Introduction to CN

Monday, January 17, 2022 8:28 AM

Computer Network

- Desktop / Laptop
- Smart phone
- smart watch
- Host
- Node

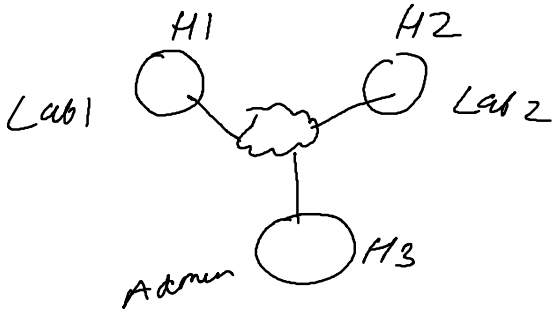
⇒ Desktop App
web App
mob App

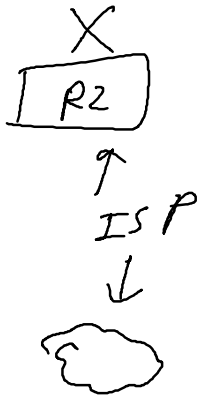
Network :- O.S → P1 P2 IPC

Network

1. Intranet :-
2. Internet :- Network of Network

Networking device
- Router
- switches
- mac Add
- IP Add
- HUB
- ISP





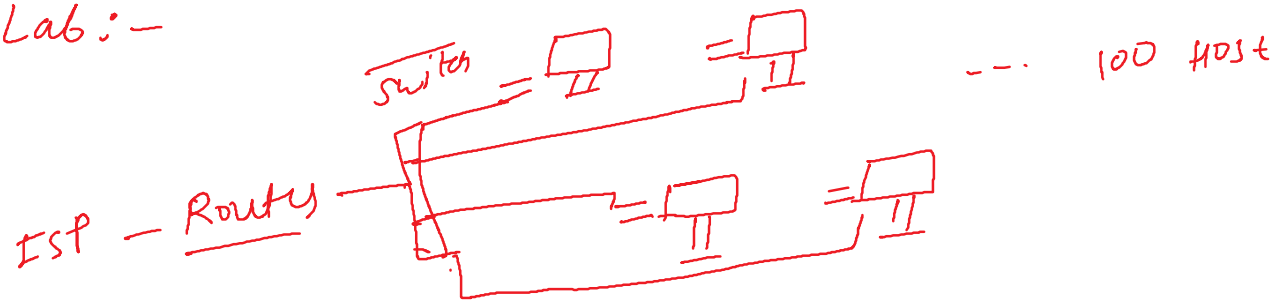
protocol :- Set of rules
- Http / Https → (secure) — DNS
- TCP/IP
- FTP

- Telnet
- URL ⇒ https://amazon.in
- Browser ⇒
- email client ⇒
- whats call ⇒
- Remote access ⇒

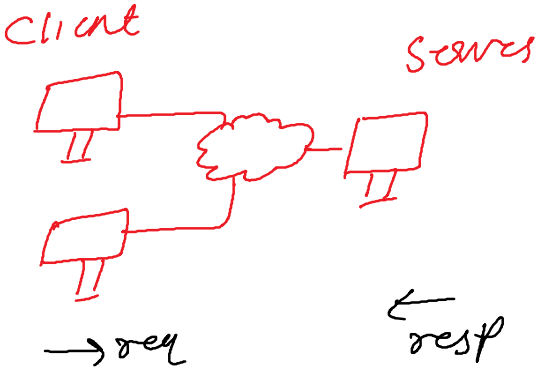
→ Cyber security
→ Information security → encryption / decryption

→ God of Network :-
→ Computer Network :-

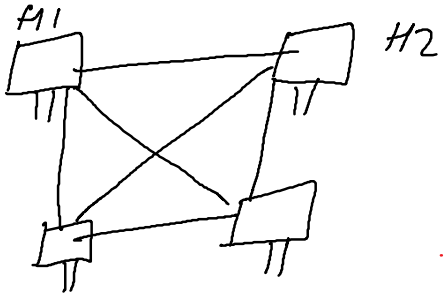
Lab :-



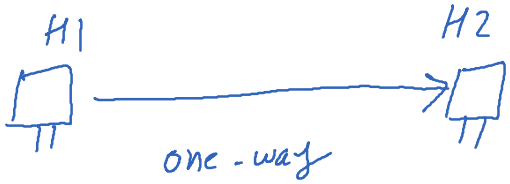
Client-Server :-



peer-to-peer :-
(Blockchain)



