# CSMA : Carrier Sense Multiple Access Protocols

- Protocols in which stations listen for a carrier (i.e transmission) and act accordingly are called carrier sence protocols.

- Persistent and Nonpersistent CSMA

# CSMA contd…

- Propagation delay in CSMA – The propagation delay has an important effect on the performance of the protocol.

- If signal from station A has not reached station B and station B is ready to send, it will sense the channel to be idle and send its frame- resulting in a collision.

- Collision can be there even when propagation delay is zero and carrier sense is also there –

Two stations wait for a third station to finish and then transmit simultaneously.

# 1 – persistent CSMA

- When a station is ready to send a frame , it first listen to the channel.
- If busy : continuously sense it and waits for it to become free
- If idle : the station transmit a frame.
- If collision occurs , it waits a random amount of time and starts all over again.
- The protocol is called 1 –persistent because the station transmits with probability of 1 when it finds the channel idle.

# Nonpersistent CSMA

- Less greedy than 1 persistent , hence better channel utilization but longer delays.
- When a station is ready to send a frame , it senses the channel :
- If no one else is sending, the station begins doing so itself.
- If busy : waits for random time rather than continuously sense it for the purpose of seizing it immediately upon detecting the end of previous transmission
- If idle : sends it .
- If collision : waits for random time and tries again

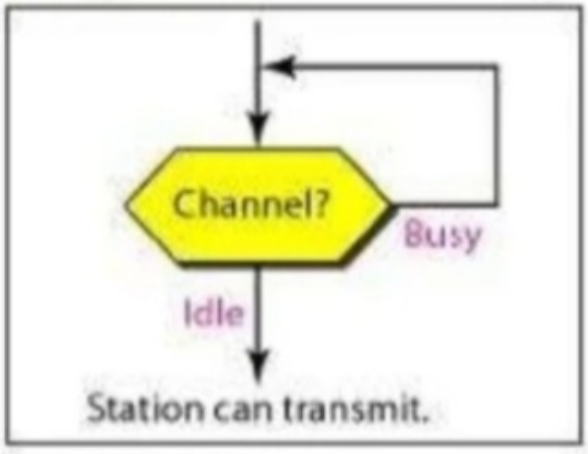
# p- persistent CSMA

- Applies to slotted channels
- Senses the channel when ready
- If busy : waits for the next slot

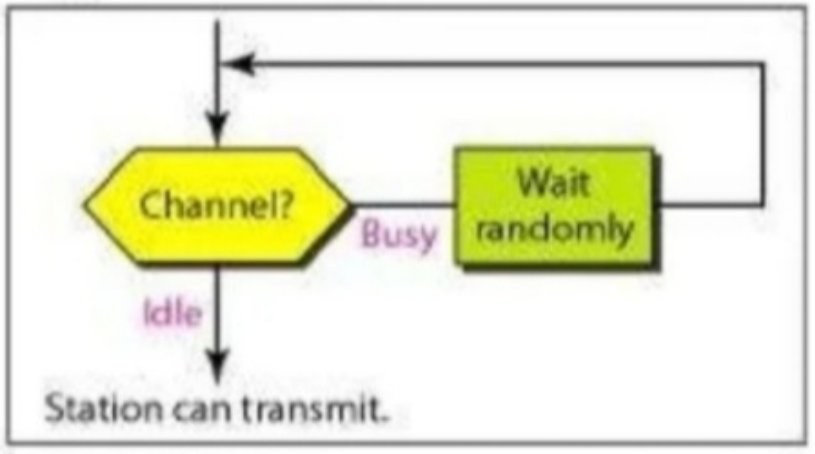
- If idle : sends its frame with probability p and defers it with probability $q = 1 - p$ to the next slot : Note that it defers even when the channel is idle

- Repeats above until either it or some other station grabs the channel. In case some other station grabs it -it treats it like a collision I.e. waits for a random time and starts again

