




# **CSMA/CD, CSMA/CA & CONTROLLED ACCESS PROTOCOLS IN COMPUTER NETWORKS**

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**Multiple Access Protocols :-** If there is a dedicated link between the sender and the receiver then data link control layer is sufficient, however if there is no dedicated link present then multiple stations can access the channel simultaneously. Hence multiple access protocols are required to decrease collision and avoid crosstalk. For example, in a classroom full of students, when a teacher asks a question and all the students (or stations) start answering simultaneously (send data at same time) then a lot of chaos is created( data overlap or data lost) then it is the job of the teacher (multiple access protocols) to manage the students and make them answer one at a time.

Thus, protocols are required for sharing data on non dedicated channels. Multiple access protocols can be subdivided further as –

1. Random Access Protocols.
2. Controlled Access Protocols.
3. Channelization Protocols.

**Random Access Protocols:-** In this, all stations have same superiority that is no station has more priority than another station. Any station can send data depending on medium's state( idle or busy). It has two features:

1. There is no fixed time for sending data
2. There is no fixed sequence of stations sending data

# WHAT IS CSMA/CD?



- CSMA/CD protocol can be considered as a refinement and modification of pure "Carrier Sense Multiple Access" (CSMA).
- In a CSMA system, the chance of collision can be reduced if a station senses the medium before trying to use it, but it can not eliminate it.
- CSMA/CD is used to improve CSMA performance and it augments the algorithm to handle the collision.

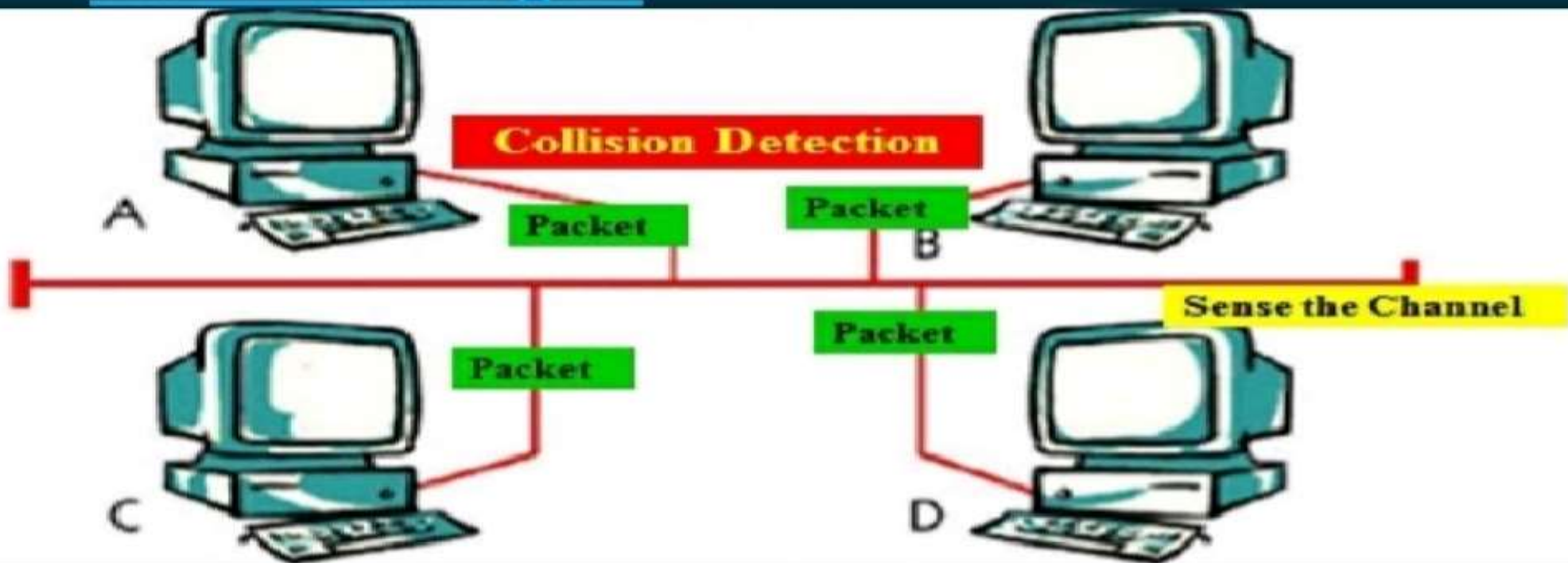
# CSMA/CD – INTRODUCTION:



- CARRIER SENSE MULTIPLE ACCESS with COLLISION DETECTION (CSMA/CD) is a MEDIA ACCESS CONTROL method used most notably in early ETHERNET technology for LOCAL AREA NETWORKING.
- This is used in combination with COLLISION DETECTION in which a transmitting station detects collisions by sensing transmissions from other stations while it is transmitting a frame.
- When this collision condition is detected, the station stops transmitting that frame, transmits a jam signal, and then waits for a random time interval before trying to resend the frame.

