CSE 320 Date: 05/05/24

Chapter: 12
Multiple Access

Data link layer
- Data link control
- Multiple-access resolution. (this chapter).

Multiple Access Protocols

- Random Access Protocols
  - ALOHA
  - CSMA
  - CSMA/CD
  - CSMA/CA ✓
- Controlled Access Protocols
  - Reservation
  - Polling
  - Token passing ✗
- Channelization Protocols
  - FDMA
  - TDMA
  - CDMA ✗

শুধু just পড়বে, আর কিছুনা লাগবে না।

→ Random Access is also called Contention

Random Access: No station will be superior than other stations. Every stations are random. No station is assigned to control over another station to send. Everything is random, so the main problem will be collusion.

For 2 features this protocol is called random access :-

i) No scheduled time to send data

ii) No rules (no order of sending data)

→ Due to random access, there will be a problem which is known as collision. Then the data will be discarded.

ALOHA

→ the earliest random access method.

→ two parts

- Pure ALOHA (original)
- Slotted ALOHA (modified).

2 types of question from ALOHA

i) Scenario will be given, then we have to identify the method and write about it.

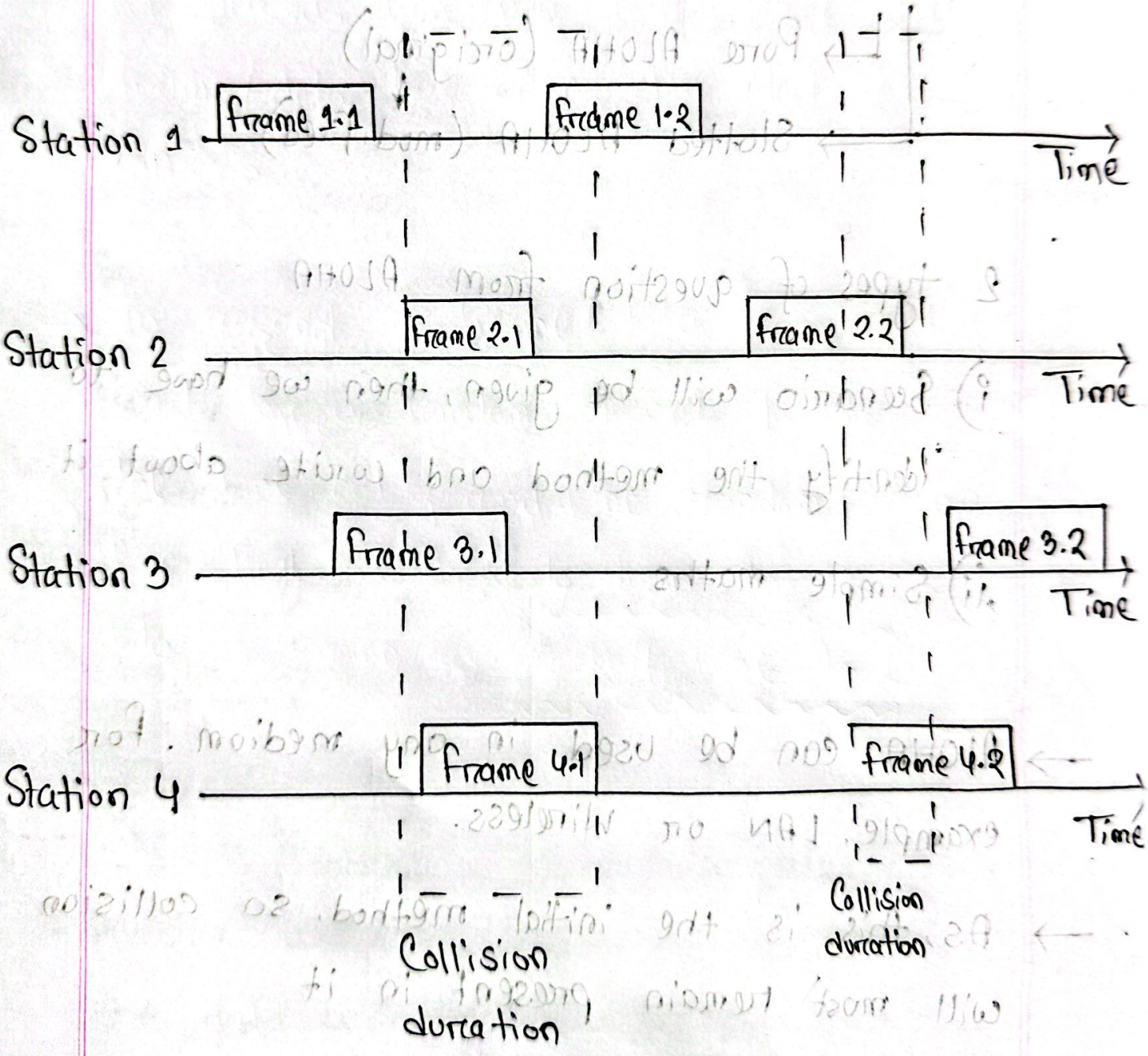
ii) Simple maths

→ ALOHA can be used in any medium. For example: LAN or Wireless.

→ As, this is the initial method, so collision will must remain present in it.

Pure ALOHA

idea: each station sends a frame/data whenever it has a frame/data to send.



প্রত্যেকটা frame এর একটা (T) transmission duration আছে, frame 1.1 এর নিচে কোন

frame নাই, so এটির আর কারোর collision হবে না। কিন্তু, frame 1.2, 2.1; Frame 3.1 and frame 4.1 collision হবে কারণ এরা একদম time এ send হবে যখন কিনা আরো অন্য frame ও send হবে, so তারা collide করবে, Same goes with the frame 2.2 and 4.2. Again, frame 3.2 will be transmitted properly without any collision.

The frames/ data which will be discarded needs to be send again. Efficiency is very less.

→ the way how the system identifies that the data/frame is discarded or not is, if a data goes to the receiver end, the receiver sends a flag/acknowledgement to the sender and, this is how, sender understands that the data went properly or not