Simlex :-



- Radio
- TV

Half-Duplex :-

- Walkie-talkie

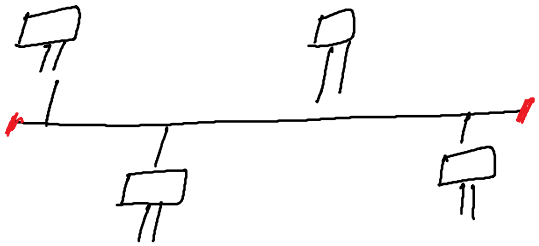
Full-Duplex :-

- Voice-Call

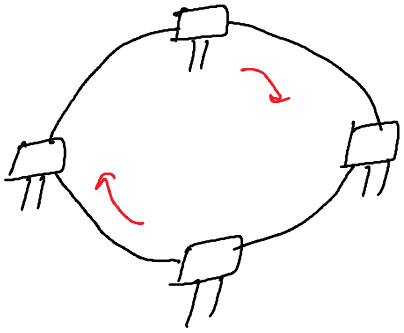
Topology

Wednesday, January 19, 2022 8:21 AM

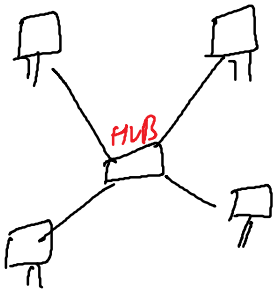
(1) Bus



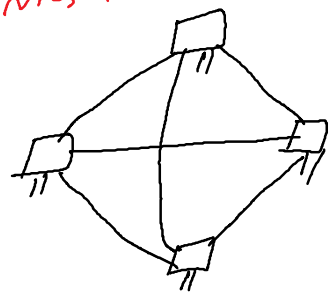
(2) Ring



(3) Star



(4) Mesh



4 Mesh T. ⇒ No of device = N

no of port = N-1 of every device

To No. of port = N × N-1

To No of link = (N × N-1)/2

*OSI – Theoritically / Refrence model

→ TCP/IP – model – Implement

Networking Addressing

Friday, January 21, 2022 8:19 AM

~ Niqve

- IP Address :— Logical Add
- MAC Address (media Address control) (Hardware Add)
  - ↓↓ physical Add
  - ↓↓ NIC

MAC Address :— size — 48 bit (6 byte)

Represent — → AB-D2-13-12-B6-23

↑ 46 bit

command — IPconfig/all

IP Address :— 32 bit (size) ⇐ IP4 ⇒ 2^{32}

IP6 ⇒ 2^{128}

12.1.2.3 ⇒ 00001100.00000001.00000010.00000011

max Range ⇒ 0.0.0.0 ⇒ 255.255.255.255

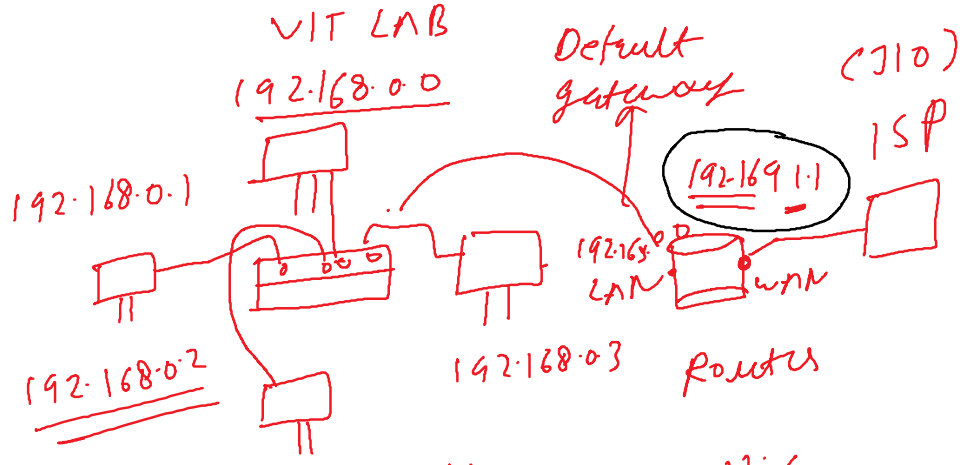
10.256.3.4 (Not valid)

192.168.43.131...my computer IP address FROM CMD...PRIVATE IP ADDRESS

157.34.31.34 **From google....PUBLIC IP ADDRESS**

10.11.1

Monday, January 24, 2022 8:52 AM



traceroute www.google.com

public

192.168.0.2 → 192.16.0.0 ⇒ 192.169.1.1 ⇒ google.com

172.25.56.79 ⇒ 172.25.56.1 ⇒ 182.7239.10 ≡

142.250.77.36

?

