CSMA Protocol

CSMA (carrier sense multiple access)

CS – It stands for Carrier Sensing. It implies that before sending data, a station first senses the carrier. If the carrier is found free, then the station transmits data else it refrains.

MA – Stands for Multiple Access i.e. if there's a channel, then there are many stations that are trying to access it.

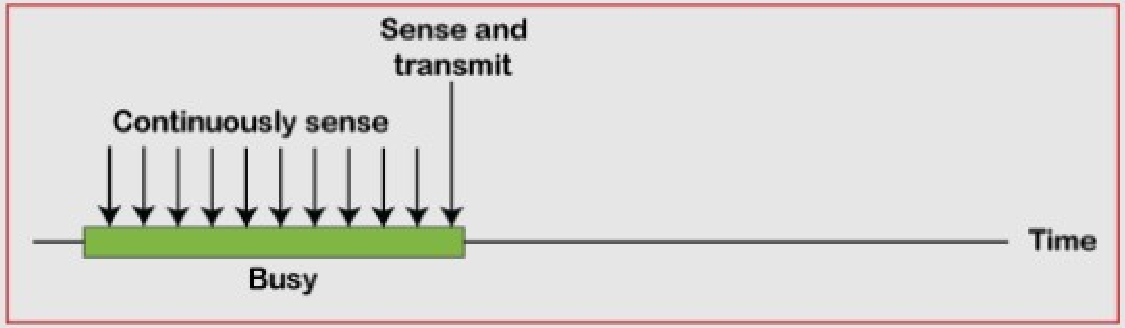
- To minimize the chance of collision and, therefore, increase the performance, the CSMA method was developed.
- **Principle of CSMA**: "Sense before transmit" or "listen before talk"
  - If channel sensed idle: transmit entire frame
  - If channel sensed busy, defer transmission
- Station must wait until the channel becomes idle. Hence, it reduces the chances of a collision on a transmission medium.

CSMA (carrier sense multiple access)

- Types of CSMA’s.
  - 1-Persistent CSMA
  - P-Persistent CSMA
  - Non-Persistent CSMA
  - O-Persistent CSMA

1-Persistent CSMA

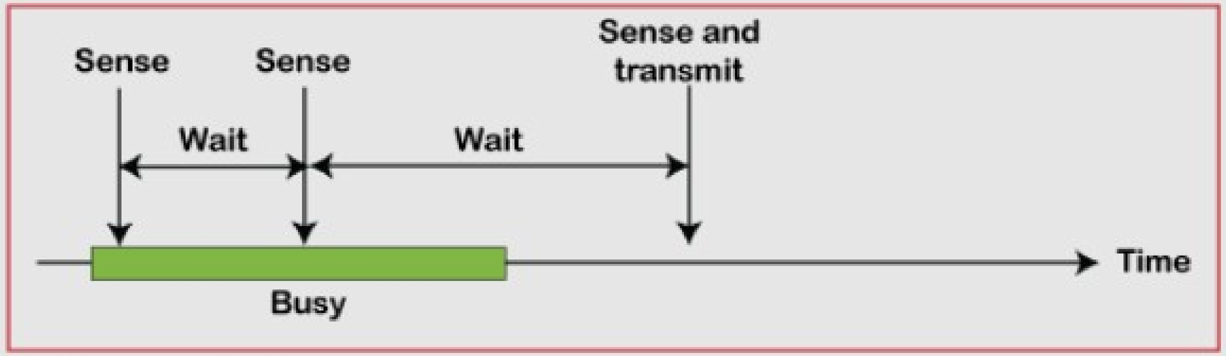
- First sense the shared channel.
- If the channel is idle, it immediately sends the data.
- Else (i.e., if the channel is busy), then it senses the transmission medium continuously until it become idle. (For example for every one seconds continuously checking the channel).
- Why it is called as 1-Persistent CSMA?
  - Since the station transmits the frame with the probability of 1 when the carrier or channel is idle, this scheme of CSMA is called as 1-Persistent CSMA.