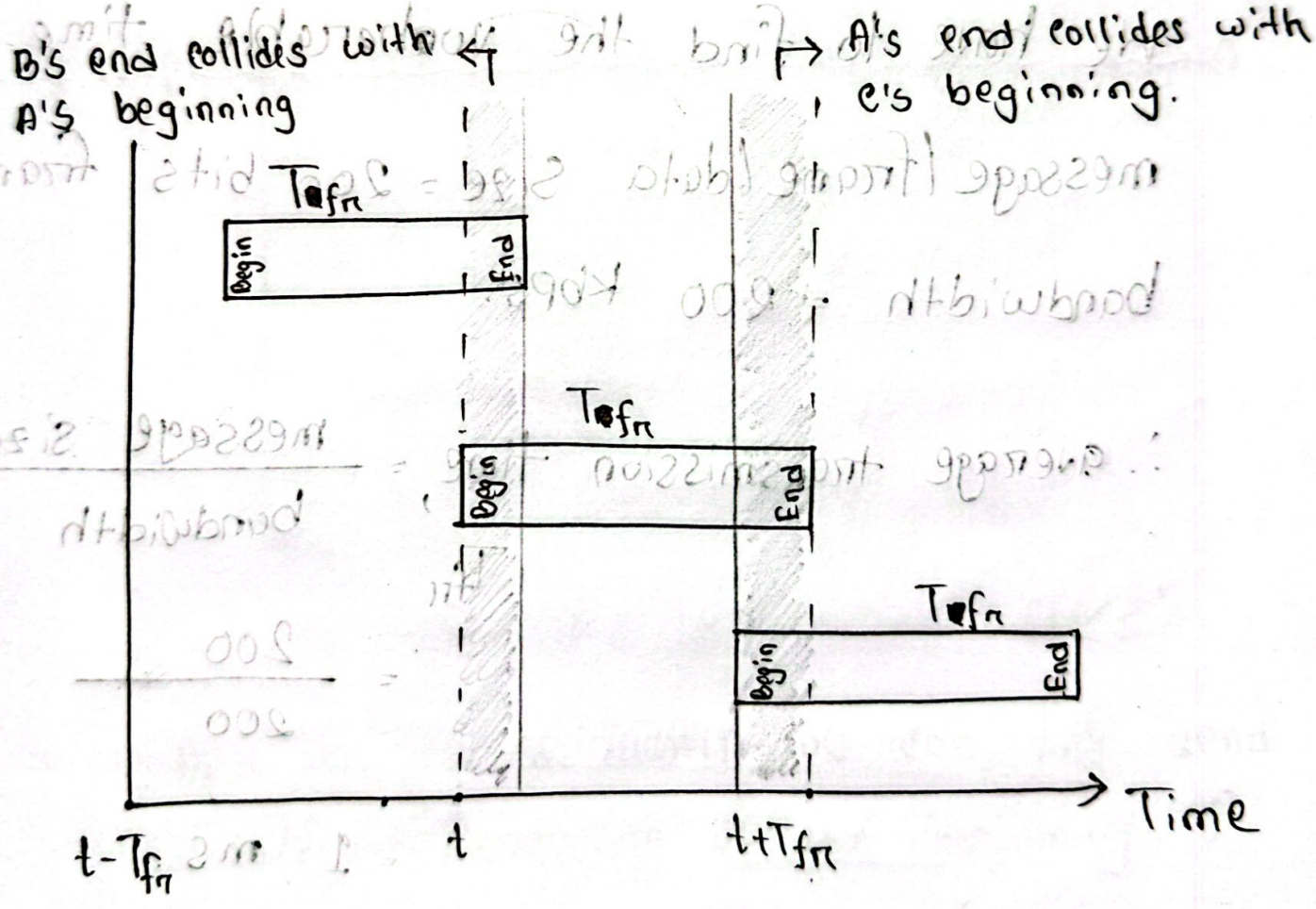
→ There is also a {time out period} to get the acknowledgement. If we don't get the acknowledgement ~~after~~ before the time out period, then we will assume that the frame/data has been discarded due to collision.

→ To resend a frame/data, we need to wait for a random amount of time after the time-out-period. The random amount of time that we have to wait to resend the data is known as {Backoff time, T_b}.

Vulnerable time for pure ALOHA Protocol

→ T_{fr} = average transmission time = $\frac{\text{message size}}{\text{bandwidth}}$

→ every message / data / frame has a begining and a ending.



Vulnerable time = $2 \times T_{fr}$

↳ after this time it will be collision

* A pure ALOHA network transmits 200-bit frames on a shared channel of 200 kbps. What is the requirement to make this frame collision free.

Solution:

We have to find the vulnerable time.

message / frame / data size = 200 bits frame.

bandwidth = 200 kbps.

$$\therefore \text{average transmission time, } T_{fr} = \frac{\text{message size}}{\text{bandwidth}}$$

