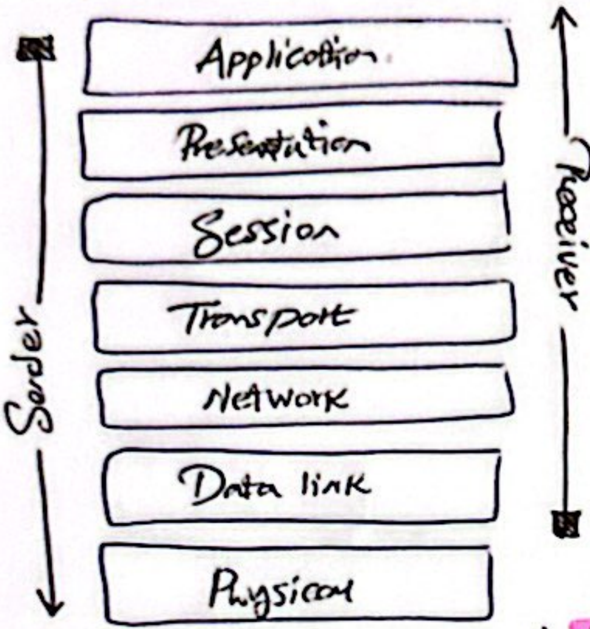
Protocol:

a Set of rules that Control data CoMMunication.

Layered Architecture:



Physical:

responsible for Movement of bit's frome one node to the next.

Data link:

responsible for Movement of frames from one node to the next.

- physical addressing (MAC) ← 48 bit (6 byte)
- flow control

Network:

responsible for the delivery of the packets from the Sender to the resiver.

- Logical addressing
- routing

⊛ if tow diriesses in diffrenet LAN we need we need also the Logical address

the Concept:

a set of task's implement separately to process data during communication.

Transport:

responsible for delivery of a Message from one process to anther

- port addressing (16 bits or less)
- connection control (oriented ← resiver must agree, less ← dont care)
- Segment's

Session:

responsible for dialog control and Synchronization ← Cheack points

Presentation:

responsible of translation

Application:

responsible of providing Seririses to the user.

- allow to network resources

TCP/IP ~~Model~~ protocol application — application, session, ...

telecommunication:

- mean communication at distance.

Data Communication:

- exchange of Data between tow devices via some form of transmission Medium such as wire cable or wireless.

Componente of Data Communication:

- Message
- Sender
- receivar
- Medium
- Protocal (rule's)

Protocall:

the set of rulse that control the exchange of Data between devices or nodes in the network

Data flow:

Simplex $\xrightarrow{\text{One way}}$

Half-duplex $\overset{\text{One way at time}}{\rightleftarrows}$

full-duplex $\xleftrightarrow{\text{both way all the time}}$

Data Representation:

- Text
- Number's
- images
- Audio
- Video

Network:

- is a set of divice's (node's) conected by communication links

Types of Conaction's:

Point to Point

- a dedicated link between to device's

Multipoint

- More than two device's share a single link

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Physical Topology

Mesh

- every device has a point to Point link to every other one.

+

- less traffic
- Secure
- robus
- easy to Maintain

−

- More resource
- expensive

* it's have a $n(n-1)/2$ full-duplex links

Star

- every device have a point to point link to a Centeral Controllar → (hud).

+

- Cheap
- robustness
- easy to install and reconfiguer

−

- Singl point of failure

* No direct traffic and link between device's

Bus

- all devices are connected to a bus cable by drop lines and taps.

+

- easy to install

−

- Difficult to reconnection
- brek or fault of the bus stop's all transmission
- no fault isolation

* all devices are linked through a backbone cable

- Multipoint Topology

Ring

- every device have a point to point with tow devices on either side of it.

+

- easy to install and reconfigure
- fault isolation is good

−

- Unidirectional traffic

Tree

- integrate Muliple Topology together.

Chapter 2 (physical layer)

- **Signals**
  - **Analog**
    - Periodic
      - Simple
        - Sin wave
      - Composite
        - Freq-Domin
    - Nonperiodic
      - Bandwith
  - **digital**
    - periodic
    - Nonperiodic

* Digital signal is a composite analog signal with infinit bandwith.