a. 1-persistent

Non-Persistent CSMA

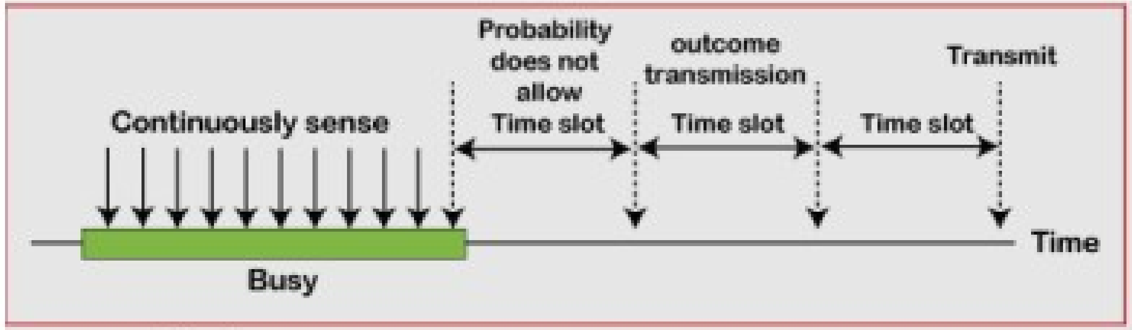
- Before transmitting the data, each node must sense the channel
- If the channel is inactive, it immediately sends the data.
- Otherwise, the station must wait for a random time (not continuously), and when the channel is found to be idle, it transmits the frames.
- This algorithm leads to better channel utilization but longer delays than 1-persistent CSMA.



b. Nonpersistent

P-Persistent CSMA

- It applies to slotted channels. Means every node will send when it get it slot.
- When a station becomes ready to send, it senses the channel.
- It is the combination of ***1-Persistent*** and ***Non-persistent modes***.
- The P-Persistent mode defines that each node senses the channel. If the channel is inactive, it sends a frame with a **P** probability.
    - If the station has the data to send, it senses the channel, if the channel is free, it has to check for one more condition, is that timeslot is allocated to that node or not. There are chances the station may have a frame/data, and the channel is also free, but that time slot is not allotted to that station. So that station can not transmit the frame that time. So it has to wait for its time slot.
- 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.



c. p-persistent

Parameter	1-persistent CSMA	p-persistent CSMA	Non-persistent CSMA
Carrier Sense	It sends with the probability of 1 when channel is idle.	It sends with the probability of p when channel is idle.	It send when channel is idle.
Waiting	It continuously senses the channel or carrier.	It waits for the next time slot.	It will wait for the random amount of time to check the carrier.
Chances of Collision	There is highest chances of collision in this.	Less chances as compared to 1-persistence and p-persistence.	Less chances as compared to 1-persistence but more than the p-persistence.
Utilization	It's utilization is above ALOHA as frames are only sent when the channel is idle.	It's utilization is depend upon the probability p.	It's utilization is above 1-persistent as not all the stations constantly check the channel at the same time.
Delay Low Load	It is low as frames are send when the channel become idle.	It is large when p is small as station will not always send when channel is idle.	It is small as station will send whenever channel is found idle but longer than 1-persistent since it checks for the random time when busy.
Delay High Load	It is high due to collision.	It is large when the probability p of sending is small when channel is idle and channel is rarely idle.	It is longer than 1-persistent as channel is checked randomly when busy.

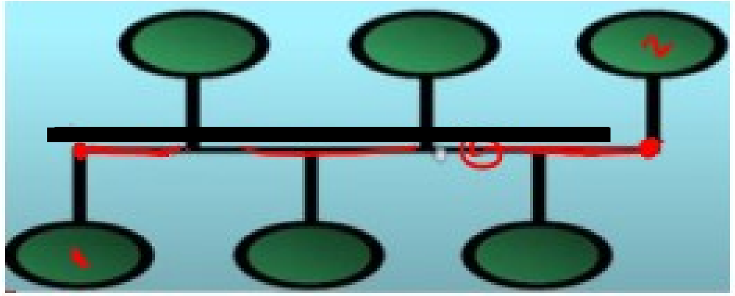
O-Persistent CSMA

O- Persistent:

- It is an O-persistent method that defines the superiority of the station before the transmission of the frame on the shared channel.
- That is each node is assigned a transmission order by a supervisory node.
- If it is found that the channel is inactive, each station waits for its turn to retransmit the data.

CSMA (carrier sense multiple access)

- Limitation: 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.