$$= \frac{200}{200}$$

$$= 1 \text{ ms}$$

$$\therefore \text{Vulnerable time} = 2 \times T_{fr}$$

$$= 2 \times 1$$

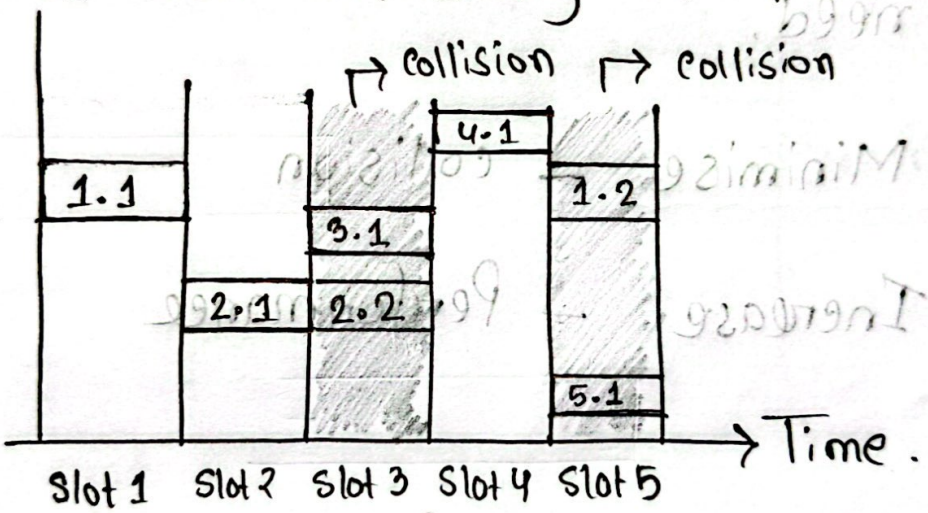
$$= 2 \text{ ms}.$$

SLOTTED ALOHA

→ in slotted ALOHA the time is divided into slots of T_{fr} seconds.

→ Stations can send frames only at the beginning of the time slot.

→ improves the efficiency of pure ALOHA.



T_{fr} time = per slot

∴ And in slotted ALOHA we can only send data/frame/message at the beginning of the slot.

And, we know each frames transmission time = T_{fr}