⊕ **Baseband transmission** of digital signal that preserves the shape of the digital signal is possible only in low-pass channel with infinit or very wide Bandwith.

⊕ **Bandpass Channel:** We can not send the digital direct we need to transform the signal to analog then send it.

Chapter 2 Lecture 3

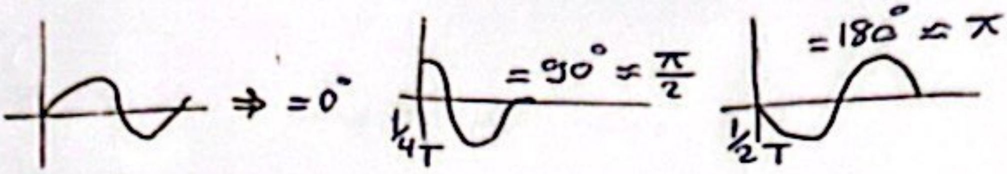
Data rate depends on 3 Factors:

- the BandWith available
- the levels of the signals we use
- the quality of the Channel (level of noise)

* increasing the levels of the signal May reduce the reliability of the System

Period and frequency : $T = \frac{1}{F}$, $F = \frac{1}{T}$

Phase :



Bandwidth : uesed for nonperiodic Signal = HF − LF

⊛ levels in digital Signals : if we add up the levels we can Send More bits

Number of bit per level = $\log_2 8$ = 3 bits
↘ levels

3,16 = 4 !!

⊛ Nyquist theorem : for noisless channel : BitRat = $2 \times$ Bandwith $\times \log_2$ levels

how Many levels we need

⊛ the levels Must be a power of 2

⊛ Shannon Capacity : for noisy chanel ; capacity = $BW \times \log_2(1 + SNR)$

the upper limit

⊛ Throughput = $\frac{\text{bits}}{\text{Sec}}$ ⇒ bandwith ال
الفعلي بس افضل شي

⊛ propagation time = $\frac{\text{distans}}{\text{Speed}}$

time for bits to propagat across the wire

⊛ Trans Mission time = $\frac{\text{bits}}{\text{Bandwith rate}}$

time to put M-bit Massage to the wire

⊛ Latency =

Chapter 3

responsible for delivering frames of information

- handles transmission errors

Framing Methods

Byte Count

- frames begin with a counter of # of byts on it.

Flag Bytes + ST

- Special flag byts delimit frams

[A][F][B] → [A][EX][F][B]

Flag bits + ST

- frame flag have 6 consecutive 1's (01111110)
- on transmit after (5) 1's in the Data 0 is added
- on recive a 0 after (5) 1's is deleted

Types of error's: 1 – Single bit error 2 – Burst error (2 or more)

* Redundancy: adding extra bit's for detecting errors

Error Detection

Parity Check

- simple parity (even, odd) for single bit errors
- Two dimensional parity

block of bits

- Parity bit's

Cyclic Redundancy check

Check Sum

Chapter 3.6 → 8

(*) the Most important responsplity for the Datalike layer :

1 - flow Control   2 - error Control

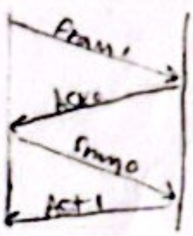
flow : refer to the protcedures used to restrict the amount of Data that the Sender can Send before ACK.

error : is based on ARQ automatic repeat request Which is retransMission of Data.

3 protocols use for error Control

Stop and Wait ARQ

- Normal operation
- the fram is lost
- the ACK is lost
- the ACK is delayed



(*) piggybacking

Combine Dat With ACK

- Save bandWidth

Go Back-N ARQ ← Sliding Window protocol → **Selective Repeat** ARQ

piplining : One task begins before other one ends

- increases the efficiency of transMission !!
- it's not in Stop and Wait

S.W.P :

- Send Multiple frams at a time.
- \# of fram's Sent is based on Window Size.
- after resiving an ack for the first fram the S.W will Slid.
- any fram Still in the S.W we didn't risived an ack for it.

Go-Back-n ARQ:

n : n here represents the Window size of the Sender

EX, Go Back-3 ⇒ we can send 3 frame without ACK

(*) If we didn't received ACK of a fram within Time
all the frams in the current window will be retransmitted !!