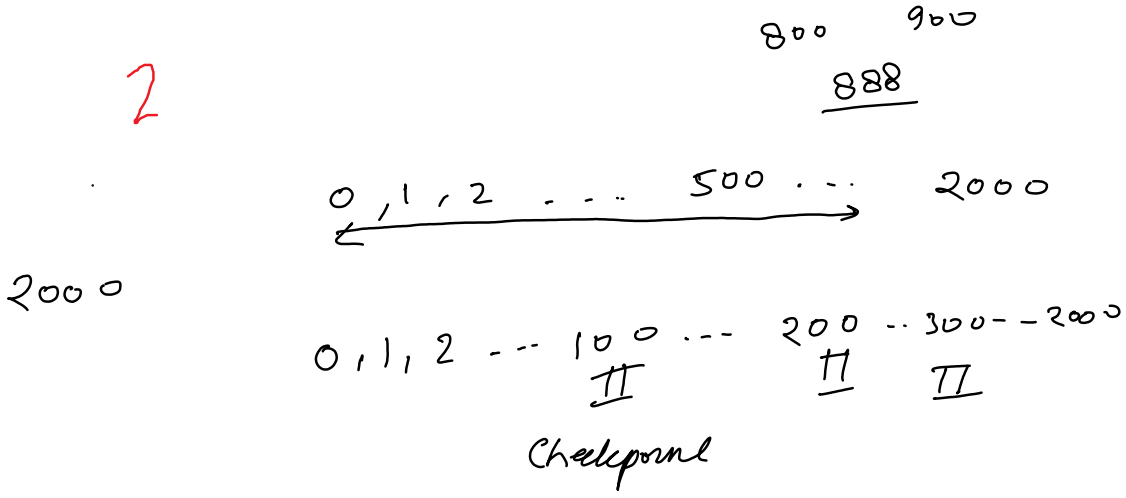
Exercise

Monday, January 24, 2022 9:48 AM

1. private Add (6 IP Address)
2. Public Add → www.VitBhopal.ac.in
   → www.facebook.com
   → www.amazon.in
3. Route :- uses → VitBhopal.ac.in

checkpoint

Monday, January 31, 2022 8:46 AM



Analog signal

Wednesday, February 2, 2022 8:18 AM

The period of a signal is 100 ms. What is its frequency in kilohertz?

$f = \frac{1}{T}$ [$T = 100\ ms$

$f = \frac{1}{100ms} = \frac{1}{100 \times 10^{-3} s} = \frac{1}{10^{-1}}\ Hz = 10\ Hz$

$= 10 \times 10^{-3}\ kHz$

$= 10^{-2}\ kHz$

A sine wave is offset 1/6 cycle with respect to time 0. What is its phase in degrees and radians?

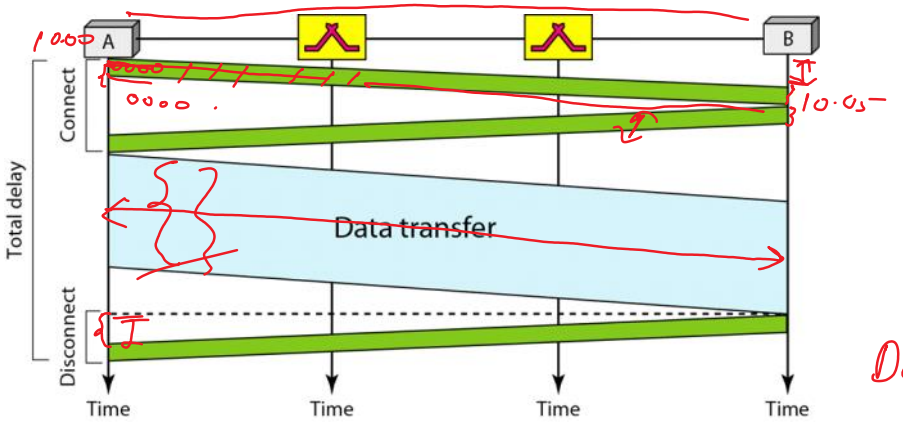
$= \frac{1}{6} \times 360^{\circ} = 60^{\circ}$