Slot এর শুরুতে data send করতে পারব না,

∴ Vulnerable time = T_{fr}

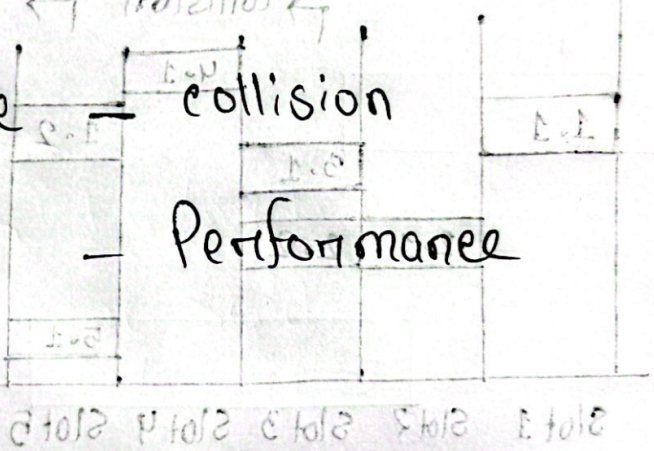
Carrier Sense Multiple Access

→ Sense the medium before sending frame.

→ Reduce the possibility of collision, but it cannot eliminate it due to propagation delay.

* Propagation Delay / Propagation time = $\frac{\text{Distance}}{\text{Propagation Speed}}$

We need,



Minimise — collision

Increase — Performance

CSMA based on Principle

→ Sense before transmit

or

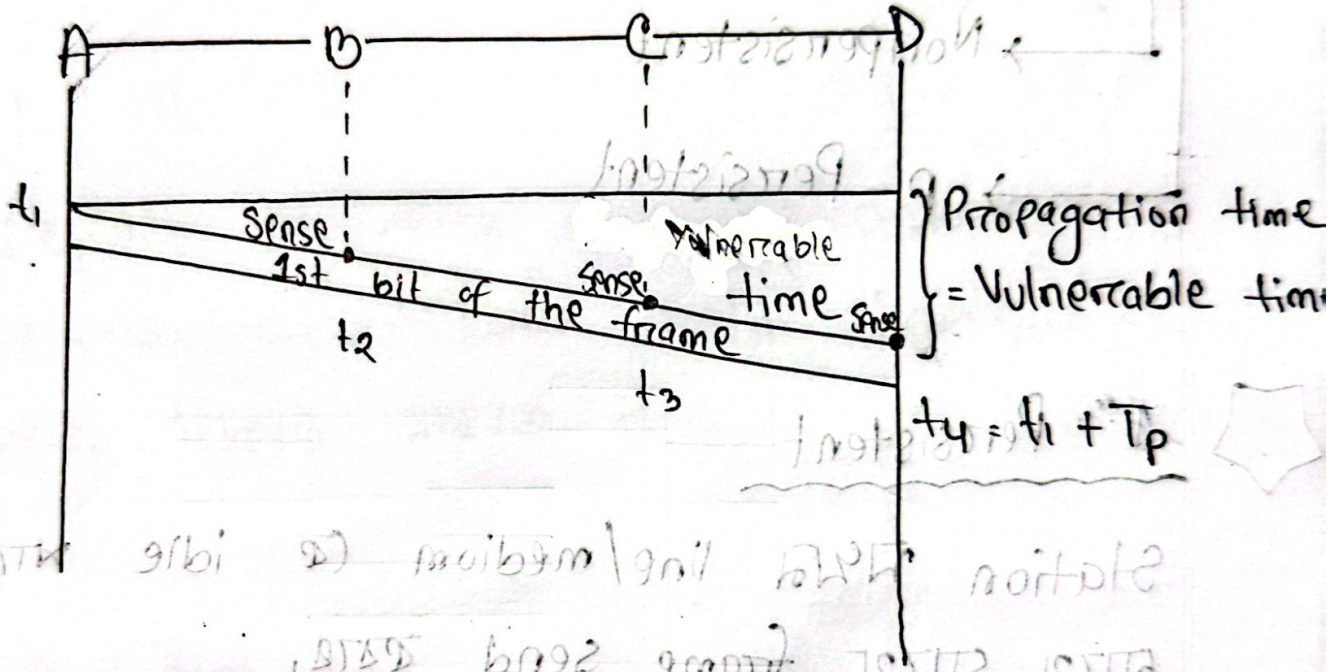
listen before talk.

