# CSMA with Collision Detection (CSMA /CD)

Persistent and non-persistent CSMA protocols improve ALOHA by ensuring that no station begins to transmit when it senses the channel busy.

**CSMA/CD (Carrier Sense Multiple Access with Collision Detection)** protocol further improves ALOHA by aborting transmissions as soon as a collision is detected.

**The conceptual model:**

- To send data, a station first listens to the channel to see if anyone else is transmitting.
- If so, the station waits until the end of the transmission (1-persistent) or wait a random period of time and repeats the algorithm (non-persistent). Otherwise, it transmits a frame.
- If a collision occurs, the station will detect the collision, abort its transmission, waits a random amount of time, and starts all over again.

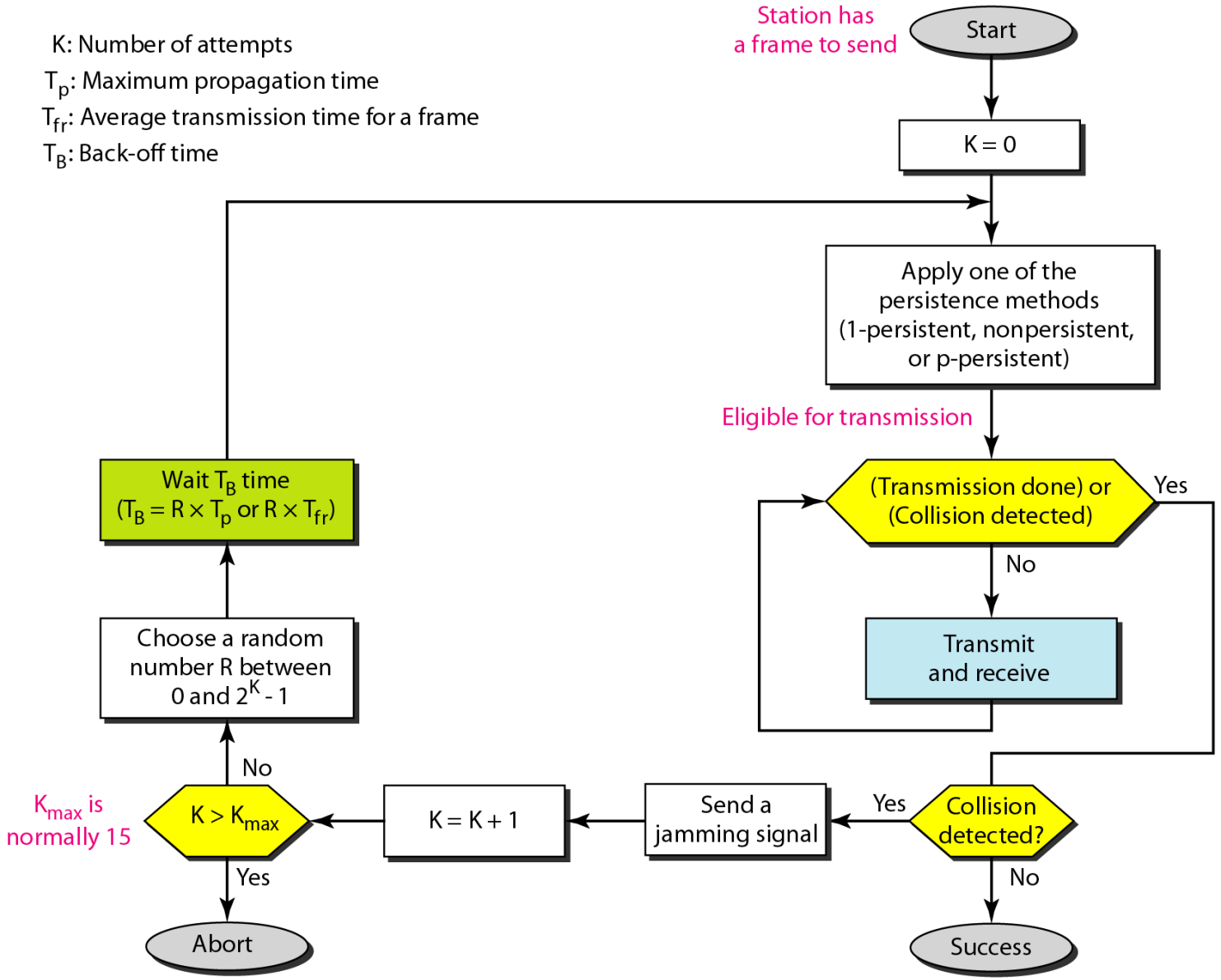
# Question

***A network using CSMA/CD has a bandwidth of 10 Mbps. If the maximum propagation time (including the delays in the devices and ignoring the time needed to send a jamming signal, as we see later) is 25.6 μs, what is the minimum size of the frame?***