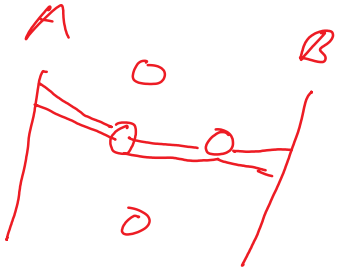
$= 60 \times \frac{2\pi}{360}\ rad$

$= \frac{\pi}{3}\ rad$

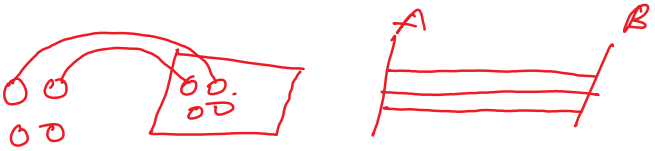
Switching

Wednesday, February 9, 2022 8:18 AM



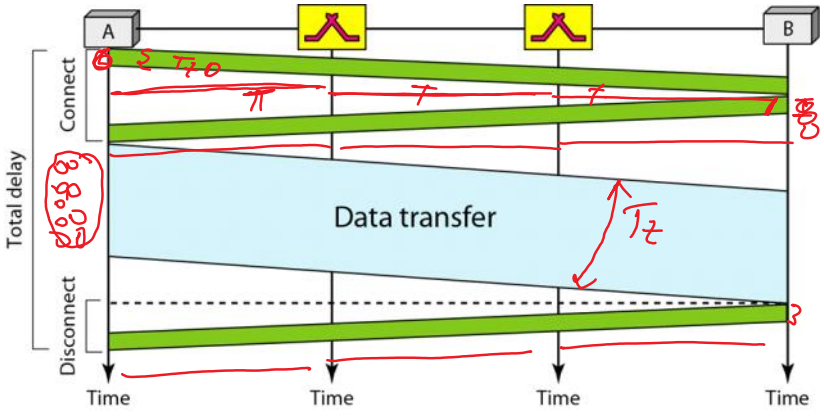


Delay = Transmission Time + Propagation Time + Processing time + Queueing Time

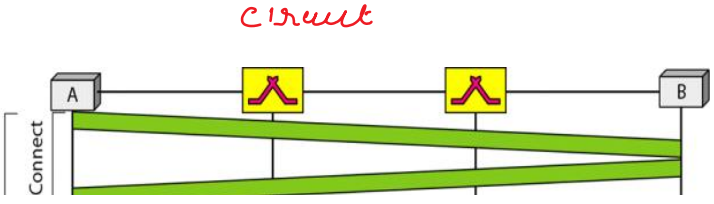


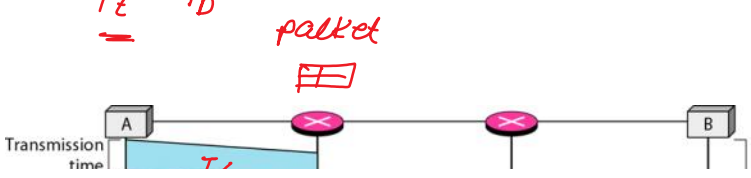
$T_{t0} + 3T_p$

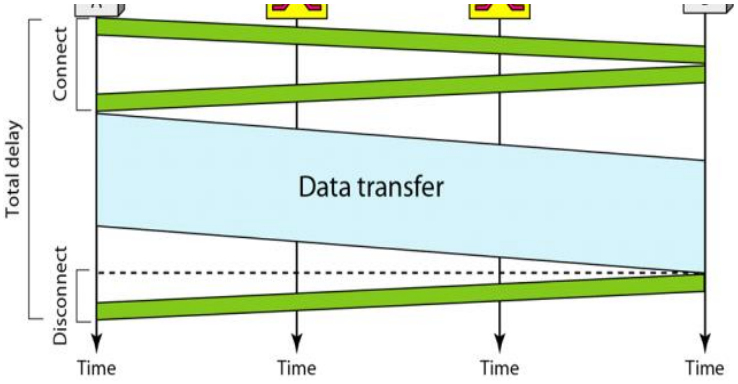
$T_{tn} + 3T_p$ + DT_t + $T_{tDis} + 3T_p$

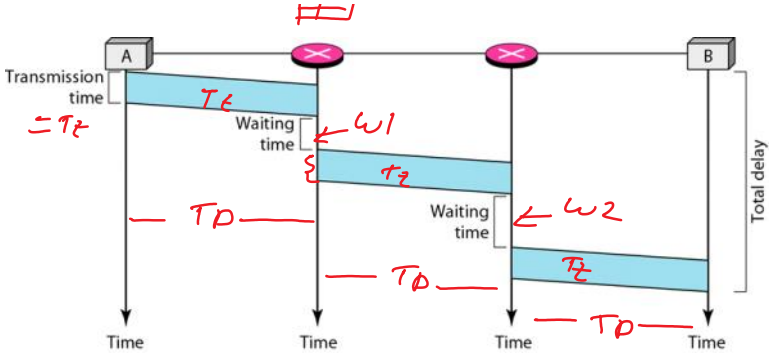


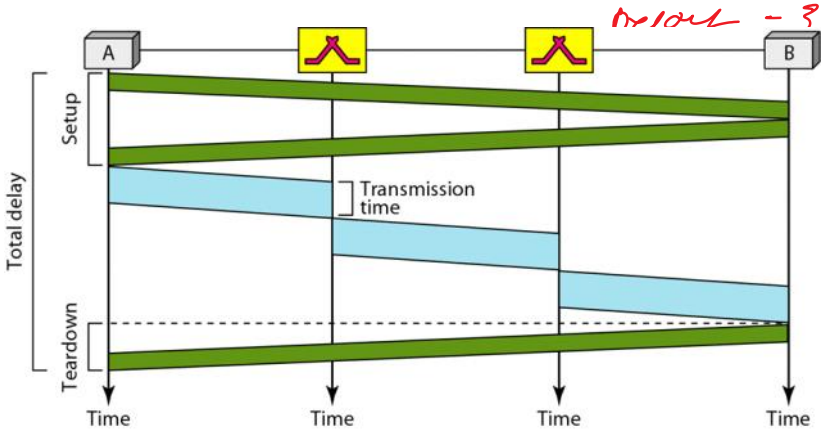
$T_{t0} + 3T_p + T_{tn} + 3T_p$ + Data Transfer Time + $T_{t0} + 3T_p$






