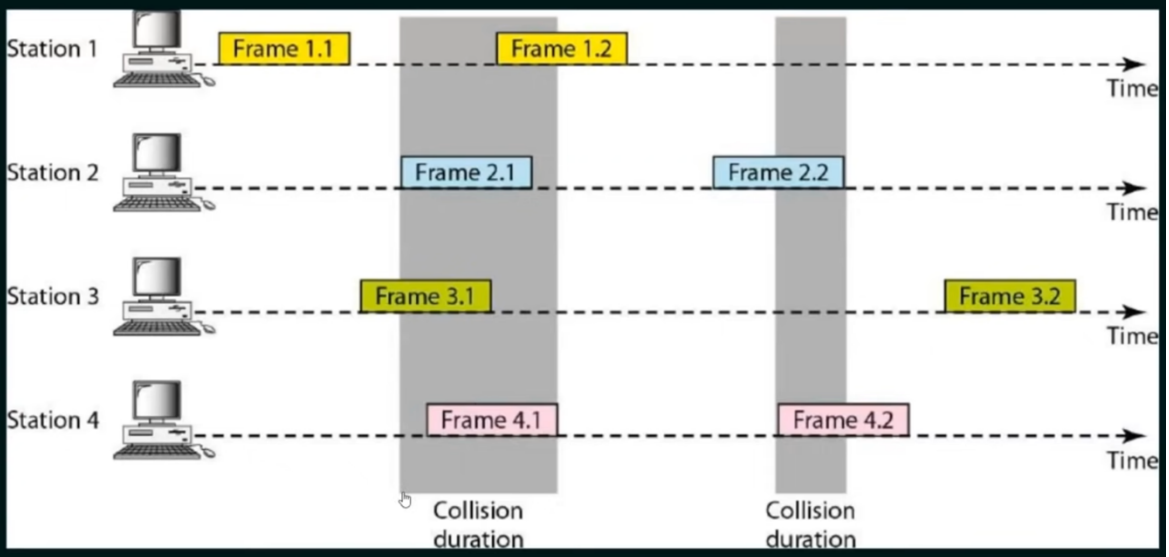
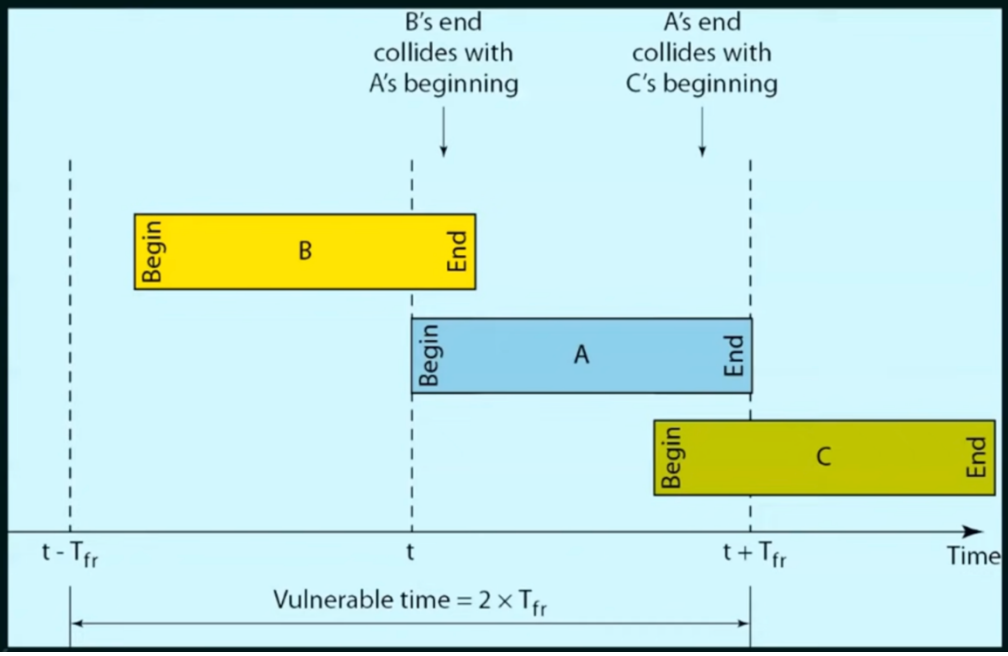