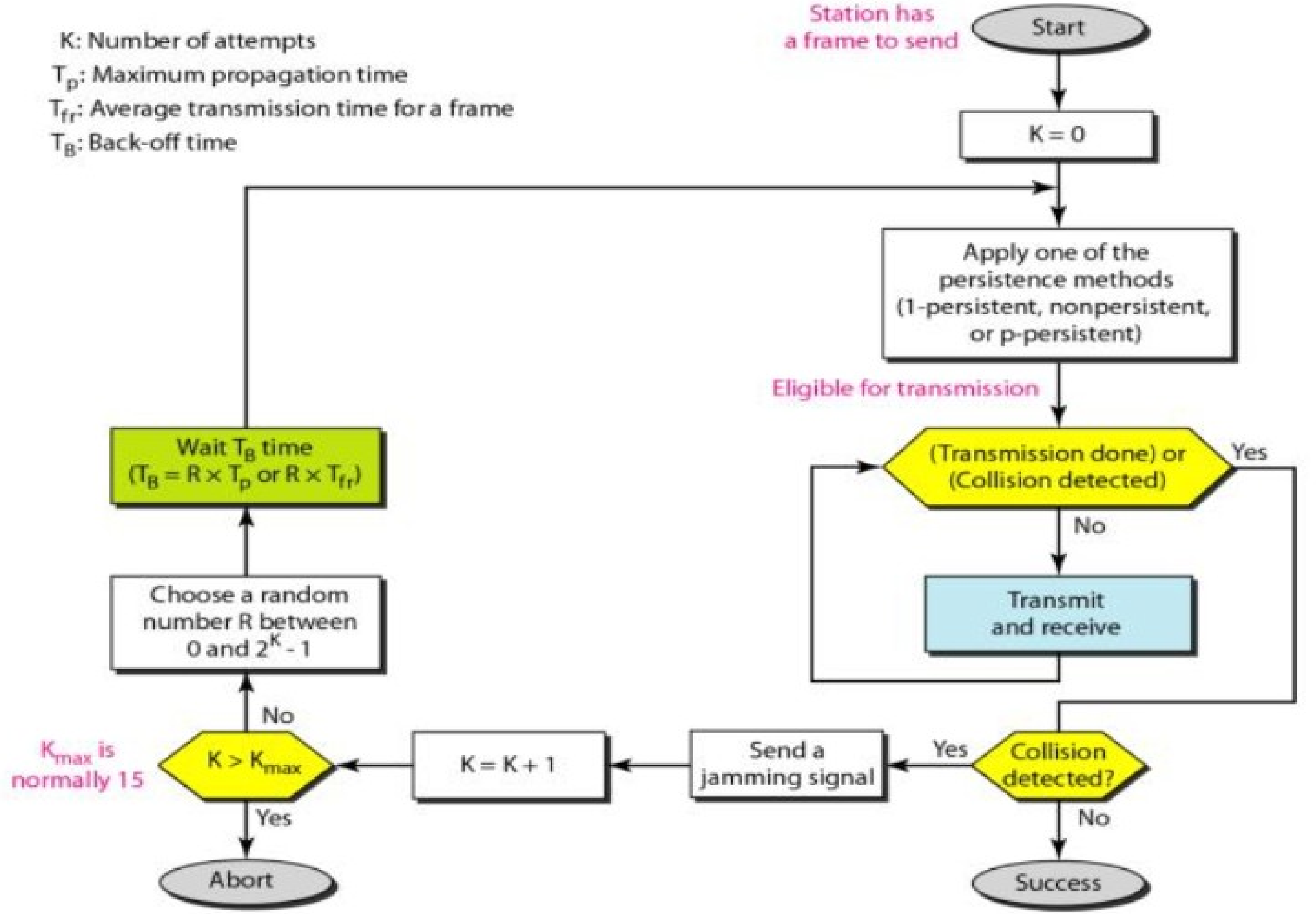


Note: If the distance between sender and receiver is high, the propagation delay is very high. That it may lead to collision.