Selective Repeat ARQ:

- the Window size for the Sender and the reseiver are
the Same 2^{m-1}

- it's resend of only the lost frame !!

(*) the Bandwidth-delay product :

- the number of bit's that the link can carry.

Bandwidth X delay = bit's

Chapter 4

Random access protocol:

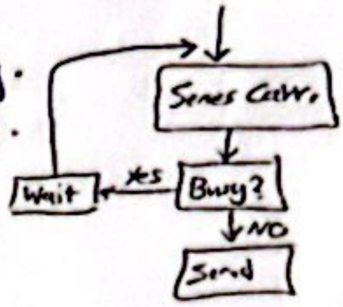
aloha: Vulnerabltime = 2 × T_{fr}
- Start, K = 0, Send fram, wite time (2 × T_p)
- if Ack yes Success if No K = K + 1
- if K > MaxK Abort, else choose R from (0 − $2^{k}-1$)
- Wait T_B = R × T_p or R × T_{fr} and Send agin

Slotted: Vulnerabl time is = T_{fr}
- frame are from the same size
- time is slotted into = size slots
- transmition start in beging of slots
- nodes are synchronized
- if 2 or more send in the same slote (collision)

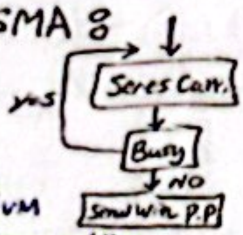
CSMA:

Vulnerabl time = T_p

- the name stand for: Carrier Sense Mulitiple access.
- Sense befor transmit
- the possibility of collision stil exist beuse of propagetion delay.
- if the propagetion delay is high, the possibility of collision incress.



the Types of CSMA:

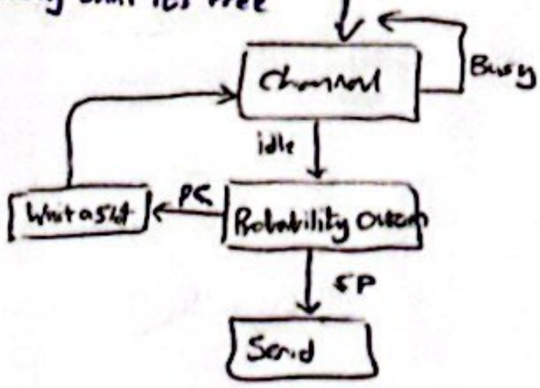


1 – persistent
- it's senses the medium continuously until it's become idle.

2 – Non persistent
- it's senes the medium if its not idle it's wait's a random period of time to check agin

3 – P-Persistent

3 – it's like a mix of one and two it's will check continuesly until it's free than it will wait for random time to send.



Collision Detection Methods:

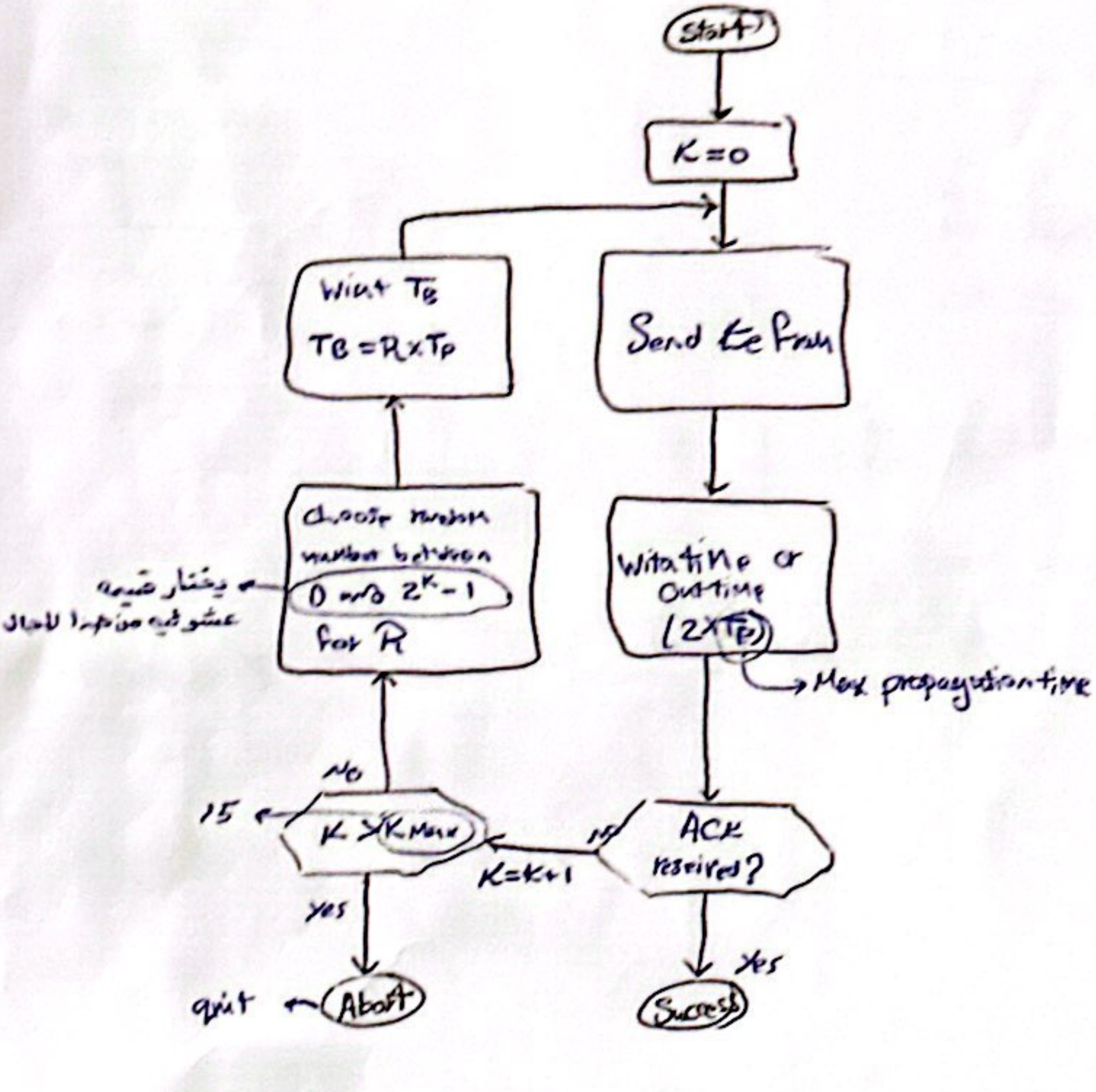
- detecting voltege leve on the line
- detecting power leve
- detecting simultaneous transmission