Connect
Data transfer
Disconnect
Total delay
Time
Time
Time
Time


A
B
Transmission time
Waiting time
Waiting time
Total delay
Time
Time
Time
Time


A
B
Setup
Transmission time
Total delay
Teardown
Time
Time
Time
Time

Sender

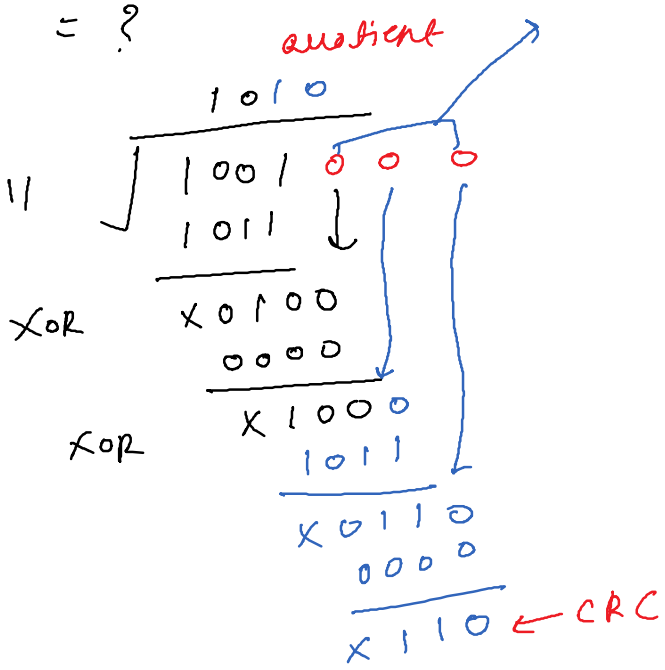
dataword — 1001

divisor — 1011

CRC = ?

(length of divisor − 1)

length of divisor = 4 ∈ 1011

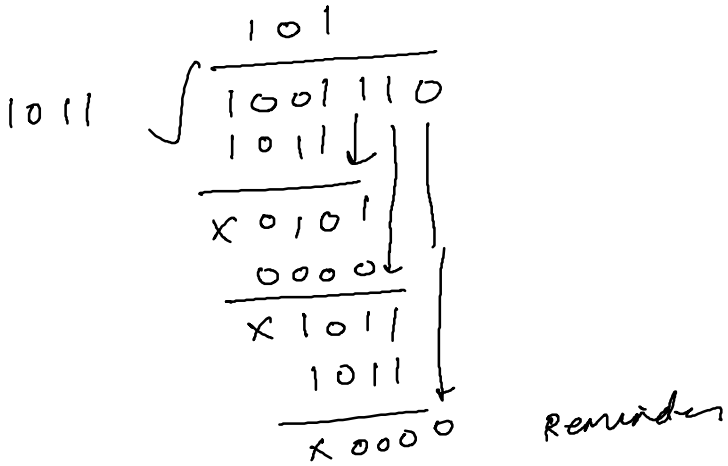


XOR

0 0 — 0
0 1 — 1
1 1 — 0
1 0 — 1

codeword 1001110

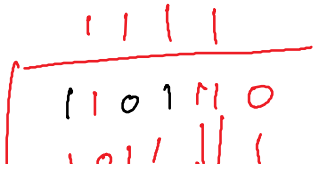
Receiver :—



1001 dataword

if Second bit is corrupted

(01)



is corrupted

(011)

```
1101110
1011
-----
X1101
 1011
-----
X1101
 1011
-----
X1100
 1011
-----
X111   ← Remainder
```

discard data

Question:-

dataword - 11010111111

divisor - 10011

(Generator)

CRC - ?

Codeword - ?

