Medium access control sublayer

→ This layer deals with the broadcast networks where the key issue is how to determine who gets to use the channel when there is a competition for it.

→ Broadcast channels are called multi-access channels or random access channels.

→ The protocols used to determine who goes next on a multi-access channel belong to a sublayer of data link layer called mac medium accessed control sublayer.

Many algorithms for allocating multiple access channels are known.

1) ~~At~~ ALOHA

In 1970's, Norman Abramson and a team of members at the University of Hawaei devised a method to solve the problem of channel allocation. They named this work as ~~Alo~~ ALOHA system which use the ground based radio broadcasting.

The 2 version of ALOHA are

i) pure ii) slotted

The difference in the 2 method is with respect to the time.

PURE ALOHA

The basic idea of ALOHA system is let the users transmit whenever they have data to be send which leads to the problem of the collision. Frames may be damaged. The feedback property of

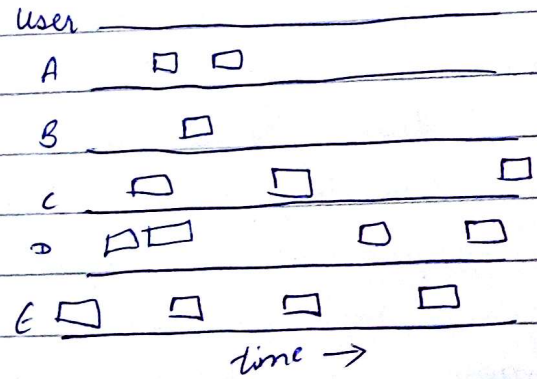
broadcasting tells the sender whether the frame is destroyed by listening to the channel.

With a LAN the feedback is immediate but with wireless network there may be a delay.

If the frame was destroyed the sender just waits a random amount of time and sends it again.

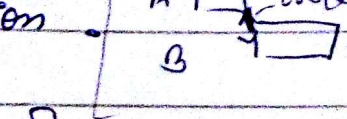
The waiting time must be random to avoid the collisions over and over. Systems in which multiple users share a common channel in a way that can lead to conflicts are known as contension systems.

In pure ALOHA frames are transmitted at arbitary times. as shown.



whenever 2 frames try to occupy the channel at the same time there will be a collision and both will be garbled.

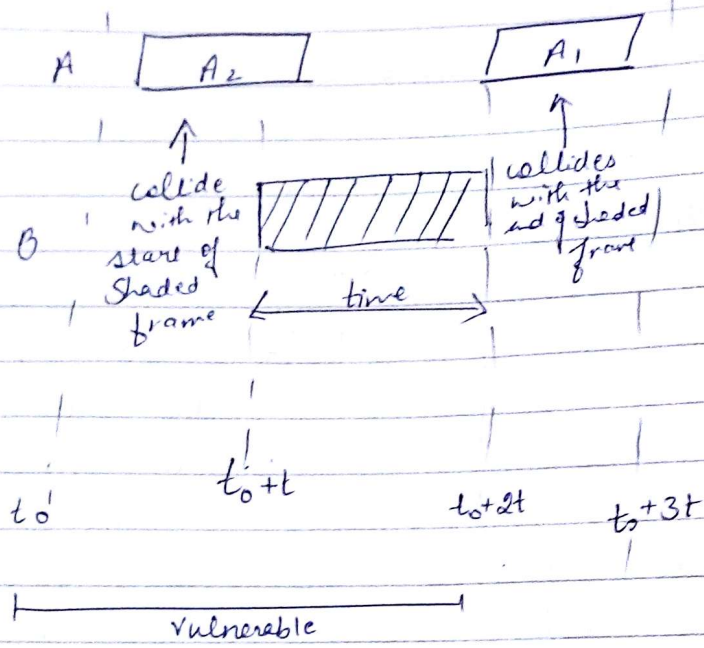
If the first bit of new frame overlap the last bit of frame almost finished, both the frames will be totally destroyed & need re-transmission.



Q what is the efficiency of an ALOHA channel?
Q what fraction of all transmitted frames escape collision under chaotic circumstances.

Assumption :- An infinite collection of interactive users sitting at their computers. A user is always in one of the 2 states, typing or waiting. Initially all users are in the typing state when a line is finished a user stops typing waiting for a response. The station then transmits the frame containing the line and checks the channel to see if it was successful. If so, the users sees a reply and goes back to typing. If not, the user continues to waits & the frame is retransmitted over & over until it has been successfully sent.