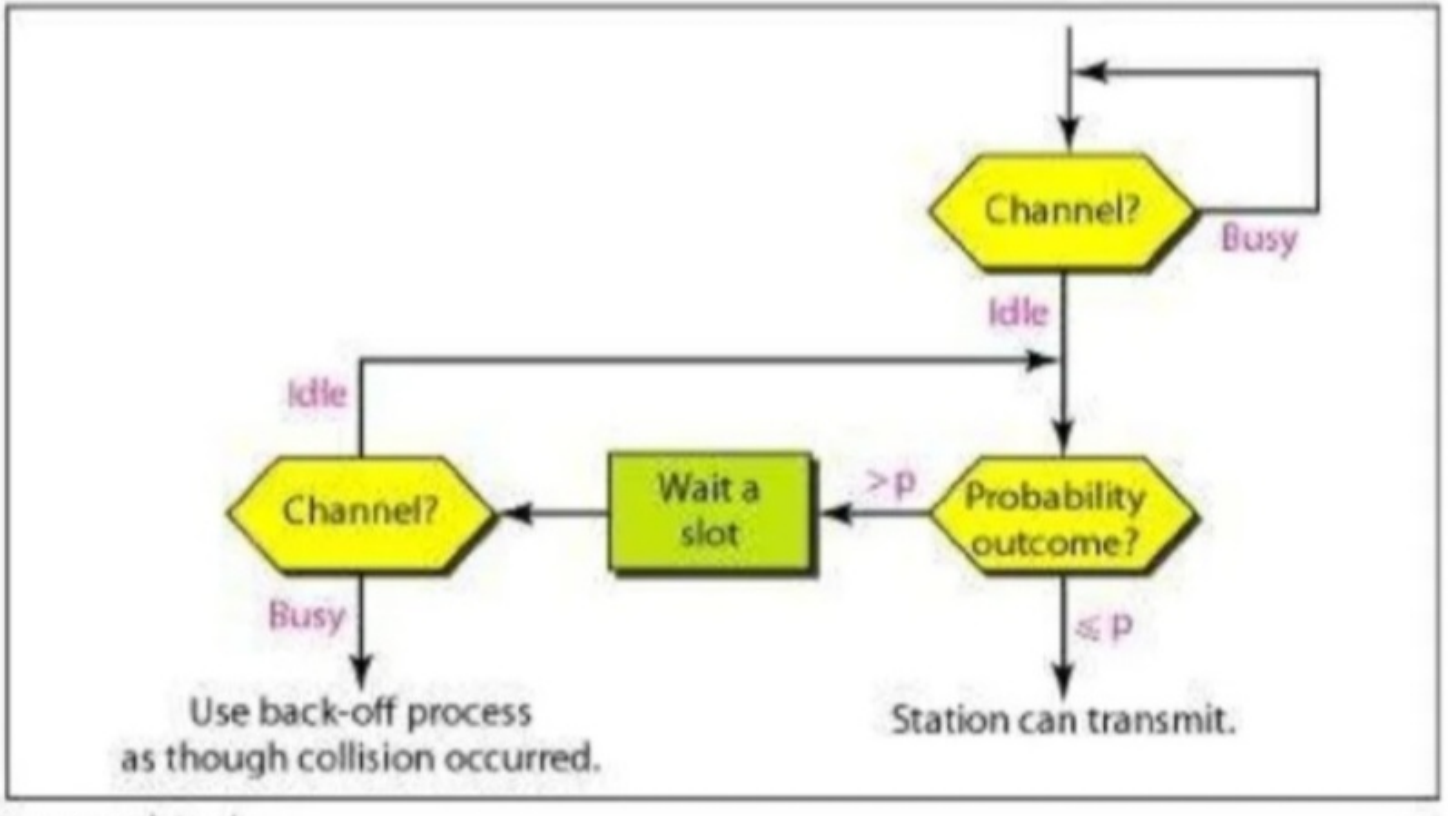
**Figure** *Flow diagram for three persistence methods*