Polynomial Representation

dataword -

1 0 1 1 0 0 0 0 1 1 0 0 0 1 1

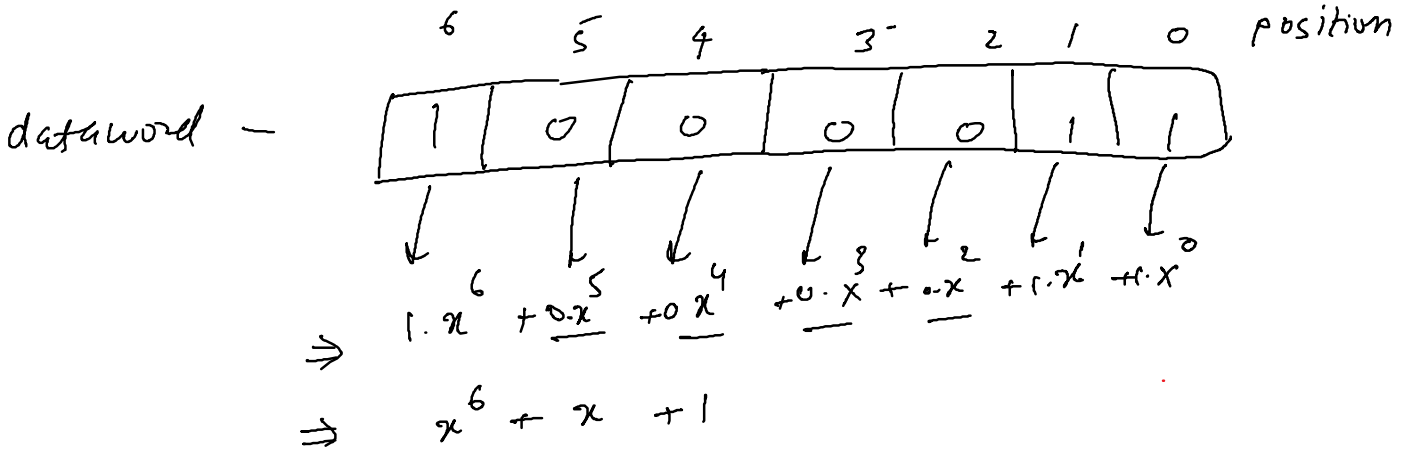
divisor - 1 0 1 0 0 0 1 0 0 0 1

OR

datawords - 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1

$\Rightarrow x^{19} + 1$ (11) $+ 1 \cdot x^0$

6 5 4 3 2 1 0 position


6 5 4 3 2 1 0 position
dataword –
1 0 0 0 0 1 1
$1.x^6 + 0.x^5 + 0x^4 + 0.x^3 + 0.x^2 + 1.x^1 + 1.x^0$
$\Rightarrow$
$\Rightarrow \quad x^6 + x + 1$

Checksum

Wednesday, February 16, 2022 9:41 AM

Checksum :-

Sender

7
11
12
0
6

36

(7, 11, 12, 0, 6, 36)

Receiver

7
11
12
0
6
36

Checksum = 36

Accepted

II

7
11
12
0
6

Sum = 36

Checksum = -36 (complement)

7
11
12
0
6
-36
---
0 → Accepted

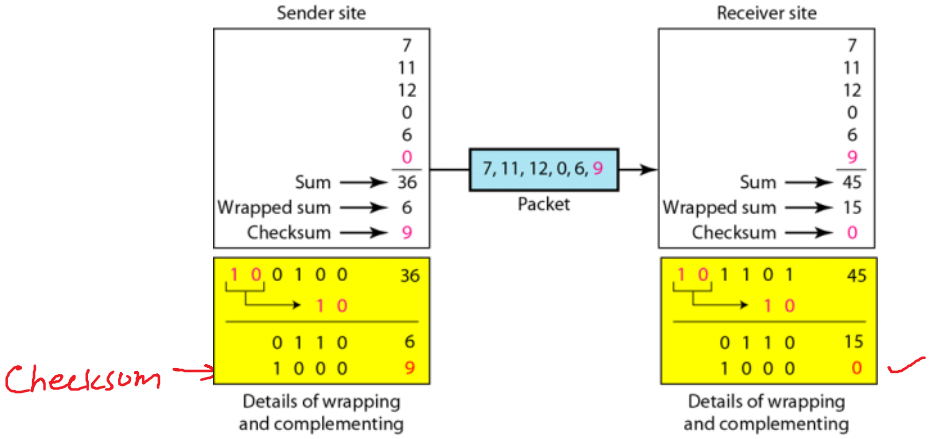
21 ⇒ 10101 ⇒

0101
+ 1

0110

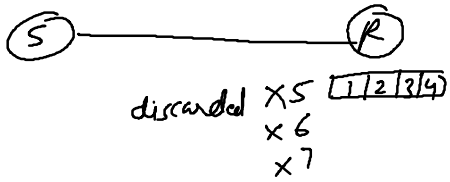
→ 0110

comp → 1001


Sender site
7
11
12
0
6
0
Sum → 36
Wrapped sum → 6
Checksum → 9
7, 11, 12, 0, 6, 9
Packet
Receiver site
7
11
12
0
6
9
Sum → 45
Wrapped sum → 15
Checksum → 0
1 0 0 1 0 0 36
1 0
0 1 1 0 6
1 0 0 0 9
Details of wrapping and complementing
1 0 1 1 0 1 45
1 0
0 1 1 0 15
1 0 0 0 0
Details of wrapping and complementing
Checksum

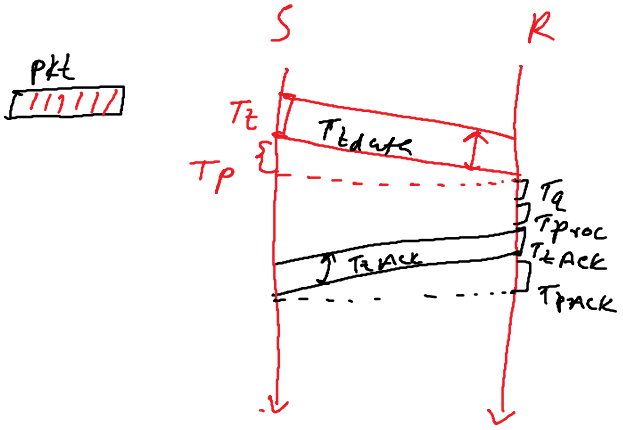
Flow control and error control

Friday, February 18, 2022 8:35 AM



Solution ⇒

Stop & wait



T_t =

T_p =

(1 pck) delay = Negligible

$= T_{tdata} + T_p + \cancel{T_q} + \cancel{T_{proc}} + T_{tAck} + T_p$

$= T_{tdata} + 2T_p + \cancel{T_{tAck}} = 0$

Total time = $T_t + 2T_p$ (one pkt)