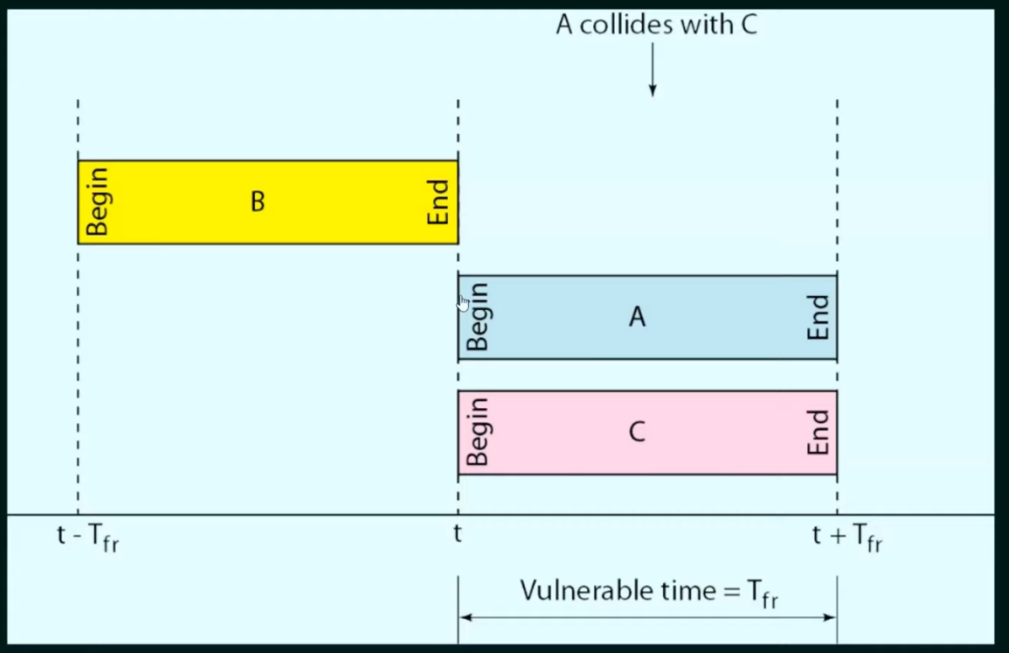
Pure aloha