a. 1-persistent




b. Nonpersistent




c. p-persistent

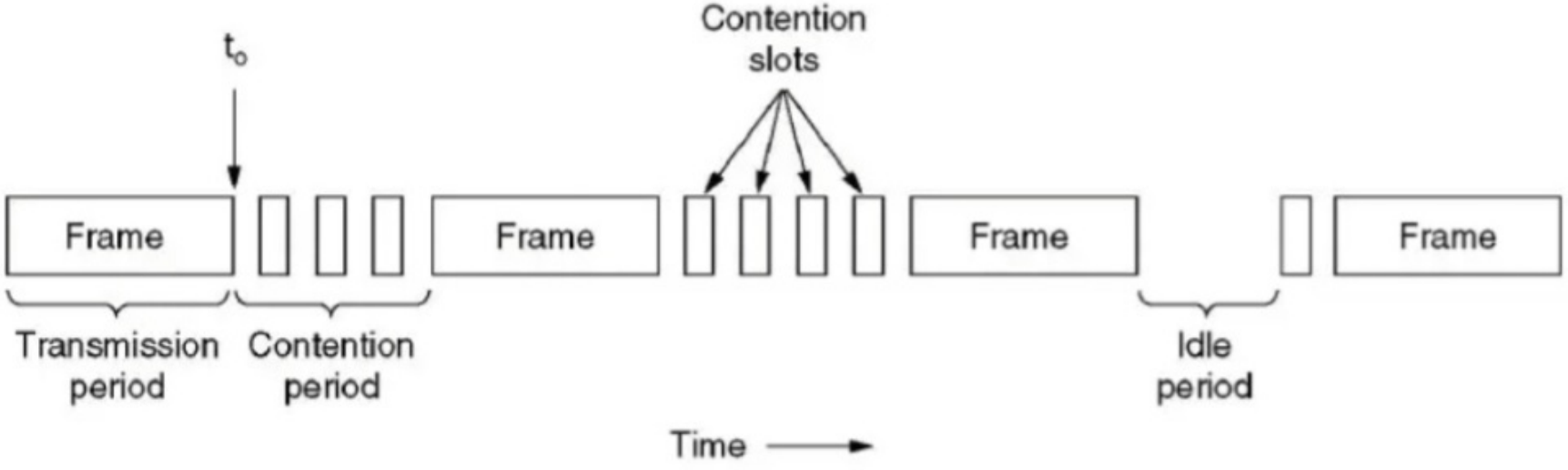
# CSMA/CD: CSMA with Collision Detection

- Persistent and non persistent CSMA protocols are better than ALOHA.
- Because they ensure that no station begins to transmit when it sense the channel busy.
- Another improvement is for stations to abort their transmission as soon as they detect a collision.

# CSMA/CD: CSMA with Collision Detection

- 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, they should abruptly stop transmitting as soon as collision is detected.
- This quick termination saves time and bandwidth.
- This protocol CSMA/CD is widely used on LANs in MAC sublayer.

# CSMA with Collision Detection




CSMA/CD can be in one of three states: contention, transmission, or idle.