η (efficiency) = $\frac{\text{useful time}}{\text{total time}}$

$= \frac{T_t}{T_t + 2T_p}$

$\Rightarrow \frac{1}{1 + 2T_p/T_t}$

$\eta \Rightarrow \boxed{\frac{1}{1+2a}}$

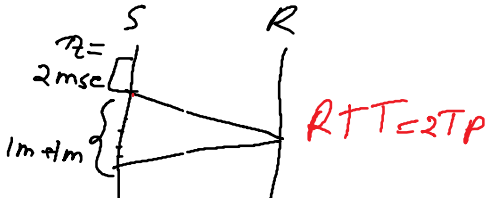
where $a = \frac{T_p}{T_t}$

$T_t = \frac{L}{B}$

$T_p = \frac{d}{S}$

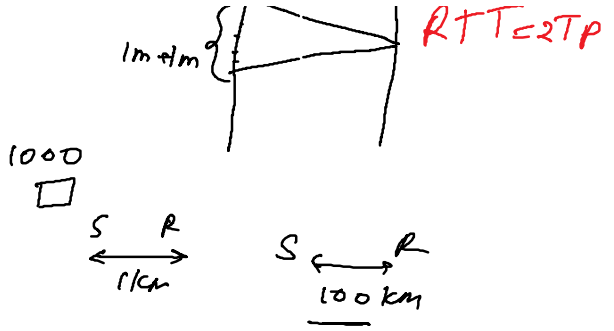
Ex

$T_t = 2$ msec $T_p = 1$ msec



$\eta = \frac{1}{1+2a} = \frac{1}{1+2\times\frac{T_p}{T_t}}$

$= \frac{1}{1+2\times 1}$



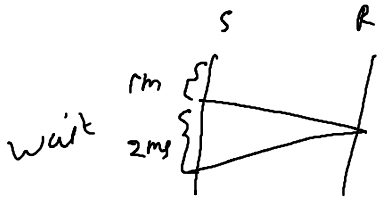
$$= \frac{1}{1+2*\frac{T_t}{T_p}}$$

$$= \frac{1}{1+2*\frac{1}{2}}$$

$$= \frac{1}{2} = 50\%$$

$T_t = 1ms \qquad T_p = 1ms$

$$\eta = \frac{1}{1+2a} = \frac{1}{1+2\times\frac{1}{1}} = \frac{1}{3}$$



ex $\eta \geq 50\%$

$$\frac{T_t}{T_t+2T_p} \geq \frac{1}{2}$$

$$2T_t \geq T_t + 2T_p$$

$$T_t \geq 2*T_p$$

$$\frac{L}{B} \geq 2*T_p$$

$$\Rightarrow L \geq 2*T_p*B$$

Throughput = $\eta \times B$

$B = 4\ mbps$

$\eta = 50\%$

Throughput = $\frac{1}{2} \times 4$

$= 2\ mbps$

Throughput = "No of bits we are actually able to xfer per sec using S & W protocol."

S & w protocol :-

$$= \frac{L/B \times B}{T_t + 2T_p}$$

$$= \frac{T_t \times B}{T_t + 2T_p}$$

$$= \frac{1}{1+2a} \times B$$

$$= \boxed{\eta \times B}$$

Problems

Wednesday, February 23, 2022 9:03 AM

If the bandwidth of the line is 1.5 Mbps, RTT is 45 msec and packet size is 1 KB, then find the link utilization in stop and wait

$B = 1.5$ Mbps

$RTT = 45$ msec

$L = 1$ KB $(2^{10} \times 8$ bits$)$

$\eta = ?$ $\quad \frac{1}{1+2\times\frac{TP}{Tt}}$

(Bandwidth $\Rightarrow$ $1K = 10^3$, $1M = 10^6$, $1G = 10^9$

(Length $\Rightarrow$ $1K = 2^{10}$ bits, $1M = 2^{20}$ bits, $1G = 2^{30}$ bits

Tt (Transmission Delay) $= \frac{L}{B} = \frac{1\ KB}{1.5\ Mbps}$

$= \frac{2^{10} \times 8}{1.5 \times 10^6}$

$= 5.461$ ms

Tp (propagation dday) $\Rightarrow RTT = 2TP$

$Tp = 45/2 = 22.5$ ms

$$\eta = \frac{1}{1+2\times\frac{Tp}{Tt}}$$

$$= \frac{1}{1+2\times\frac{22.5}{5.461}}$$

$$= 10.8\ \%$$

A channel has a bit rate of 4 Kbps and one way propagation delay of 20 msec. The channel uses stop and wait protocol. The transmission time of the acknowledgement frame is negligible. To get a channel efficiency of at least 50%, the minimum frame size should be:

$B = 4\,kbps$

$T_p = 20\,msec$

$L = ?$

$\Rightarrow \eta \geq 50$

$\Rightarrow \frac{1}{1+2a} \geq 50\%$

$\Rightarrow \frac{1}{1+2a} \geq \frac{1}{2}$

$2 \geq 1+2a$

$1 \geq 2a$

$1/2 \geq a$

$a \leq 1/2$

$\frac{T_p}{T_t} \leq 1/2$

$T_p \leq \frac{T_t}{2} \Rightarrow 20 \leq T_t/2$

$40 \leq T_t$

$T_t \geq 40$

$\frac{L}{B} \geq 40 \Rightarrow L \geq 40ms \times 4\,kbps$

$L \geq 40 \times 10^{-3} \times 4 \times 10^3\,bps$

$L \geq 160\,bits$

Consider a MAN with average source and destination 20 Km apart and one way delay of 100 µsec. At what data rate does the round trip delay equals the transmission delay for a 1 KB packet?