# CSMA/CD – CONCEPT:

- In CSMA/CD method, a station MONITORS the MEDIUM after it sends a frame to see if the transmission was successful. If so, the station is finished. If however, there is a Collision, the frame is sent again.



## RULES FOR CSMA/CD:-

If the medium is idle, then start transmitting; otherwise, go to **step 2**.

If the medium is busy, continue to listen until the channel is idle, then start transmitting immediately.

If during transmission a collision is detected, transmit a brief jamming signal to assure that all stations know that there has been a collision and then cease transmission.

After transmitting the jamming signal, wait a random amount of time, referred to as the back-off, then attempt to transmit again(start repeating from **step1**).

# HOW TO CSMA/CD PROTOCOL WORKS?

1.

**If Medium**  
**IDLE**

- TRANSMIT,
- Otherwise step 2

2.

**If Medium**  
**BUSY**

- WAIT until idle,
- Then, TRANSMISSION with  $p=1$

3.

**If Collision**  
**DETECTED**

- Transmit brief "**JAMMING SIGNAL**"
- ABORT Transmission

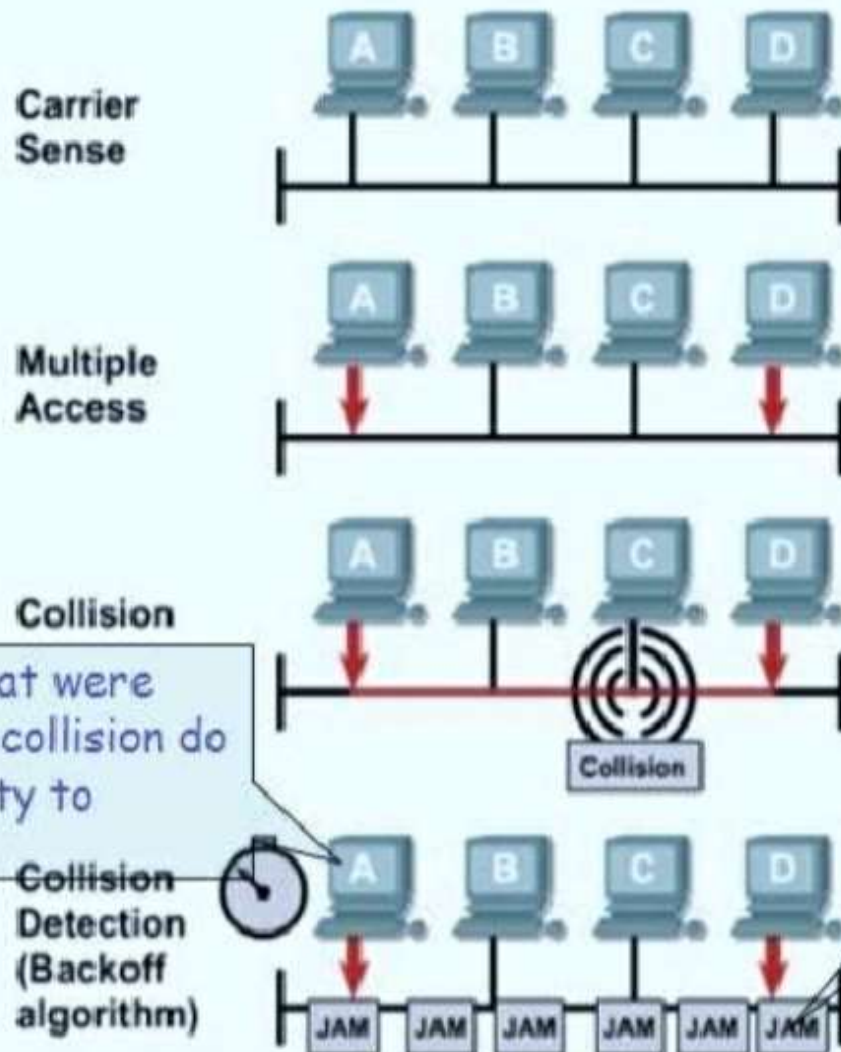
**After Aborting- WAIT RANDOM Time, Try again**