# CSMA/CD: CSMA with Collision Detection

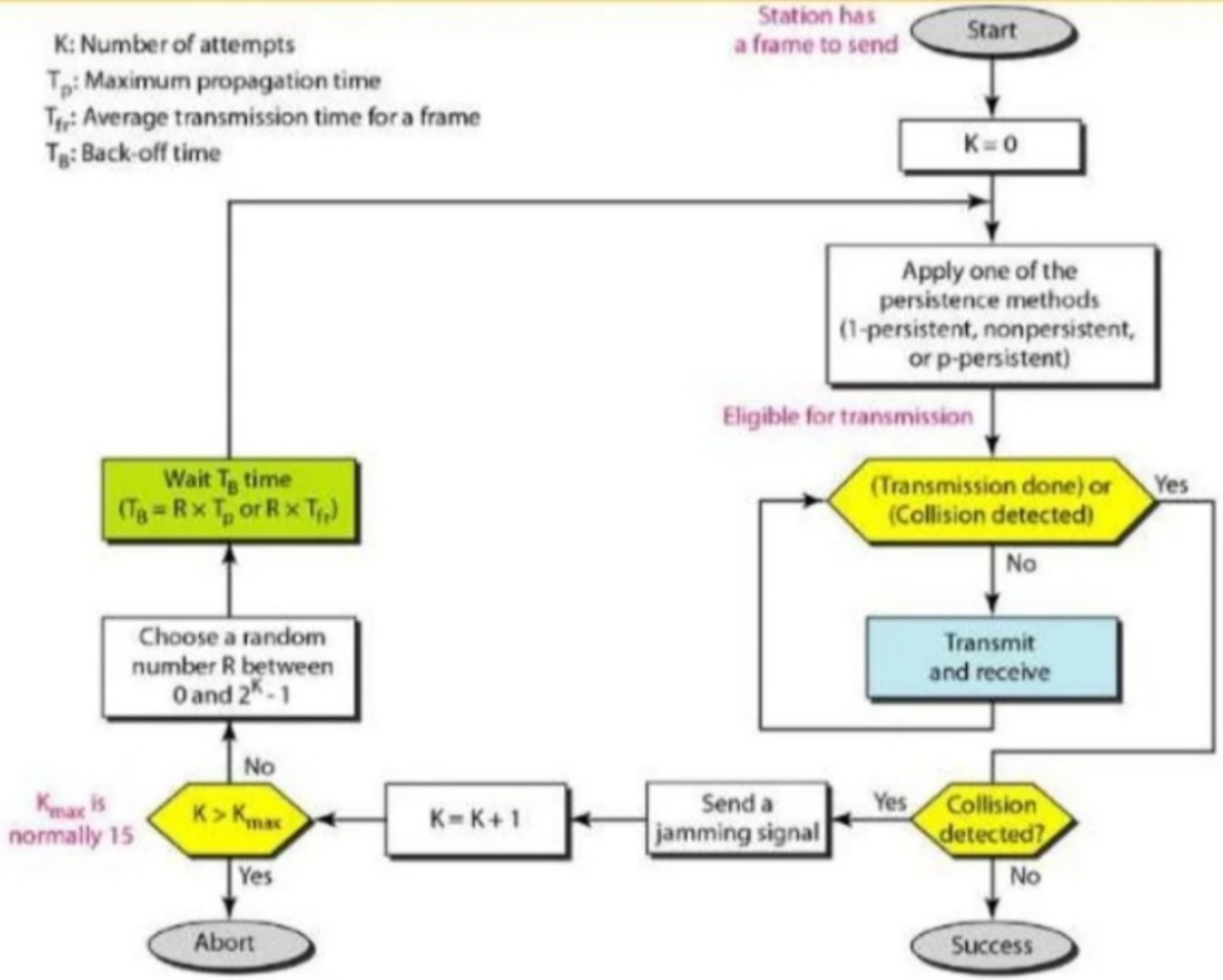
- CSMA/CD can be in one of three states: contention, transmission, or idle.
- At time $t_0$, a station has finished transmitting its frame.
- Any other station having a frame to send may now attempt to do so.
- If two or more stations decide to transmit simultaneously, there will be a collision.
- After station detects a collision, it abort its transmission, waits a random period of time and then tries again.
- Thus CSMA/CD consist of alternating contention and transmission periods, with idle periods occurring when all stations are quiet.

# CSMA/CD contd..

- If a station detects collision in the midway of generating its frame, it stops immediately rather than generating the entire frame.
- Widely used
- Also in Ethernet LAN.

# What should be the size of the contention interval?

- How long does it take for a channel to detect a collision (max time)?
  - Let the time it takes for a signal to travel between the two farthest stations, say A and B, is t
  - At t0, A starts transmitting.
  - At t-epsilon, an instant before the signal reaches B, B also starts transmitting, collision occurs
  - But the collided signal reaches back to A not before additional t time .. I.e. at an instant 2t-epsilon
- Hence it takes about 2t time for A to detect a collision
- Hence the contention interval must be 2t.


K: Number of attempts
$T_p$: Maximum propagation time
$T_{fr}$: Average transmission time for a frame
$T_B$: Back-off time
Station has a frame to send
Start
K = 0
Apply one of the persistence methods (1-persistent, nonpersistent, or p-persistent)
Eligible for transmission
(Transmission done) or (Collision detected)
Yes
No
Transmit and receive
Collision detected?
Yes
No
Success
Send a jamming signal
K = K + 1
$K > K_{max}$
$K_{max}$ is normally 15
No
Yes
Abort
Choose a random number R between 0 and $2^K - 1$
Wait $T_B$ time ($T_B = R \times T_p$ or $R \times T_{fr}$)