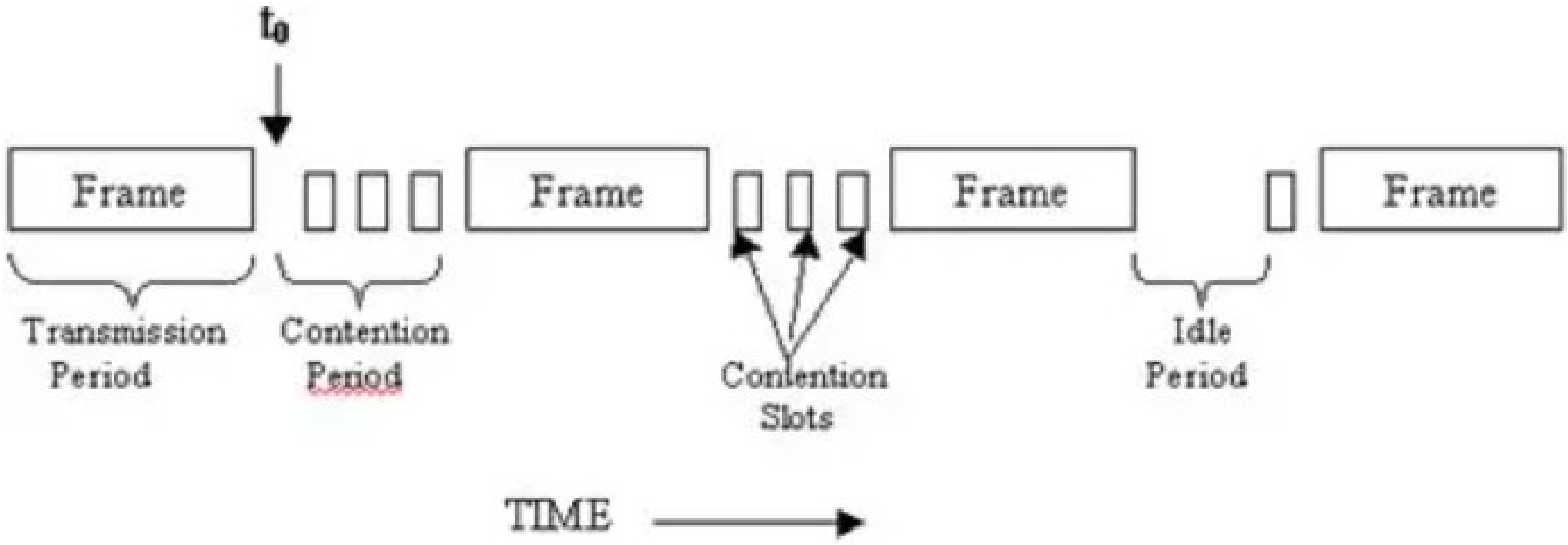
CSMA/CD

- The transmission method used in **Ethernet networks**.
- Procedure:
  - Any station willing to transmit the data.
  - When a frame is ready, the transmitting station checks whether the channel is idle or busy.
  - If the channel is busy (carrier busy), the station waits until the channel becomes idle.
  - If the channel is idle (carrier free), the station starts transmitting and
    - continually monitors the channel to detect collision.
  - If a collision is detected,
    - the transmitting station stops transmitting and waits for some random amount of time called the 'back-off time'. After this time, the station retransmits again.

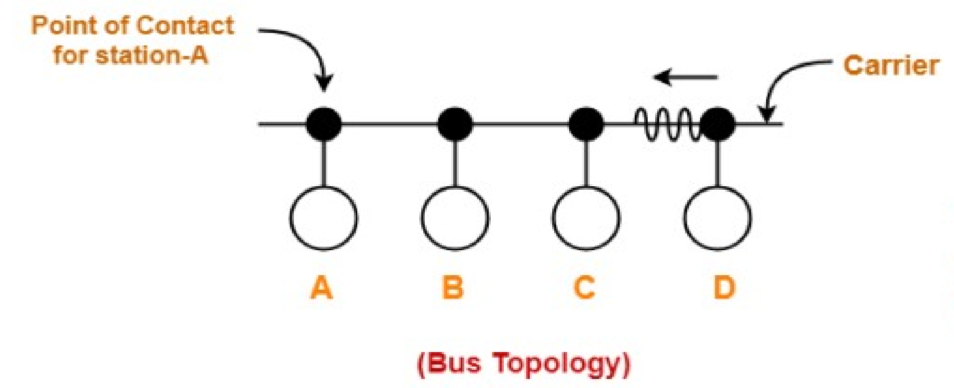
CSMA/CD: Flow Diagram



CSMA/CD PROTOCOL



Case 1



- Consider we have four stations A, B, C and D. Let the propagation delay from station A to station D be 1 hour i.e. if the data packet bit starts to move at 10 a.m., then it will reach D at 11 a.m.
- At 10 a.m. both the stations, A and D sense the carrier as free and start their transmission.
- If the total propagation delay is 1 hour, then after half an hour both the station's first bits will reach halfway and will soon experience a collision.
- So, exactly at 10:30 a.m., there will be a collision which will produce collision signals.
- At 11 a.m. the collision signals will reach stations A and D i.e. exactly after one hour the stations receive the collision signal

- Therefore, for the respective stations to detect that it’s their own data that got collided the transmission time for both the stations should be greater than their propagation time. i.e. Tt>Tp
- Where Tt is the transmission time and Tp is the propagation time

Case 2

- Station A started the transmission at 10 a.m. and is about to reach station D at 10:59:59 a.m.

• At this time, station D started its transmission after sensing the carrier as free.

• So here the first bit of data packet sent from station D will face collision with the data packet of station A.

• After collision occurred, the carrier starts sending a colloidal signal. • Station A will receive the collision signal after 1 hour.

- In this is the condition for detecting collision in the worst case where if a station wants to detect collision then it should keep on transmitting the data till 2Tp, i.e. Tt>2*Tp.

CSMA/CD

Now the next question is if the station has to transmit the data for at least 2*Tp time then how much data should the station have so that it could transmit for this amount of time?

$Tt >= 2 * Tp$

$Tt = L/B$

where, L=Data size

B= Bandwidth

So, $L >= 2 * Tp * B$

So in order to detect a collision, the minimum size of the packet should be 2*Tp*B.

If the transmitting station don't have this much (2*Tp*B) amount of data, padding (add extra bits) is used to increase the data size.

- Efficiency = Tt / (C*2*Tp + Tt + Tp)
- Tt -> transmission time
- Tp -> propagation time C -> number of collision