Chapter 4

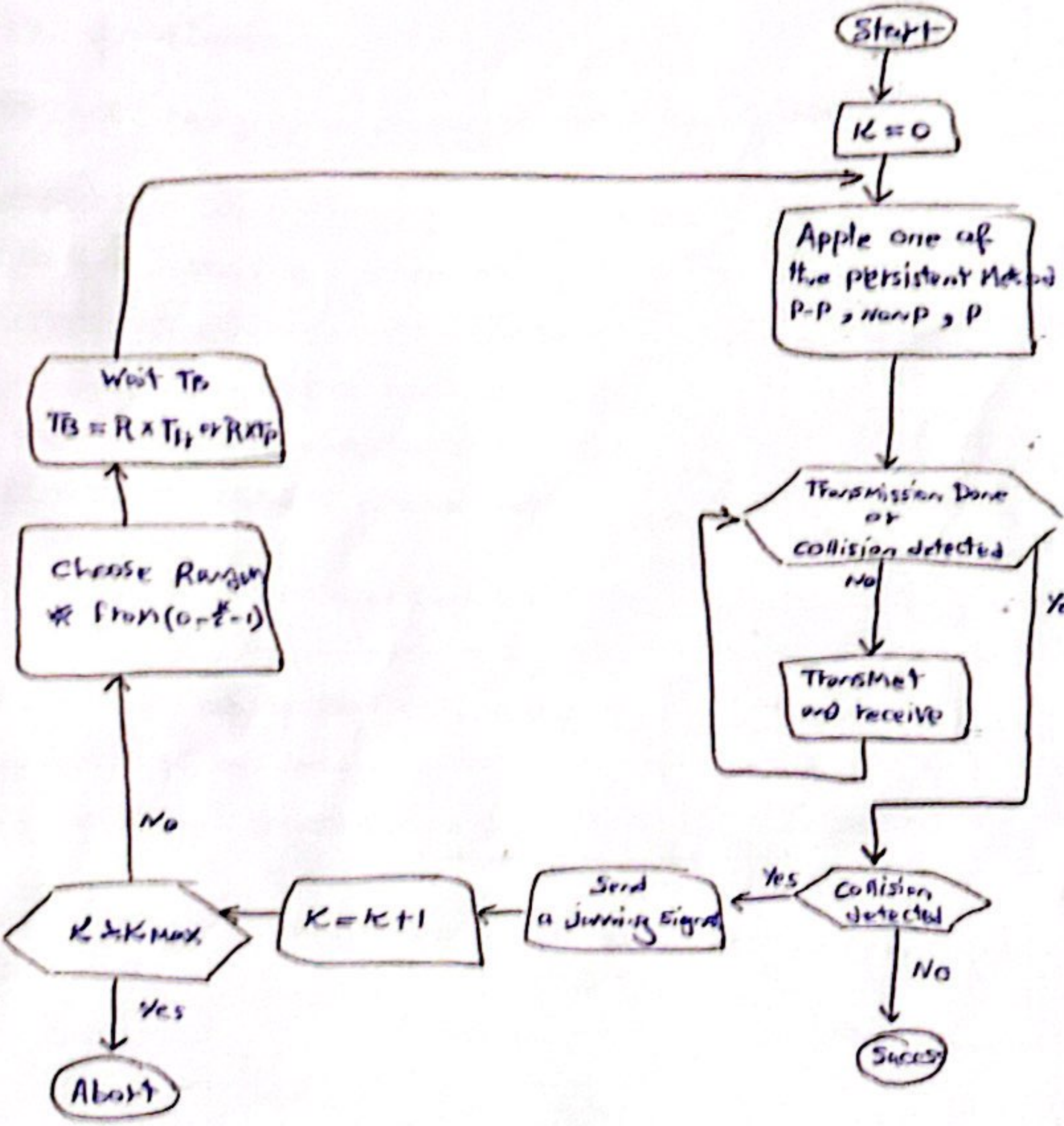
- Random Access Protocols { ALOHA

Pure Aloha — Slotted Aloha

Procedure for pure Aloha:



CSMA/CD


Start
K=0
Apple one of the persistent Method P-P, Non-P, P
Transmission Done or Collision detected
No
Transmit and receive
Yes
Collision detected
Yes
No
Success
Send a Jamming Signal
K=K+1
K > Kmax
No
Yes
Abort
Choose Random R from (0 - 2^K - 1)
Wait TB
TB = R × Tfr or R×Tp

CSMA / CA

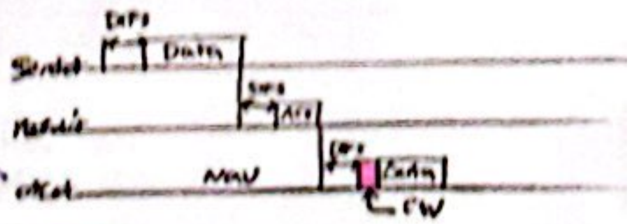
Inter-Fram Spacing (IFS):

* it's helps Managing the priority of differnt types of frams

- (SIFS) Short Inter fram Space :
  for time sensitive frame like ACK, CTS

- (PIFS) PCF IFS - Point Coordination function :
  it's used for or in the point coordination function
  longer than SIFS but shorter than DIFS

- (DIFS) DCF - Distributed Coordination function
  - lowest priority
  it's used in the Distributed Coordination function



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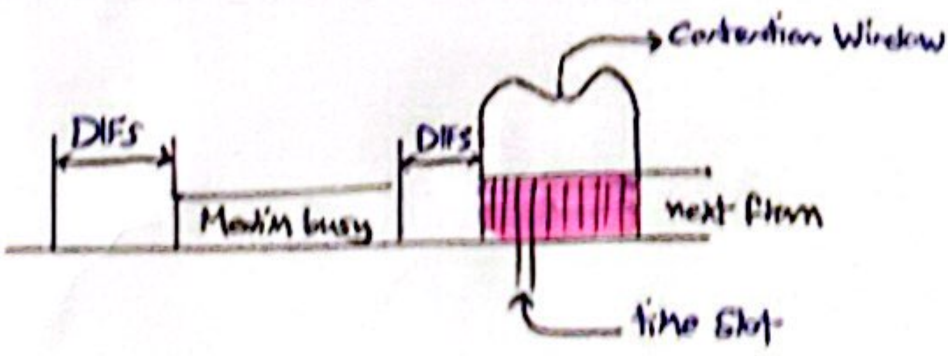
1 - Station ready to send start sensing the channel