# FRAME FORMAT OF CSMA/CD

- **Preamble:-** A 7-octets pattern of alternating 0s and 1s are used to establish bit synchronization by the receiver.
- **Start Frame Delimiter(SFD):-** The sequence 10101011, which indicates the actual start of the frame and enables the receiver to identify the first bit of the rest of the frame content.
- **Destination Address(DA):-** Specifies the stations for which the frame is intended.
- **Source Address(SA):-** Specifies target station's address.
- **Length/Type:-** Length of LLC data field in octets format.
- **LLC Data:-** The LLC Data unit.
- **Pad:-** Octets added to ensure proper CD operation.
- **Frame Check Sequences(FCS):-** Used for error detection, a 32 bit cyclic redundancy check, based on all fields except preamble, SFD and FCS.



# COLLISION DETECTION PROCEDURE :



(JAM) When a collision occurs, each node that is transmitting will continue to transmit for a short time to ensure that all devices see the collision.

The devices that were involved in the collision do not have priority to transmit data.

Collision Detection (Backoff algorithm)

# COLLISION DETECTION METHOD :

Use one of the **“PERSISTENT METHOD”** as-

- Non-Persistent
- 1-Persistent
- P-Persistent

What should a station do if the channel is busy or idle?

Constantly monitor in order to detect one of two conditions:



Transmission is Finished or

A Collision is detected.

Proceed according to the conditions.

Sending of a short **“JAMMING SIGNAL”** that enforces the collision in case **other stations have not yet sensed the collision.**

## ADVANTAGES OF CSMA/CD :



**RELIABLE**; Collisions are detected and packets are re-sent, so no data is lost.



**Relatively FAST**; A computer does not have to wait its "turn" to transmit data.



**EFFECTIVE**; handle data collisions.

## DISADVANTAGES OF CSMA/CD :



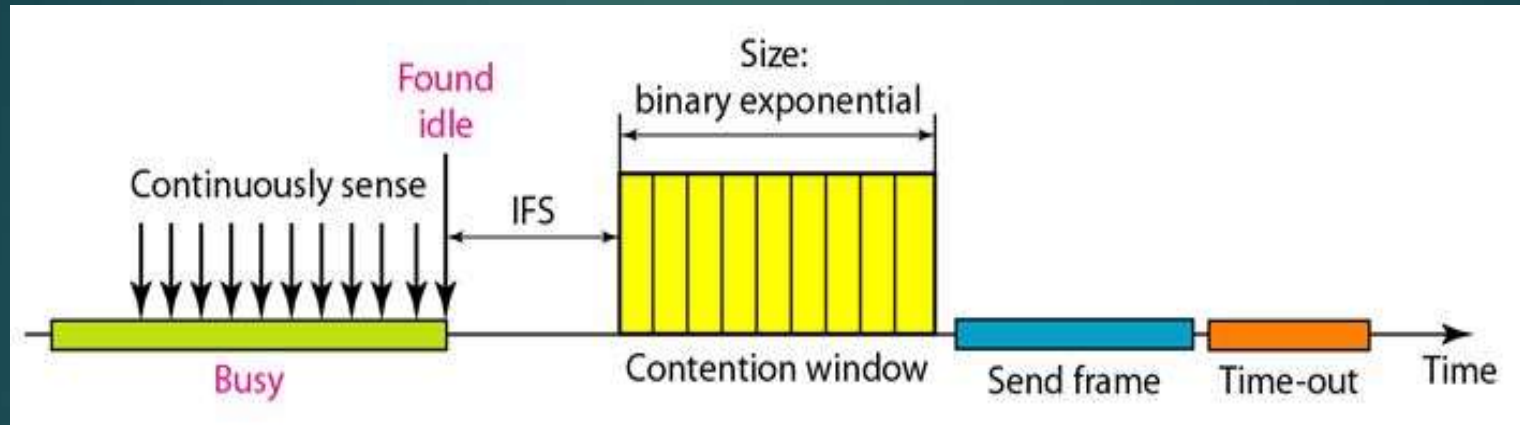
**LIMITED to 2500 meters/1 1/2 mile; The collision detection mechanism restricts the length of cable segment that can be used.**



**Inappropriate for LARGE/active networks; The slowdown increases, as the network grows larger.**


# WHAT IS CSMA/CA ?

- ▶ CARRIER SENSE MULTIPLE ACCESS WITH COLLISION AVOIDANCE (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 technique.
  1. Interframe Space
  2. Contension window
  3. 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).

