CN

	period	frequency		
sec	1s	HZ	1HZ	B - 1
milli	10^{-3}s	KH	10^3HZ	KB - 10^3
Micro	10^{-6}s	MH	10^6HZ	MB - 10^6
Nano	10^{-9}s	GH	10^9HZ	GB - 10^9
Pico	10^{-12}s	TH	10^{12}HZ	

if go down devide

if go up multiply

1. Period $= \frac{1}{\text{frequency}}$

2. Phase in degree = multiply by 360

   phase in radians = multiply degree to $\frac{2\pi}{360}$

3. Bandwidth = fh - fl

4. lowest frequency = middle freq $-$ $\frac{\text{Bandwidth}}{2}$

   highest frequency = middle freq + $\frac{\text{Bandwidth}}{2}$

5. No of bits per level = $\log_2 L$ i.e L = level

6. Bit length = propagation speed × bit duration

Bit Rate	Harmonic 1	Harmonics 1, 3	Harmonics 1,3,5
n = 1Kbps	B = 500HZ	B = 1.5KHZ	B = 2.5KHZ
n = 10Kbps	B = 5KHZ	B = 15KHZ	B = 25KHZ
n = 100kbps	B = 50KHZ	B = 150KHZ	B = 250KHZ

The max bit rate can be achieved if we use the first harmonic ~~Bit~~

7. Bit rate = 2 × Bandwidth

8. Attenuation = $10 \log_{10} P2/P1$ unit dB

Amplification

Loss ~~in~~ cable = dB/Km

9. SNR = $\frac{\text{Signal Power}}{\text{noise Power}}$ $1 mw = 10^3 \mu w$

Value of SNR and SNR_{dB} for noiseless channel

$SNR = (\text{Signal power})/0 = \infty$

$SNR_{dB} = 10 \log_{10} \infty = \infty$

10. Nyquist Rate

Bit Rate = $2 \times \text{bandwidth} \times \log_2 L \rightarrow$ Signal Level

unit = bps

Shannon capacity

11. Capacity = $\text{bandwidth} \times \log_2 (1 + SNR)$ unit = bps

12. Latency = propagation time + transmission time + queuing time + processing delay

13. Total Bits per min = Avg frame per min × Avg bit per frame

14. Throughput = $\frac{\text{Total bit per min}}{\text{Time taken to transmit these bits}}$

15. Propagation time = $\frac{\text{distance}}{\text{Speed}}$

16. Transmission time = $\dfrac{\text{Message Size}}{\text{Bandwidth}}$

17. volume = bandwidth × delay

18. Signal element = $\underset{\text{(bit rate)}}{\text{no of bits}} \times \dfrac{1}{\text{no of element per signal element}}$

OR

baud Rate = bit rate × $\dfrac{1}{\text{no of element per signal element}}$

$$S = N \times \frac{1}{r}$$

$$r = \log_2 L$$

19. ASK (Amplitude changes frequency and phase remain constant)

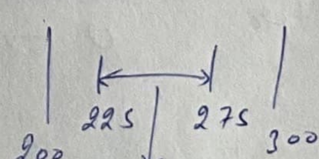
Bandwidth = (1 + d) × baud Rate

$$B = (1+d) \times N \times \frac{1}{r}$$

20 FSK (Frequency changes and Amplitude & phase remain constant)

Bandwidth = (1+d) × baud Rate + 2 diff b/w frequencies

$$B = (1+d)\,S + 2\Delta f \qquad S = N \times \frac{1}{r}$$



$2\Delta f = 50$

here $2\Delta f = 50$ not 100
Remember this

NRZ → NRZ scheme me jab same bit aae to previous signal continue karna hai but jab diff bit aae to signal change karna hai yha signal +ve side hi rehta h

NRZ-L → NRZ-L me jab same bit aae to previous signal continue karna hai yha base line signal k midme hoti h yha signal -ve side bhi ja sakta h

NRZ-I → NRZ-I me jab ~~same~~ bit 1 aae to signal change karna h agar bit 0 h to previous signal ko continue karte h yha signal -ve side bhi ja sakta h ye islyea karte h taaki base line wandering min rahe

21. NRZ-I average signal rate $= \frac{N}{2}$

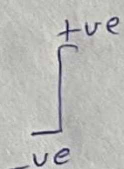
$$S = \frac{N}{2}$$

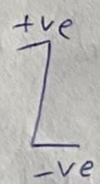
RZ Polar scheme

0 → 

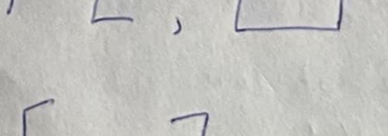
1 → 

Manchester

0 → 

1 → 

D-Manchester

0 → 

1 → 

AMI - 0 bit on base line and when 1 comes signal on upper side when next time 1 bit come it goes to lower side

Pseudoternary - 1 bit on line and when 0 firstly come signal on upper side when next time 0 bit come it goes to lower side

Category	Scheme	Bandwidth	Charactersitics
Unipolar	NRZ	$B = N/2$	costly, no-self-synch if long 0 or 1s, DC
Polar	NRZ-L	$B = N/2$	no self-sych if long 0 or 1s, DC
	NRZ-I	$B = N/2$	" " " ", DC
	Biphase	$B = N$	self-sych, no DC, high Bandwidth
Bipolar	AMI	$B = N/2$	No self-sych for long 0, DC
Multilevel	2B1Q	$B = N/4$	" " " " " ", same double bits
	8B6T	$B = 3N/4$	Self sych no DC
	4D-PAM5	$B = N/8$	" " " "
Multitransition	MLT-3	$B = N/3$	No self for long 0s