Let the frame time denotes the amount of time needed to transmit fixed length frame. (frame length / bit rate)
At this point we assume that infinite users generate new frames with a mean of N frames / frame time. If $N > 1$, the user community is generating frames at a higher rate than the channel can handle and nearly every frame suffers a collision.
In addition to the new frame, the station also generates re-transmission of frames that previously suffered collision.
We assume that the probability of k transmission attempts per frame time.



Slotted ALOHA

In 1970, Roberts devised a method for doubling the capacity of ALOHA by dividing the time into discrete intervals. Each interval corresponding to one frame which requires users agreement on slot boundaries. This is called slotted ALOHA.

CSMA protocols

In LAN, if it is possible for stations to detect what other stations are doing & adapt there behaviour accordingly.

Protocols in which station listens for a carrier and act accordingly are called carrier sense protocols.

1-Persistent and Non persistent CSMA

The first carrier sense protocol is called 1-persistent CSMA. When a station has data to send, it listens to the channel to see if anyone else is transmitting at that moment.

If the channel is busy, the station waits until it becomes idle. When the station detects an idle channel, it transmits a frame.
If collision occurs the station waits a random amount of time & retransmits again.

If the first station signal has not yet reached the second one the latter will sense an idle channel & will also begin transmission resulting in collision.

non-persistent CSMA

In this protocol a conscious attempt is made to be less greedy than previous. Before sending, station sense the channel, if no one else is sending the station begins doing itself. However if channel is already in use, the station does not continuously sense it for the purpose of seizing it immediately upon detecting the end of previous transmission instead it waits a random amount of time and then repeats the algo.

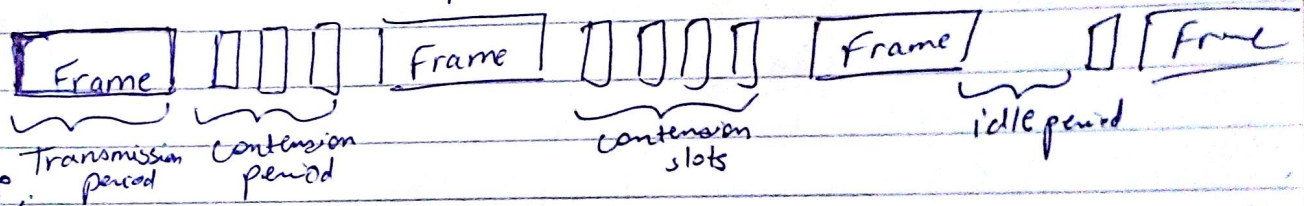
p-persistent CSMA

This is applied to slotted channels where when a station becomes ready to send, it sends the channel if it is idle it transmits with a probability p with a probability $q = 1-p$ it defers until the next slot. If that slot is also idle, it either transmits or defers again. This process is repeated until either the frame has been transmitted or another station has begun transmission.

CSMA with collision detection

Persistent & non-persistent CSMA are better as compared to ALOHA because they ensure that no station begins to transmit when it senses the channel busy. Another improvement is for stations to abort their transmission immediately as they detect collision. Rather than finishing the transmission of the frames which are garbled, the sender should stop transmission as soon as collision is detected which says time & bandwidth. This protocol is known as CSMA/CD

CSMA uses the conceptual model



3/Nov 2016

Ethernet

The IEEE has standarized a no. of LAN's & MAN's under the name of IEEE802. The most important are
IEEE 802.11 wireless LAN. IEEE 802.15 → bluetooth
IEEE 802.16 → wireless man.

Ethernet cabling

Ethernet refers to the cable i.e ether cable.
4 types of cabling are commonly used

speed mbps / Name (baseband signaling, length of segment)	cable	Max Seg	Nodes/seg	Advantages
10 Base 5 (Thick ethernet)	Thick coax	500 m	100	obsolete
10 Base 2	Thin coax	185 m	30	No hub needed. cheap & easy to install
10 Base-T	Twisted pair	100 m	1024	cheapest
10 Base-F	Fiber optics	2000 m	1024	Best b/w buildings