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- 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.

# 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 is set of one slot the first time and then double 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 item slot.
- If the station finds the channel busy, it does not restart the process. It just stops the timer and restarts it when the channel is sensed as idle.

## Acknowledgement

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

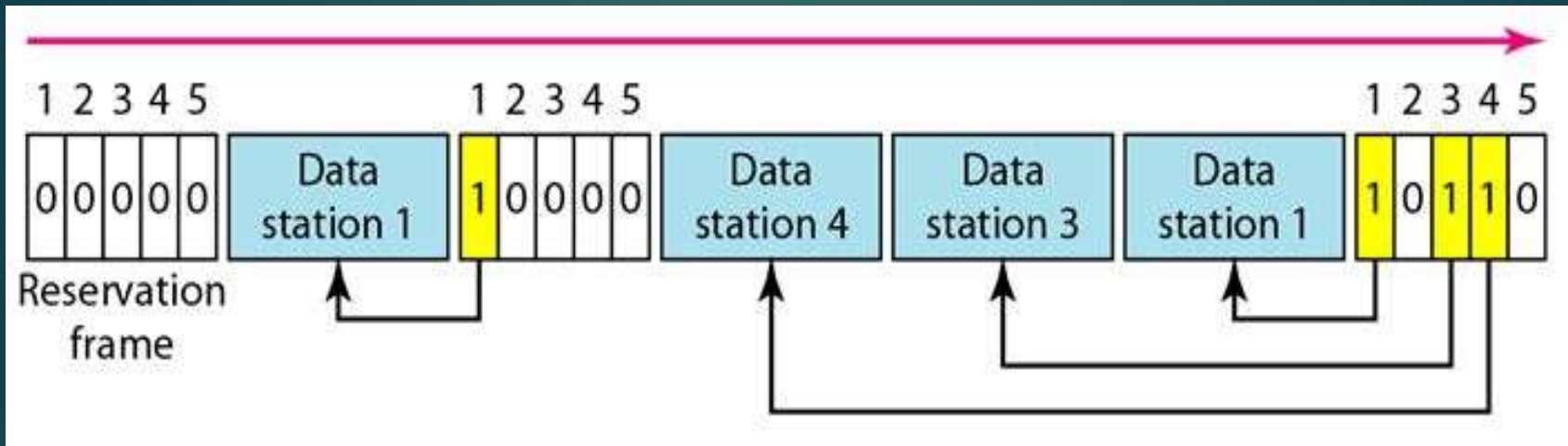


# CONTROLLED ACCESS PROTOCOLS :

- In this method, the stations consult each other to find which station has a right to send.
- A station cannot send unless it has been authorized by other stations.
- The different controlled access methods are:
  1. Reservation
  2. Polling
  3. Token Passing

## Reservation :

- In reservation method, a station needs to make a reservation before sending data.
- The 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 mini slots in the reservation frame.
- Each mini slot belongs to a station.
- When a station needs to send a data frame, it makes a reservation in its own mini slot.
- The stations that have made reservation can send their data frames after the reservation frame.



- A diagram shows a situation with five stations and a reservation frame with five mini-slots.
- In the first interval, only stations 1, 3 and 4 have made reservations. In second interval only station 1 has made a reservation.

## Polling :

- Polling method work in those networks where primary and secondary stations exist.
- All data exchanges are made through primary device even when the final destination is a secondary device.
- Primary device controls the link and secondary device follows the instructions.
- Polling method has two different modes, Poll and select.

# Token Passing :

- Token passing method is used in those networks where the stations are organized in a logical ring.
- In ring network, each station has a predecessor(station which is logically before other station) and a successor(station which is after the other station).
- In such networks, a special packet called token is circulated through the ring.
- Station that possesses the token has the right to access the channel and transmit its data.
- Whenever any station has some data to send , it waits for the token. It transmits data only after it get the possession of the token.
- After transmitting the data, the station releases the token and passes it to the next station in the ring.
- If any of the station that receives the token has no data to send, it passes the token to next station in the ring.