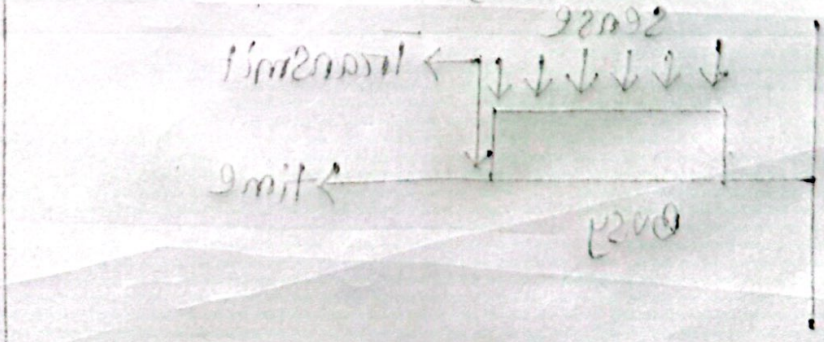
→ CSMA collision ~~2টা~~ propagation time এর জন্য হয়।

→ Vulnerable time = Propagation time

V.T = Tp for CSMA.

Vulnerable time in CSMA





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Behaviour of three persistence methods of CSMA

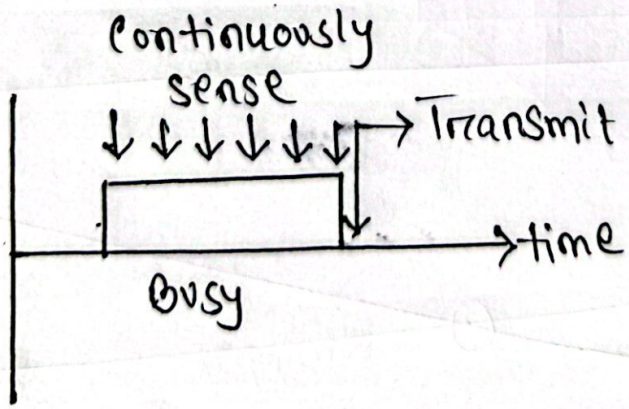
3 methods

- 1 - Persistent
- Nonpersistent
- p - Persistent

1 + Persistent

Station যখন line/medium কে idle পায় তখন সাথে সাথে frame send করে।

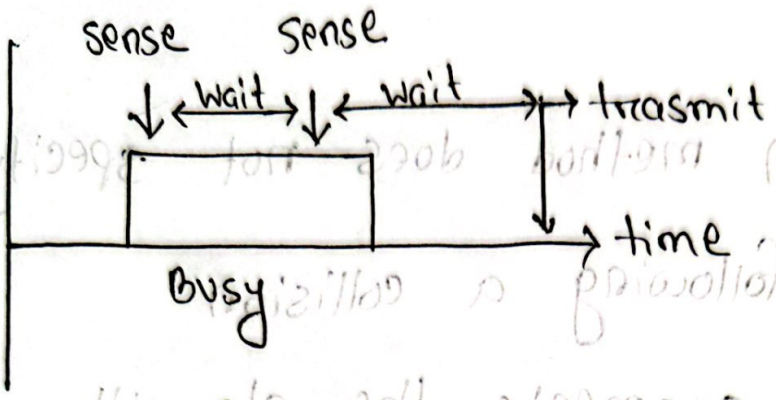
→ Highest Chance of collision



1 - persistent

Continuously sense করতে থাকে, খালি বোঝাই পাঠায় দিবে Data.

Nonpersistent

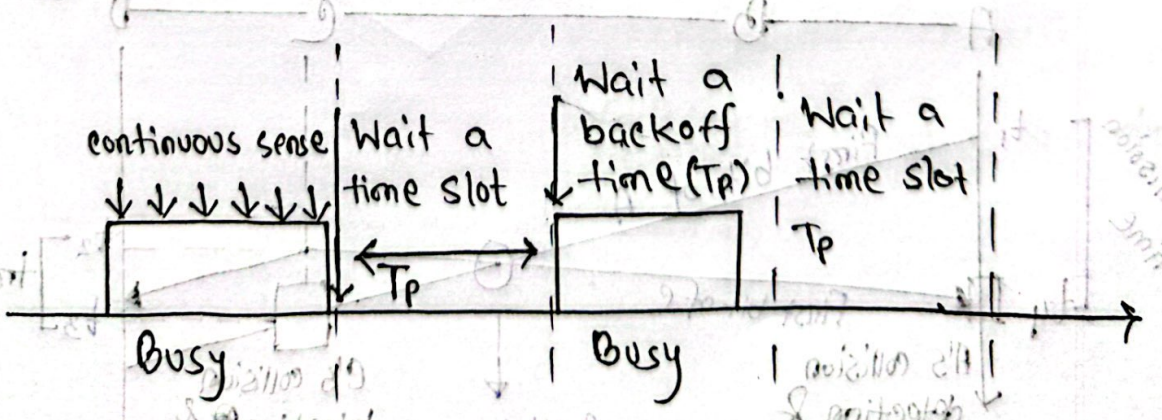


প্রথমে কোনো random amount of time wait করে sense করে then transmit করার Data.

Efficiency less কারণ random amount of time এ wait করতেছি তখন channel/line already ফাকাও থাকতে পারে।

P-persistent:

একটা time slot দেয়া থাকবে প্রত্যেকটা station এর জন্য, এই time slot duration =< than propagation (Tp) time এর উপর Depend করে এই method.



Carrier Sense Multiple Access with Collision Detection

CSMA/CD:

→ The CSMA method does not specify the procedure following a collision

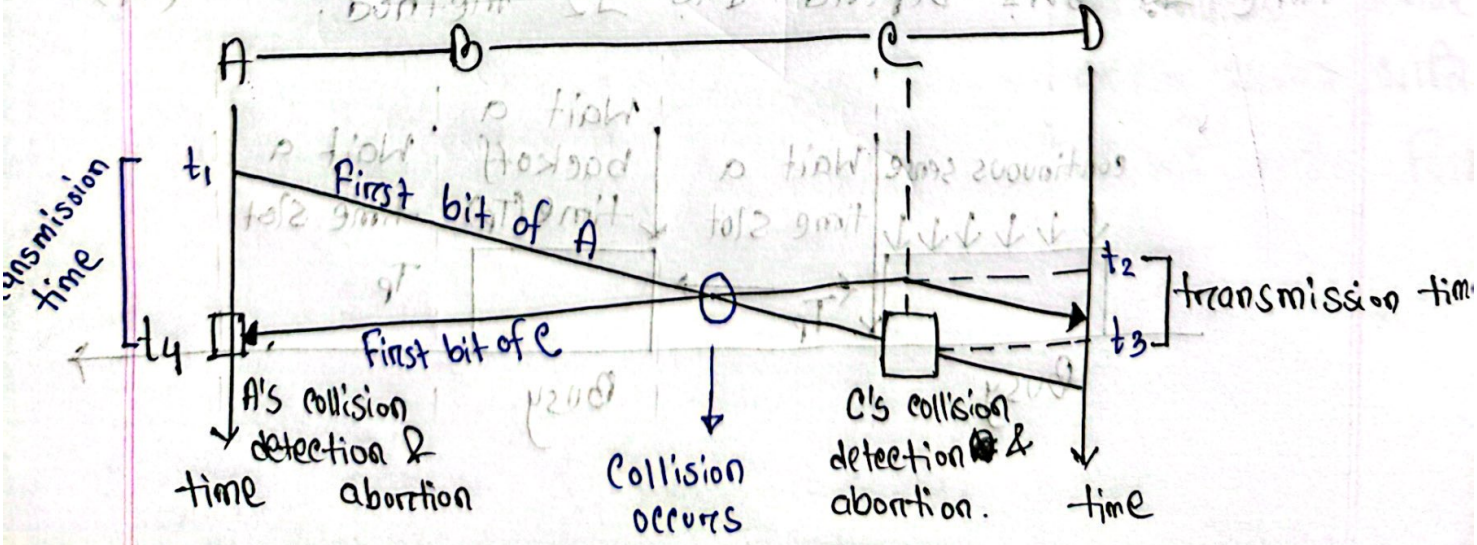
→ CSMA/CD augments the algorithm to handle the collision.

→ the medium is monitored continuously by each station

→ if there is a collision

↳ immediately aborts transmission

↳ the frame is sent again.



Transmission time, T_{fr} = 2× Propagation time ($2T_p$)

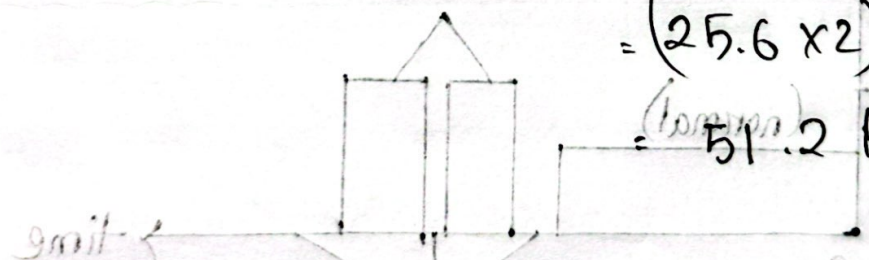
* A network using CSMA/CD has a bandwidth of 10 Mbps. If the maximum propagation time (including the delays in the devices and ignoring the time needed to send a jamming signal, as we see later) is 25.6 Ms, what is the minimum size of the frame.

Solution:

Frame transmission time, $T_{fr} = 2 \times T_p$

$= (25.6 \times 2)$ Ms

$= 51.2$ Ms.



This means, in the worst case, a station needs to trasmit for a period of 51.2 Ms to detect the collision.