# CSMA/CA(carrier sense multiple access/collision avoidance)

1- It was invented for wireless networks

2- It avoid from collision

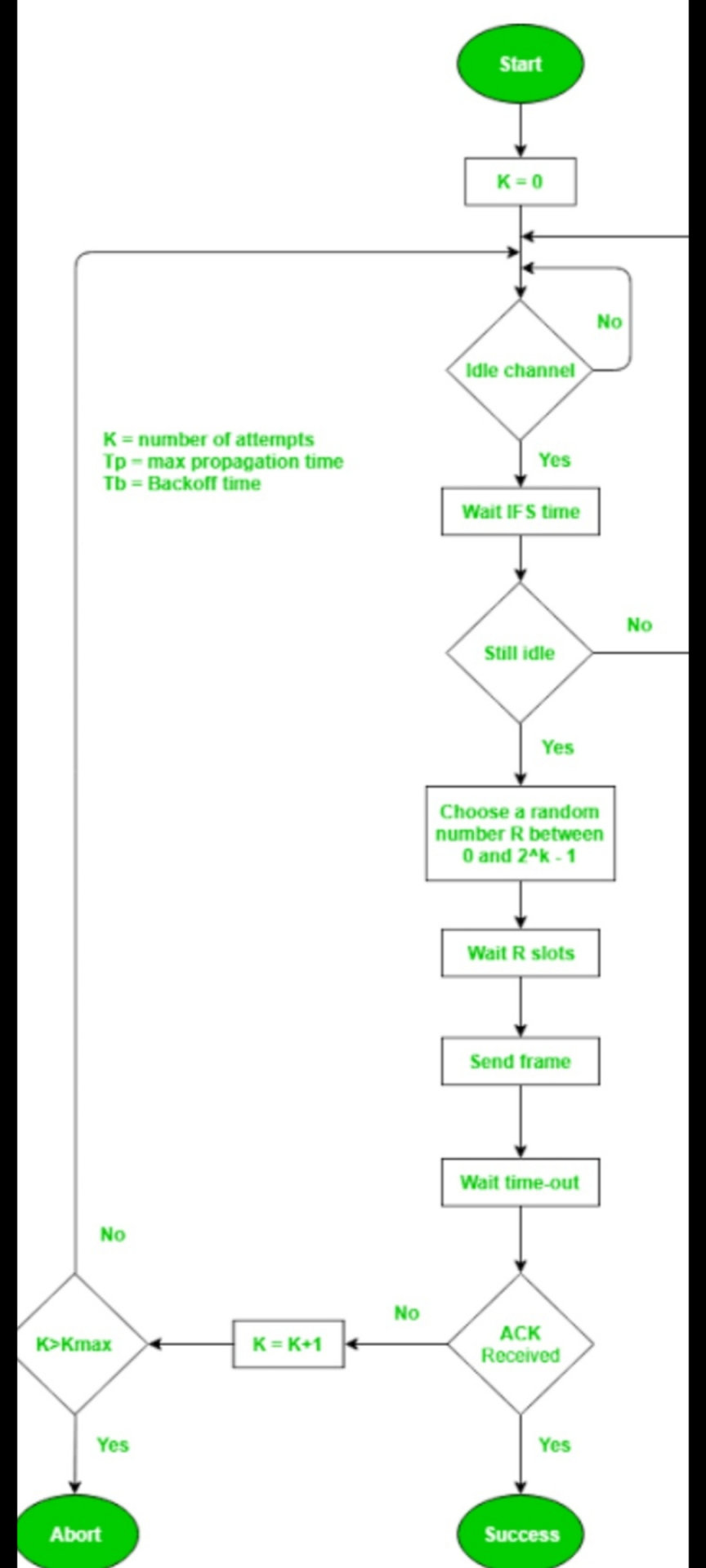
3- It uses three stages to avoid from collision