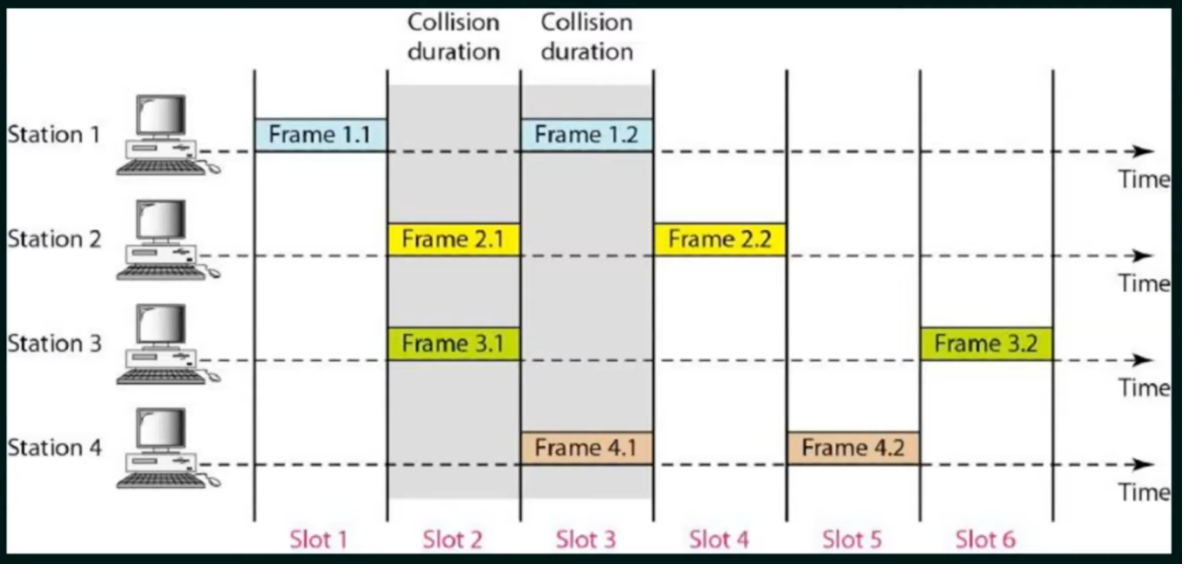
Pure aloha



SLOTTED ALOHA



SLOTTED ALOHA



CSMA PROTOCOL

- ★ Carrier Sense Protocol.
- ★ To minimize the chance of collision and, therefore, increase the performance, the CSMA method was developed.
- ★ Principle of CSMA: "sense before transmit" or "listen before talk."
- ★ Carrier busy = Transmission is taking place.
- ★ Carrier idle = No transmission currently taking place.
- ★ The possibility of collision still exists because of propagation delay; a station may sense the medium and find it idle, only because the first bit sent by another station has not yet been received.

TYPES OF CSMA

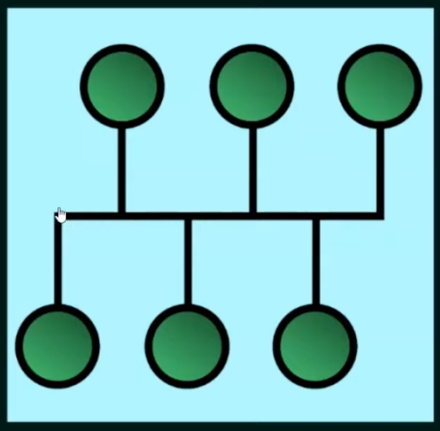
1. 1-Persistent CSMA
2. P-Persistent CSMA
3. Non-Persistent CSMA
4. O-Persistent CSMA

CSMA/CD (CSMA with Collision Detection)

CSMA/CA (CSMA with Collision Avoidance)

1-Persistent CSMA

★ The longer the propagation delay, the more important this effect becomes, and the worse the performance of the protocol.



Non-Persistent CSMA

★ Before sending, a station senses the channel. If no one else is sending, the station begins doing so itself.

★ However, if the channel is already in use, the station does not continually sense it for the purpose of seizing it immediately upon detecting the end of the previous transmission.

★ Instead, it waits a random period of time and then repeats the algorithm. Consequently, this algorithm leads to better channel utilization but longer delays than 1-persistent CSMA.

P-Persistent CSMA

★ It applies to slotted channels.

★ When a station becomes ready to send, it senses the channel.

★ If it is idle, it transmits with a probability P.

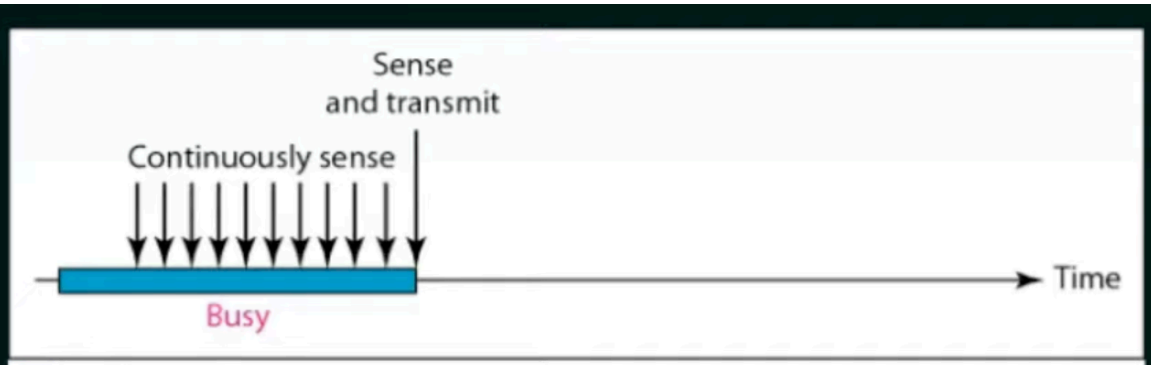
★ With a probability Q=1-P, it defers until the next slot.