2 - if it's free from duration of an IFS it's can start sending

3 - if it's busy it's must wait for free IFS + wait a random back off time
(collision window, Multiply of slot time)

4 - if another station jump in channel we stop the backoff time to be continued



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Local Area Network

chapter 4

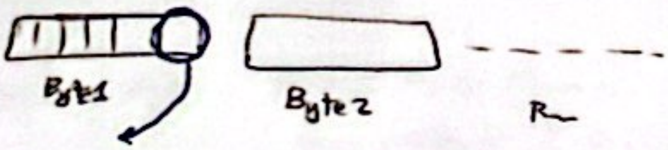
name	description
IEEE802.3	Ethernet
IEEE802.11	Wireless LAN & Mesh (Wi-Fi certification)

- Ethernet from format:

Preamble	SFD	Destination address	Source address	Length or type	Data and padding	CRC
7	1	6	6	2		4

$\underbrace{\text{Preamble} + \text{SFD}}_{\text{Physical layer header}}$

* frame length: Min : 64
Max : 1518



- if it's = 0 it's a unicast and if it's 1 its Multi or broadcast
- broadcast is all 1's (FF,FF,FF,FF,FF,FF)

* Max length = propagation Speed X (Slot time/2)

Chapter 5

Network Architecture

Datagram forwarding	Virtual - Circuits Switching
- No call Setup	- call Setup
- Data take different path's	- all Data flow to the Same path
Ex. internet	Ex. ATM
- Smart end ~~users~~ computers	- "dumb" end ~~users~~ System
- no strict timing	- strict timing
- unifrom service difficult	- need for guaranteed Service
- Simple network	- complexity inside Network

IP

* IPv4 is a 32 bit address

- No leading zero
- no More than 4 numbers
- no Mixture of B and D
- number Most ≤ 255

IP. | Network | host |

Class A uniad	0				0 - 127
class B uni	10				128 - 191
Class C uni	110				192 - 223
Class D Multi	1110				224 - 239
Class E Reser	1111				240 - 255

Mask

- 32 bit of contiguous 1s followed by contiguous 0s
- 1s for network IP and 0s for host IP

* the # of addresses in block can be found by using 2^{32-n}

* the first address : ANDing the Mask and the address

* the last address : ORing the complement of the Mask and the address

Routing Algorithm Classificion

Centralized
"link state"

- all routers learn about its directly connected network.
- routers exchang hello packet to "Meet"
- each router build it's own link stat packet (LSP) which includes info. about neighbors
- routers floods the network with the LSPs and then all have the same info
- then using Dijkstra's algo. the forwarding table is Made

Requirements:

1 - Memory

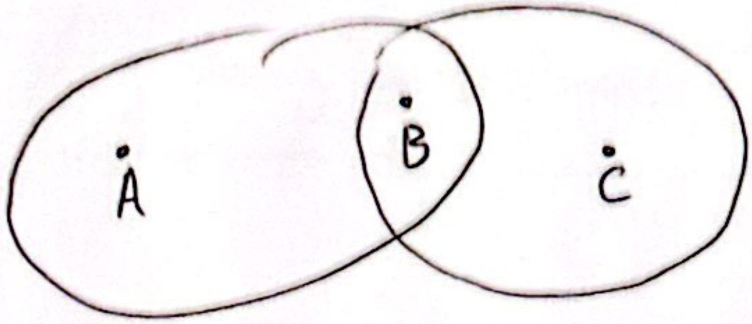
2 - CPU processing

3 - lots of Bandwidth

Distributed
"distance Vector"

forwarding: Move pacates from rater input to the appropatet router output

routing: determent rout taken by packets from the Source to the dest.



Hidden terminals:

they are the Senders that can not Seas eatch other but Collide at intended resiver

ARP: Maping the IP abberrs to the MAC address

RARP: العكس

3,62