22. Nyquist rate $= 2 \times f_{max}$

23. duration of input time slot $= \frac{1}{\text{data rate}}$

24. duration of output time slot $= \frac{1}{\text{divided time slot}}$

24. Each frames = The duration of a frame is the same as duration of input unit

25. output bit rate = $\frac{1}{\text{output bit duration}}$

26. frame rate = the frame rate is always the same as any input rate

27. Duration of frame = $\frac{1}{\text{input rate/frame rate}}$

28. bit rate for each link = frame per second × size of each frame

29. bit duration = $\frac{1}{\text{bit rate for each link}}$

Total no of Crosspoints is = $2KN + K\left(\frac{N}{n}\right)^2$

30. Unicast link layer address :- 48 bits, 2nd digit needs to be an odd no

eg:- A3:34:45:11:92:F1

31. Multicast link layer address :- 48 bits, 2nd digit need to be an even no

eg:- A2:34:45:11:92:F1

32. Broadcast link-layer address :- 48 bits, All F

Even Parity :- Calculate 1 in bits if they are odd than add 1 to make even Parity otherwise add 0 1010, 11101

Haming distance:- firstly XOR than check how many one's in it

Valunerable time :- $2 \times T_{fr}$ (fixed length frames each take T_{fr} second) (Pure ALOHA)

Average no of succ transmitted frame of pure ALOHA = $S = G \times e^{-2G}$ (throughput)

$G = \frac{1}{2}$ $S_{max} = 0.184$

$G = 1$ $S_{max} = 0.368$

Slooted aloha valunerable time = T_{fr}

The no of sequences in a walsh table needs to be $N = 2^m$

Efficiency of standard Ethernet $= \frac{1}{(1+6.4 \times a)}$ OR $\frac{\text{Propogation Delay}}{\text{Transmission Delay}}$

Transmission Delay $= \frac{\text{Packet length}}{\text{Transmission rate}}$

Propogation Delay $= \frac{\text{Distance}}{\text{Propogation speed}}$

Processing Delay = Time required to process a packet in a router or a destination host

Queuing Delay = Time a packet wait in input and output queues in a router

Total Delay $= (n+1)(\text{Delay}_{tr} + \text{Delay}_{pg} + \text{Delay}_{pr}) + (n)(\text{Delay}_{qu})$

Throughput = minimum $(TR_1, TR_2, TR_3 --- TR_n)$

The no of address in Block $= N = 2^{32-n}$

To find first address we keep the n leftmost bits and set the $(32-n)$ rightmost bit all to 0's

To find the last address we keep the n leftmost bits and set the $(32-n)$ rightmost bit all to 1's

The no of address mask $= 2^{32-n} - 1$

The no of address in the block N = NOT(mask) + 1

The first address in the block = (Any Address in the Block) AND (mask)

The last address in the block = (Address) OR (NOT(mask))

The no of requested address $= N = 2^{32-n}$ or $n = 32 - \log_2 N$

first address = (prefix in decimal) $\times 2^{32-n}$

address of each subNetwork is N_{sub}

prefix length for each subnetwork is n_{sub}

$$n_{sub} = 32 - \log_2 N_{sub}$$

wrapped Sum = Sum mod FFFF

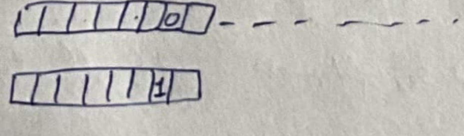
Checksum = FFFF − wrapped Sum

Mapping EUI-64

To map a 64 bit physical address, the global / local bit of this format needs to be changed from 0 to 1 (local to global) to define an interface address

EUI-64 → to interface

7th bit 0 → to 1



Mapping Ethernet MAC Address

we need to change the local/global bit to 1 and insert an additional 16 bits. The additional 16 bits are defined as 15 ones followed by one zero, or $FFFE_{16}$

7^{th} bit 0 to 1

25 → to 32 bit → FFFE

For error control the sequence no are modulo 2^m

m = size of sequence no

Go Back N → send window max size = $2^m - 1$

Go Back N → size of send window must be less than 2^m

Selective repeate size of window max = 2^{m-1}

Shrinking of Windows :- newackNo + new rwnd ≥ lastackNo + last rwnd

TCP throughput = (0.75) W_{max} / RTT

local IP address :- 192.
10.
172.

In an ACK arrives cwnd = cwnd + 1

Actual window size = min(rwnd, cwnd)

If an ack arrive $cwnd = cwnd + \frac{1}{cwnd}$

Smoothed RTT

Initially → Novalue

first mesure → $RTT_S = RTT_M$

2nd mesure → $RTT_S = (1+\alpha) RTT_S + \alpha \times RTT_M$

RTT Deviation

Initally → Novalue

first measure → $RTT_D = RTT_M / 2$

2nd measure → $RTT_D = (1-\beta)\, RTT_D + \beta \times |RTT_S - RTT_M|$

Retransmission Time-out (RTO)

original → Inital value

any measure → $RTO = RTT_S + 4 \times RTT_D$