★ If that slot is also idle, it either transmits or defers again, with probabilities P and Q.

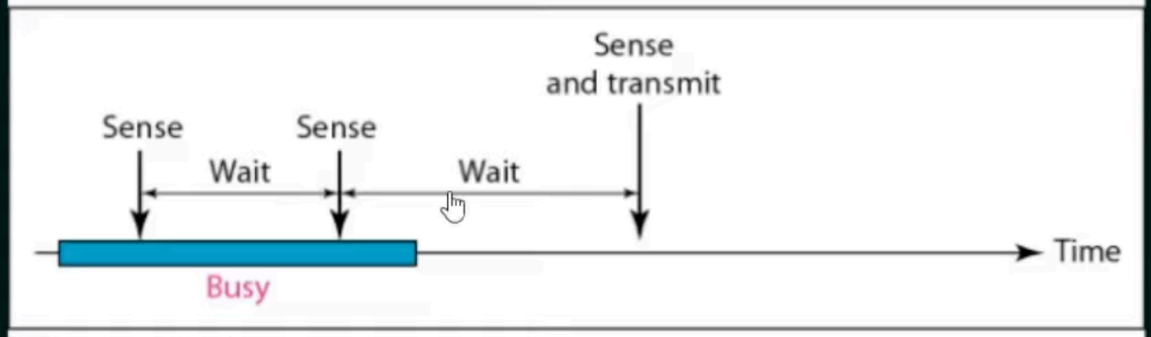
★ This process is repeated until either the frame has been transmitted or another station has begun transmitting.

★ In the latter case, the unlucky station acts as if there had been a collision (i.e., it waits a random time and starts again).

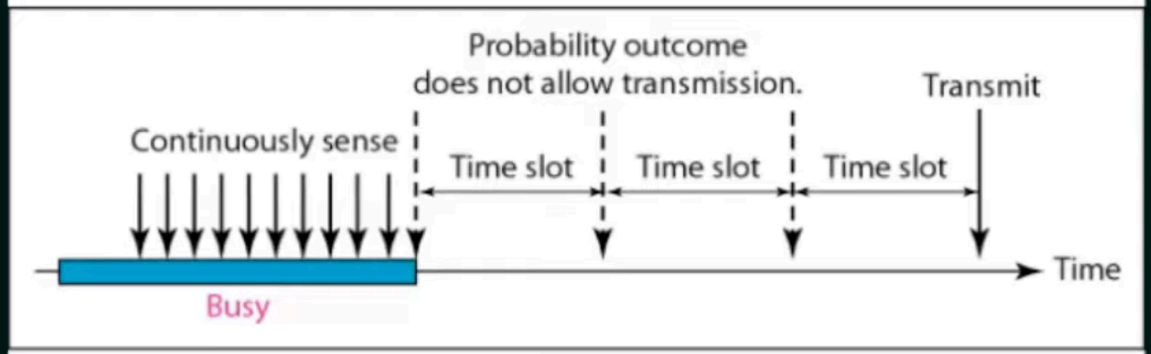
★ If the station initially senses the channel busy, it waits until the next slot and applies the above algorithm.



