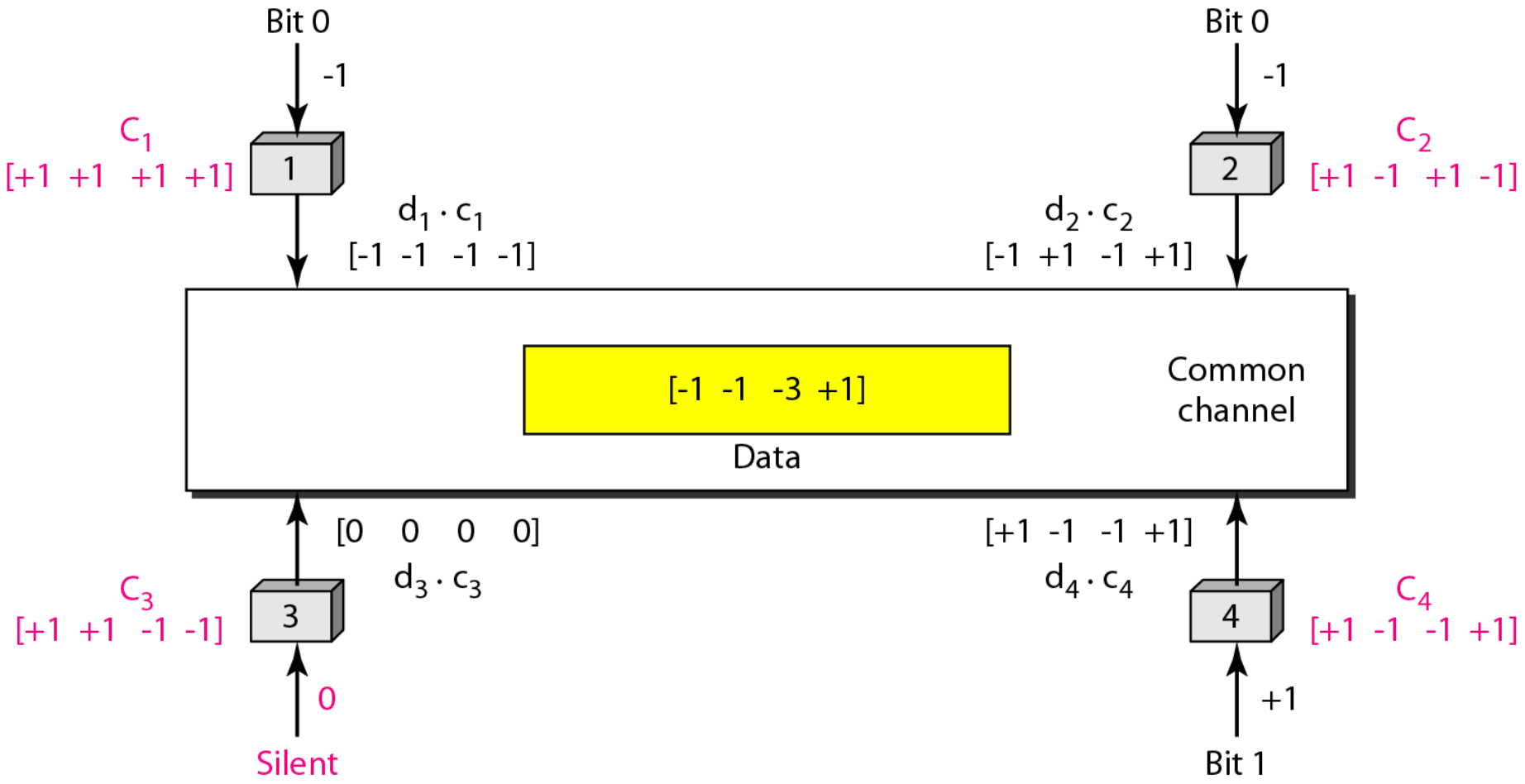


Chip sequences

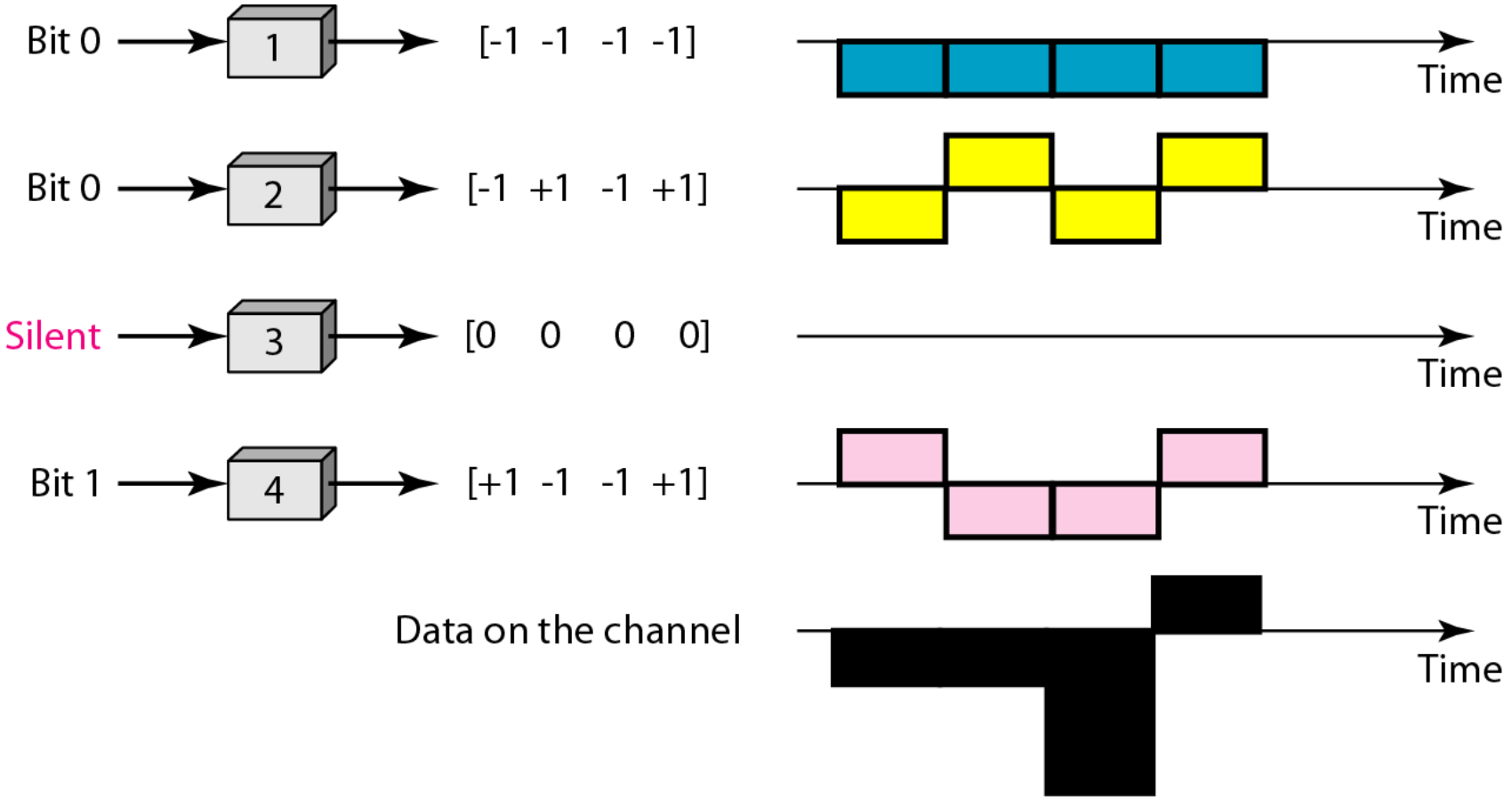


Data representation in CDMA

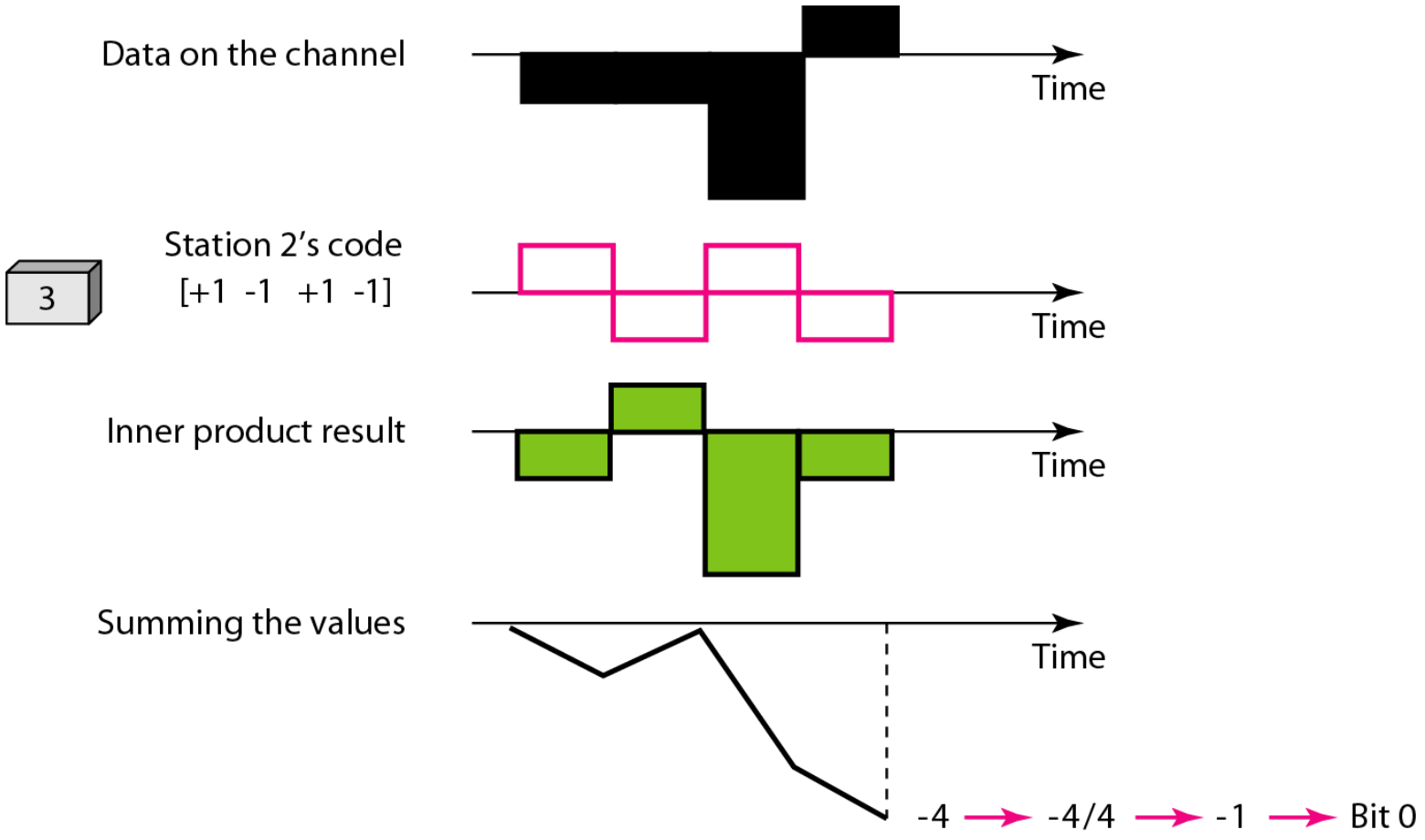
Sharing channel in CDMA



Digital signal created by four stations in CDMA



Decoding of the composite signal for one in CDMA



General rule and examples of creating Walsh tables

$$W_1 = [+1] \qquad W_{2N} = \begin{bmatrix} W_N & W_N \\ W_N & \overline{W_N} \end{bmatrix}$$

a. Two basic rules

$$W_1 = [+1]$$

$$W_2 = \begin{bmatrix} +1 & +1 \\ +1 & -1 \end{bmatrix}$$