MEMORY UTILISATION

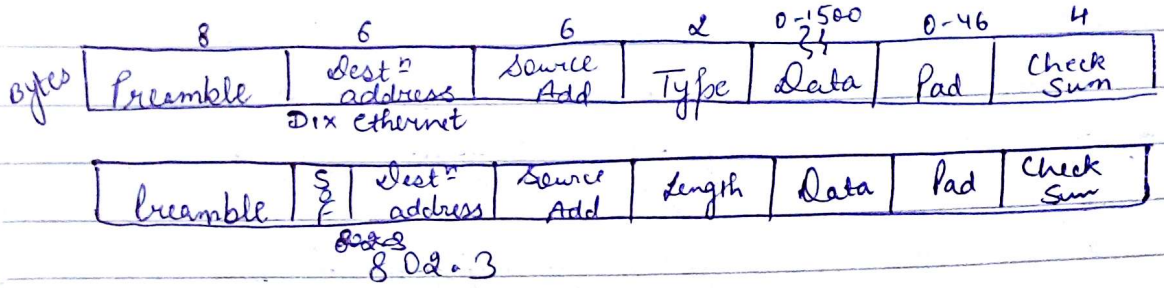
- 10 Base 5 is also known as thick ethernet connections to the cable are generally made with the help of vampire taps (we can tightly bind 2 wires by vampire taps)
- 10 Base 2 is also known as thin ethernet. It bends easily. Connections to this are made using ~~vm~~ BNC connectors to form T-junction. It is cheaper & easier to install. Detecting cable breaks, excessive length, bad taps or loose connectors can be a problem. different techniques are used to deal with these problems. eg:- a pulse of known shape is injected into the cable if the pulse hits an obstacle or end of the cable an ~~eco~~ echo will be generated and sent back. By looking at timing interval b/w signal sent & echo received, it is possible to localise the origin of the echo. This technique is known as time domain reflectometry.

- 10 Base-T :- In this, all the stations have a cable running to a central hub in which they all are connected. these wires are twisted pairs. Hubs do not buffer incoming traffic.

- 10 Base-F uses fibre optics which makes it expensive due to the cost of connectors and terminators but it has excellent noise immunity.

- There are different ways of wiring a building

Ethernet MAC sublayer protocol



→ The high order bit i.e preamble of 8 bytes contains the bit pattern 10101010.

→ Destination address - The highest order bit (from left) of destination address defines whether its an ordinary or group address 0 define ordinary & 1 define group address.

→ Group address allow multiple stations to listens to a single address when a frame is sent to a group address all the stations in the group receive it.

→ Sending a message to a group is called multi-cast. The address consisting of all 1 bits is reserved for broadcasting.

→ Type field tells the receiver what to do with the frame (it specifies which process to give the frame to)

→ Data field specifies the data to be transmitted.

→ If the data portion of the frame is less than 46 bytes then padding field is used to fill out the frame to min. size of 64 bytes.

→ Checksum - This field is basically used for error detection.

→ The length field is used to measure the length of frame

→ Any no. less than or equal to 1500, can be interpreted as length any no greater than 1500 can be interpreted as type.

→ The layer matters because diff devices use different pieces of info to decide how to switch

Appln	—	gateway
Transport	—	"
Network	—	Router
DLL	—	Bridge, Switch
Physical layer	—	Hub / Repeater

* Repeaters are analogue devices connected to 2 cable segments Signal appearing on one cable is amplified and put on the other cable.
* Hubs - A hub has a no. of input lines that it joins electrically. Frames arriving on any of the lines are send out on all the others.
All the lines coming into a hub must operate at the same speed. Hubs do not amplify the incoming signals
* Bridge - A bridge connects 2 or more LAN's when a frame arrives software in the bridge extracts the destr address from the frame header and looks it up in a table to see where to send a frame.
* Switch - Switches are similar to bridge. Both route on frame addresses, Switches are most used to connect individual computers. Each switch port usually goes to a single computer. Modern switches start forwarding frames as soon as the destination header field has come in. Smart switches are also known as cut-through switches
* Gateways - These are used to connect 2 computers that use different connection oriented transport protocol. The transport gateways copy the packets from one connection to the other reforming them as needed. It helps to

translate the messages from one format to other.

Ans

At 1Kbps

0.1% → receiver interpret faster.

$\frac{0.1}{100} \times \overbrace{1000}^{1Kbps}$

$= \frac{0.1}{1000} \times 1000$ ---

line coding schemes

Only 3 in syllabus

1) unipolar — NRZ (not return to zero)

Polar

Bipolar — AMI (alternate mark inversion)

unipolar — 0 → -ve, 1 → +ve voltage

0 → 0 voltage

polar NRZ-L (level) 0 → +ve

1 → -ve

NRZ-I (inversion) 0 → no change

1 → change.

Biphase

Manchester 0 → high to low

1 → low to high