a. 1-persistent



b. Nonpersistent



c. p-persistent

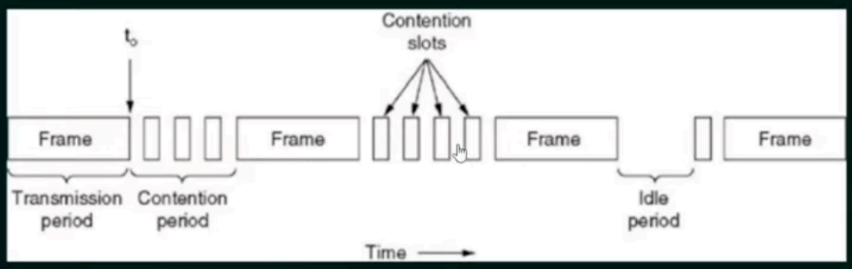
O-Persistent CSMA

★ Each node is assigned a transmission order by a supervisory node.

CSMA/CD

- ★ If two stations sense the channel to be idle and begin transmitting simultaneously, they will both detect the collision almost immediately.
- ★ Rather than finish transmitting their frames, which are irretrievably garbled anyway, they should abruptly stop transmitting as soon as the collision is detected.
- ★ Quickly terminating damaged frames saves time and bandwidth.
- ★ This protocol, known as CSMA/CD (CSMA with Collision Detection) is widely used on LANs in the MAC sublayer.
- ★ Access method used by Ethernet: CSMA/CD.

CSMA/CD



$$\text{Efficiency} = \frac{1}{1 + 6.44 \times a}$$

$$a = \frac{Tp}{Tt}$$

- ★ If distance increases, efficiency of CSMA decreases.
- ★ CSMA is not suitable for long distance networks like WAN; but works optimally for LAN.
- ★ If length of packet is bigger, the efficiency of CSMA also increases; but maximum limit for length is 1500 Bytes.
- ★ Transmission Time >= Round Trip Time of 1 bit
- ★ Transmission Time >= 2*Propagation Time

CSMA/CA

★ The Access method used by IEEE 802.11 Wi-Fi is CSMA/CA.

CSMA/CA

★ Carrier-sense multiple access with collision avoidance (CSMA/CA) is a network multiple access method in which carrier sensing is used, but nodes attempt to avoid collisions by beginning transmission only after the channel is sensed to be "idle".

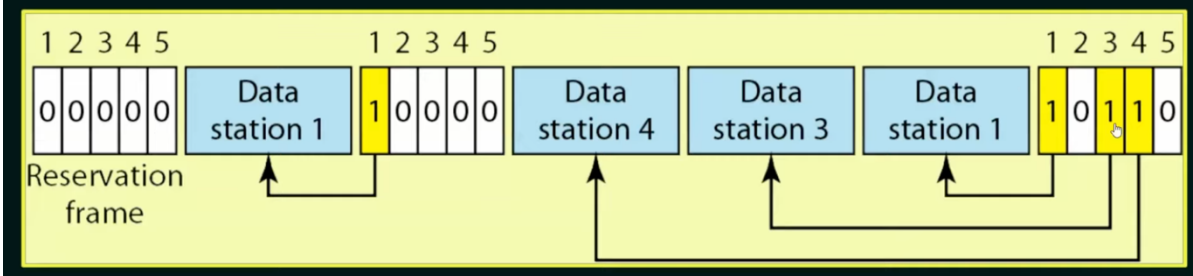
★ It is particularly important for wireless networks, where the collision detection of the alternative CSMA/CD is not possible due to wireless transmitters desensing their receivers during packet transmission.

★ CSMA/CA is unreliable due to the hidden node problem and exposed terminal problem.