- ★ IFS (Interface space )
- ★ Contention window
- ★ Acknowledgement

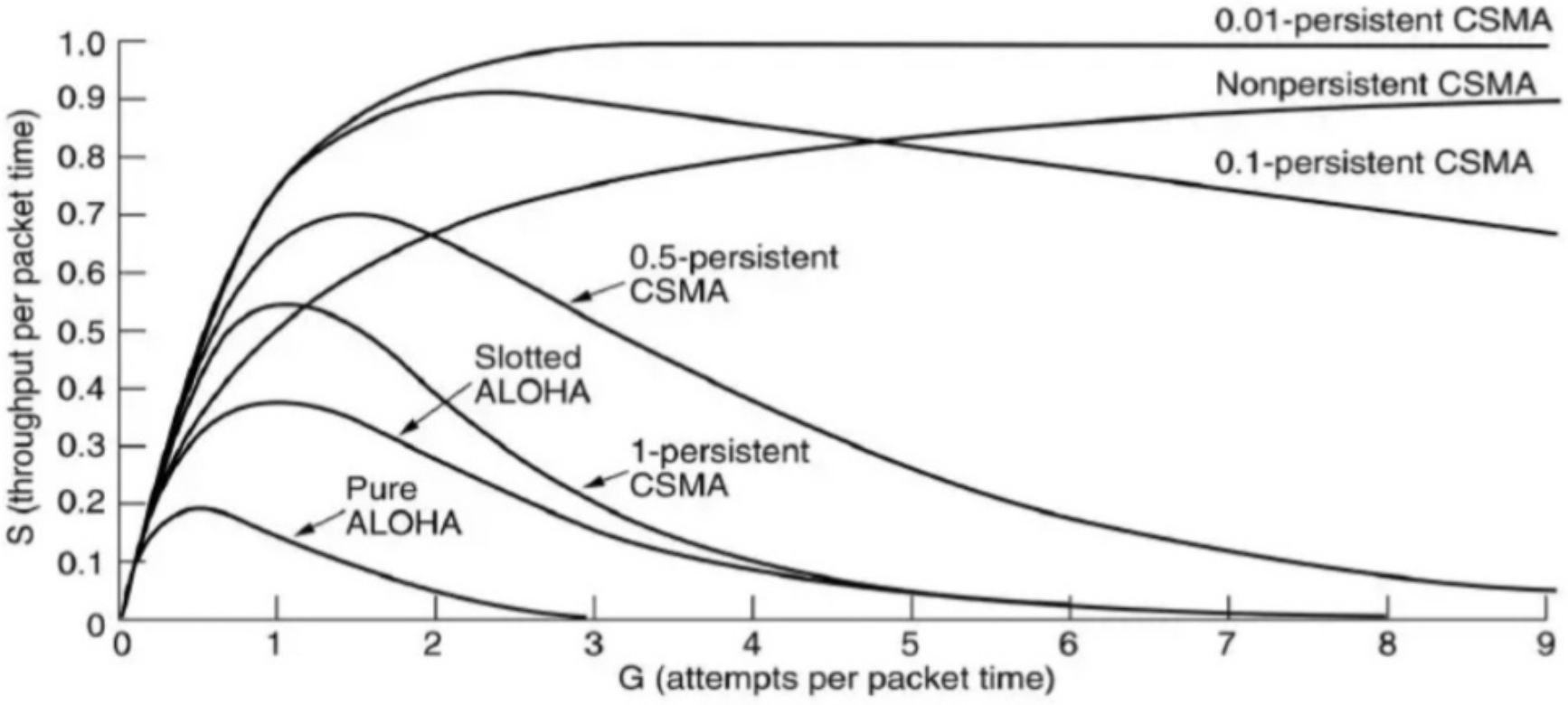
4-It use RTS= Request to send

5- It use CTS= clear to send

6-its similar to CSMA, but instead of sending packets control frame are exchanged


Start
K = 0
Idle channel
No
Yes
K = number of attempts
Tp = max propagation time
Tb = Backoff time
Wait IFS time
Still idle
No
Yes
Choose a random number R between 0 and 2^k - 1
Wait R slots
Send frame
Wait time-out
ACK Received
No
Yes
K = K+1
K>Kmax
No
Yes
Abort
Success

# Comparison


0.01-persistent CSMA
Nonpersistent CSMA
0.1-persistent CSMA
0.5-persistent CSMA
Slotted ALOHA
1-persistent CSMA
Pure ALOHA
S (throughput per packet time)
G (attempts per packet time)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
1
2
3
4
5
6
7
8
9