## Solution

***The frame transmission time is $T_{fr} = 2 \times T_p = 51.2$ μs.***
***This means, in the worst case, a station needs to transmit for a period of 51.2 μs to detect the collision.***
***The minimum size of the frame is 10 Mbps × 51.2 μs = 512 bits or 64 bytes. This is actually the minimum size of the frame for Standard Ethernet.***

# Binary exponential back off algorithm used in CSMA/CD



**CSMA/CA Protocol** is used in wireless networks because **they cannot detect the collision** so the only solution is collision avoidance.

• CSMA/CA avoids the collisions using three basic techniques.

(i) Interframe space

(ii) Contention window

(iii) Acknowledgements

**1. Interframe Space (IFS)**

• Whenever the channel is found idle, the station does not transmit immediately. It waits for a period of time called interframe space (IFS).

• When channel is sensed to be idle, it may be possible that same distant station may have already started transmitting and the signal of that distant station has not yet reached other stations.

• Therefore the purpose of IFS time is to allow this transmitted signal to reach other stations.

• If after this IFS time, the channel is still idle, the station can send, but it still needs to wait a time equal to contention time.

• IFS variable can also be used to define the priority of a station or a frame.

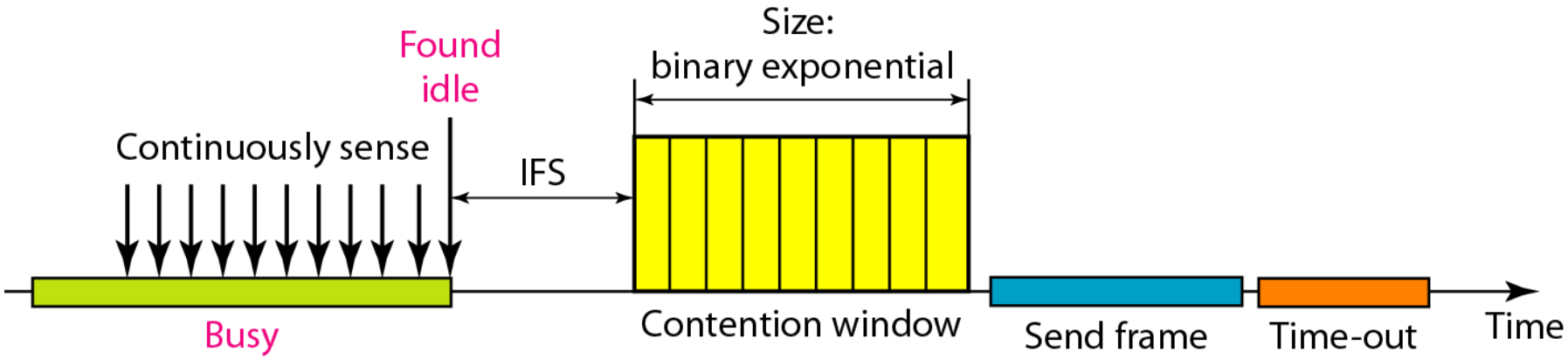
## 2. Contention Window

• Contention window is an amount of time divided into slots.
• A station that is ready to send chooses a random number of slots as its wait time.
• The number of slots in the window changes according to the binary exponential back-off strategy. It means that it is set of one slot the first time and then doubles each time the station cannot detect an idle channel after the IFS time.
• *This is very similar to the p-persistent method except that a random outcome defines the number of slots taken by the waiting station.*
• In contention window the station needs to sense the channel after each time slot.
• If the station finds the channel busy, it does not restart the process. It just stops the timer & restarts it when the channel is sensed as idle.

## 3. Acknowledgement

• Despite all the precautions, collisions may occur and destroy the data.
• The positive acknowledgment and the time-out timer can help guarantee that receiver has received the frame.

## *Timing in CSMA/CA*



# *Flow diagram for CSMA/CA*