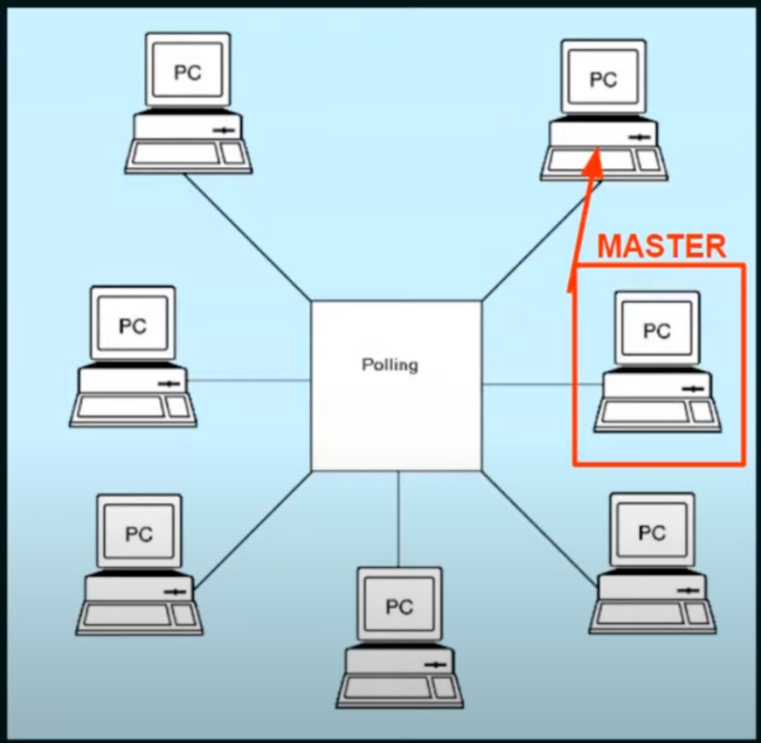
★ Solution: RTS/CTS exchange.

★ CSMA/CA is a protocol that operates in the Data Link Layer (Layer 2) of the OSI model.