$$W_4 = \begin{bmatrix} +1 & +1 & +1 & +1 \\ +1 & -1 & +1 & -1 \\ +1 & +1 & -1 & -1 \\ +1 & -1 & -1 & +1 \end{bmatrix}$$

b. Generation of W_1, W_2, and W_4

- The number of sequences in a Walsh table needs to be $N = 2^m$.

Example

$$
\begin{aligned}
D \cdot c_1 &= (d_1 \cdot c_1 + d_2 \cdot c_2 + d_3 \cdot c_3 + d_4 \cdot c_4) \cdot c_1 \\
&= d_1 \cdot c_1 \cdot c_1 + d_2 \cdot c_2 \cdot c_1 + d_3 \cdot c_3 \cdot c_1 + d_4 \cdot c_4 \cdot c_1 \\
&= d_1 \times N + d_2 \times 0 + d_3 \times 0 + d_4 \times 0 \\
&= d_1 \times N
\end{aligned}
$$

When we divide the result by N, we get d1 .

Problem

- Find the chips for a network with
- a. Two stations b. Four stations

Solution

Solution

a. For a two-station network, we have

$$[+1\ +1] \text{ and } [+1\ -1].$$

b. For a four-station network we have

$$[+1\ +1\ +1\ +1],\ [+1\ -1\ +1\ -1],$$
$$[+1\ +1\ -1\ -1],\ \text{and}\ \ [+1\ -1\ -1\ +1].$$

Problem

- What is the number of sequences if we have 90 stations in our network?

Solution

Solution

The number of sequences needs to be 2^m. We need to choose m = 7 and N = 2^7 or 128. We can then use 90 of the sequences as the chips.