The minimum size of the frame is 10×51.2

$= 512$ bits

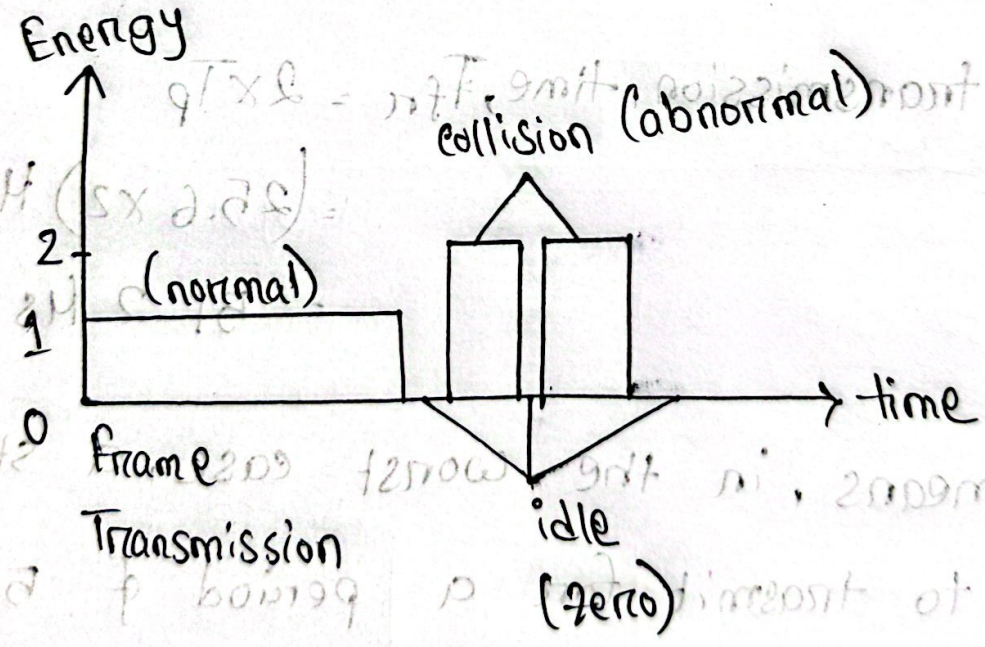
$= 64$ bytes.

1 bit = .125 byte

(5) Energy level during transmission, idleness or collision

In a channel, there can be 3 types of energy level

- zero (idle)
- normal (sending)
- abnormal (collision) [Normal energy x 2]



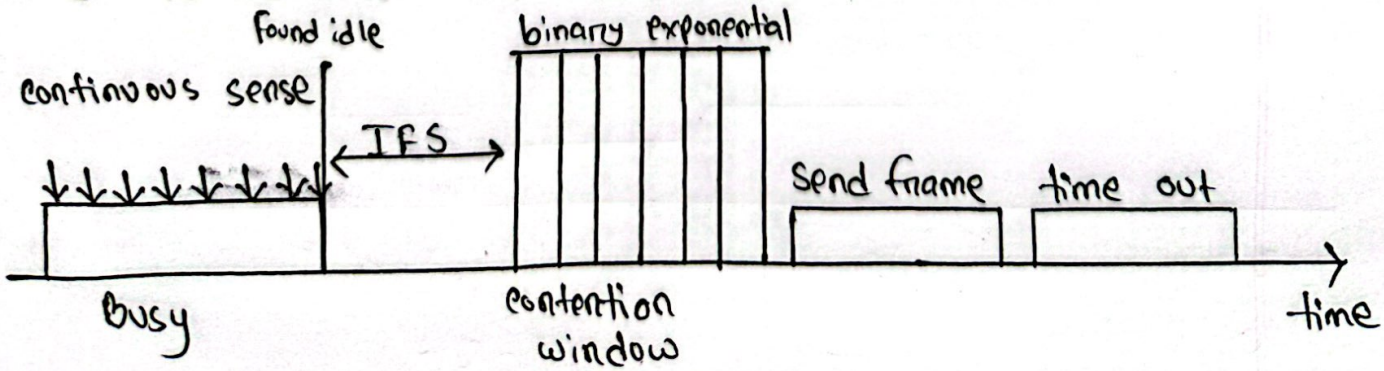
Carrier Sense Multiple Access with Collision Avoidance

CSMA/CA (for wireless)

Collisions are avoided using 3 strategies:

→ The interframe space (IFS)
→ The contention window (similar to p-persistent)
→ Acknowledgement.

if we get a channel idle, we won't send frame immediately. We wait some time and that time is (IFS). After that if we again, get the channel idle we again wait for some time. This is contention window, and this time is divided in some slots.



→ In CSMA/CA, the IFS can also be used to define the priority of a station or a frame.

→ Acknowledgement or time out is used to understand that the data has been received properly by the receiver. Acknowledgement is like a positive flag sent to the sender by receiver.