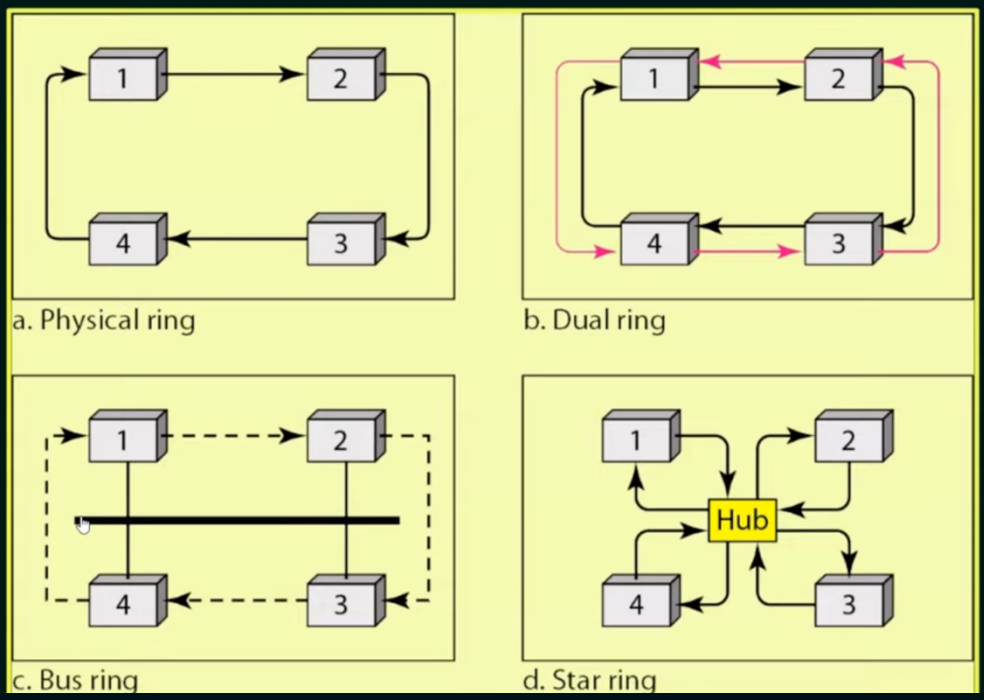
RESERVATION



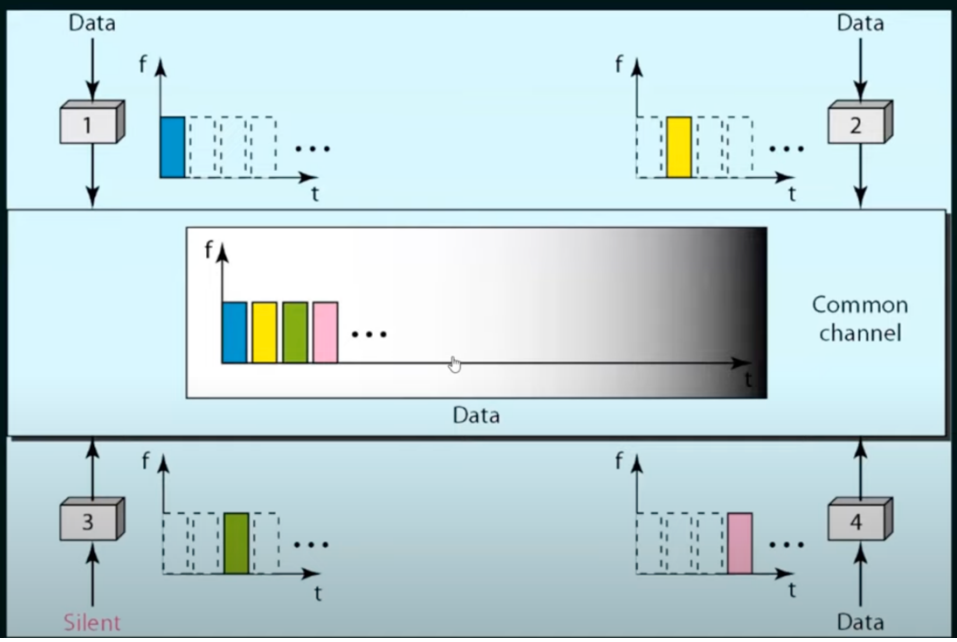
POLLING



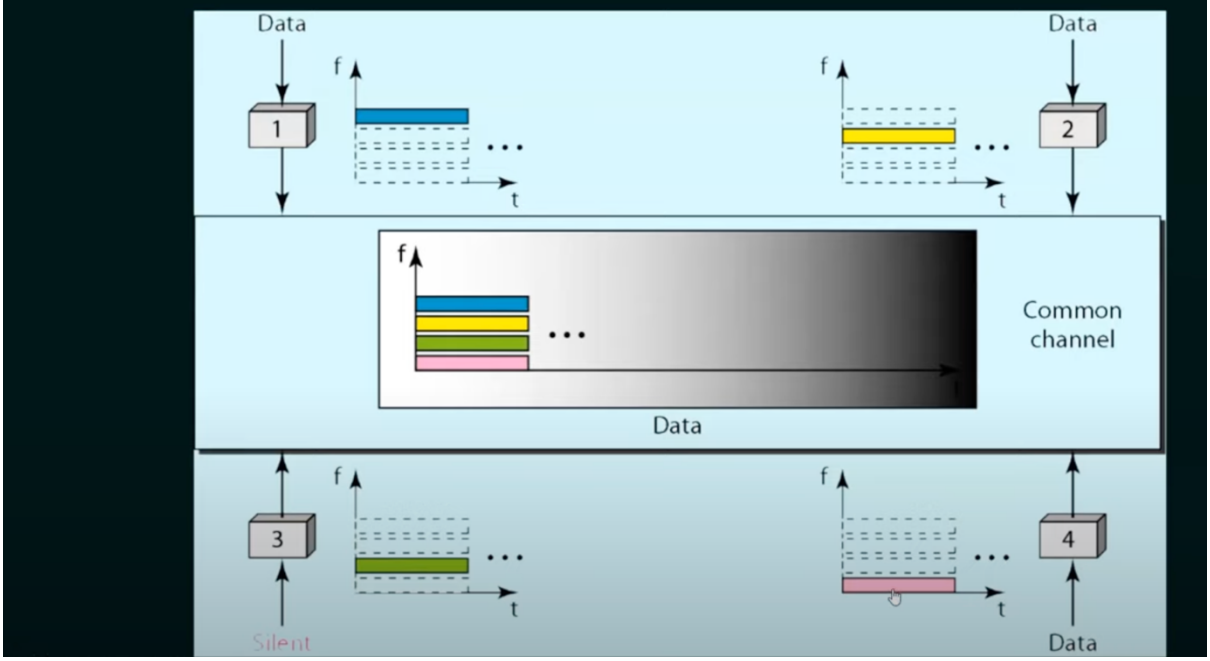
Token passing



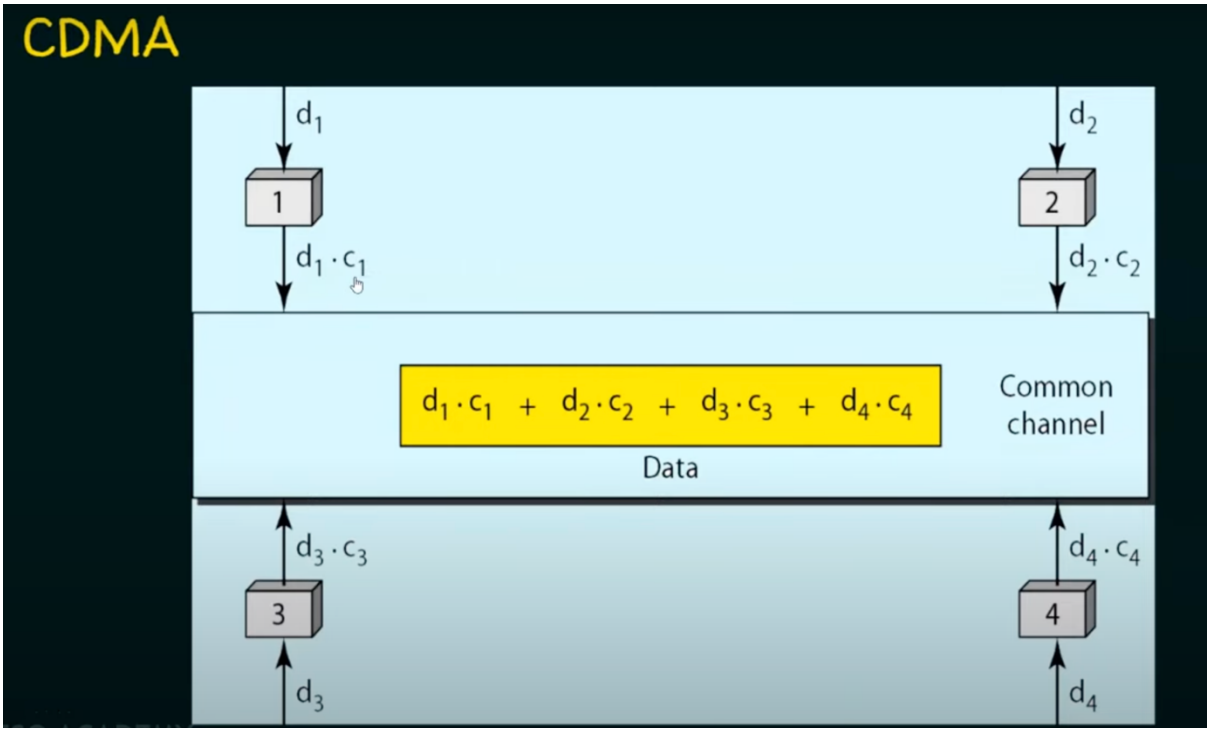
TDMA



FDMA


Data
Data
f
t
1
2
Common channel
Data
3
4
Silent
Data

CDMA


d_1
d_2
1
2
$d_1 \cdot c_1$
$d_2 \cdot c_2$
$d_1 \cdot c_1 + d_2 \cdot c_2 + d_3 \cdot c_3 + d_4 \cdot c_4$
Common channel
Data
$d_3 \cdot c_3$
$d_4 \cdot c_4$
3
4
d_3
d_4