$d = 20\,km$

$Tp = 100\mu sec = (100 \times 10^{-6} s)$ $\Rightarrow$ $RTT = 1t$

$L = 1KB$

$2Tp = Tt$

$2 \times 100 \times 10^{-6} = \frac{L}{B}$

$2 \times 100 \times 10^{-6} \times B = 1KB$

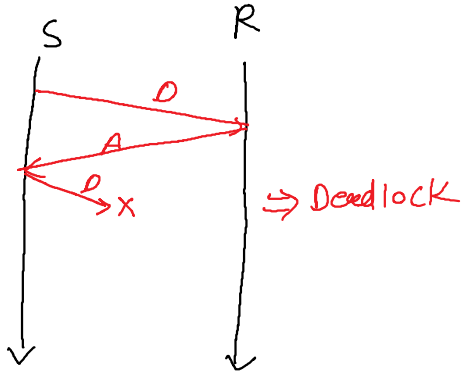
$B = \frac{2^{10} B}{2 \times 100 \times 10^{-6}}$

$B = \frac{2^{10} \times 10^{6}}{200}$ $\Rightarrow 5.12 MBPS$ $\Rightarrow 40.96 mbps$

Stop and Wait ARQ (ERROR control)

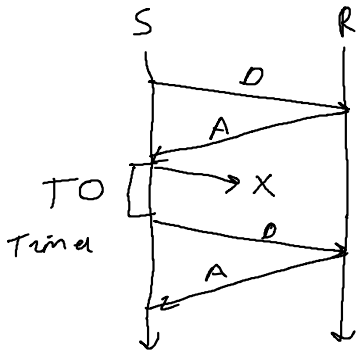
Friday, February 25, 2022 8:41 AM

Data lost



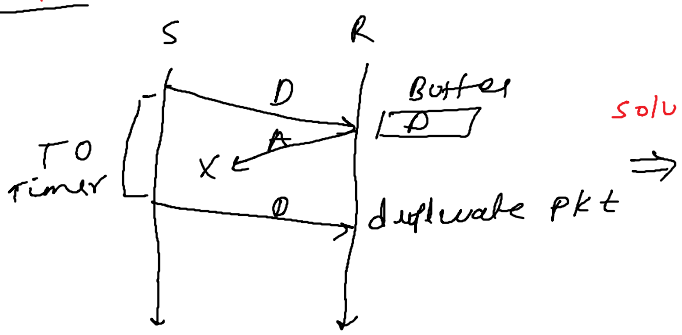
⇒ Deadlock

Solut ⇒



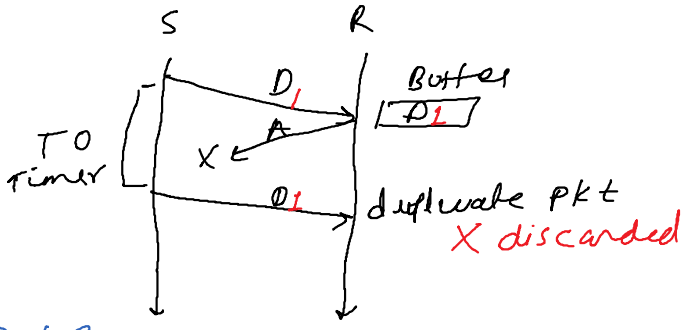
S/w ARQ ⇒ S&w + Time out Timer

ACK lost



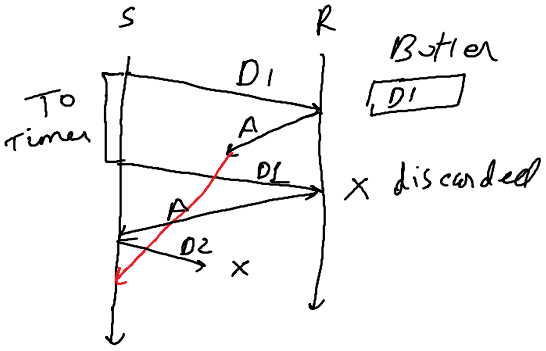
solut ⇒

lost

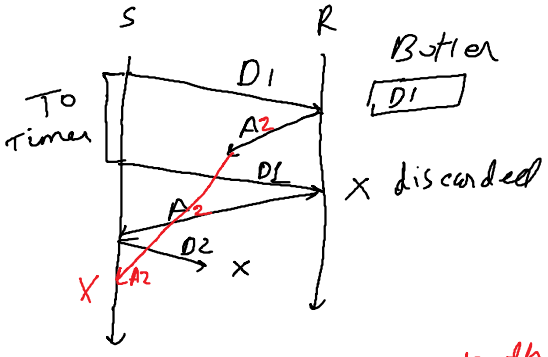


S&w + TO + seq no to the data pkt

Delayed ACK



Sol ⇒



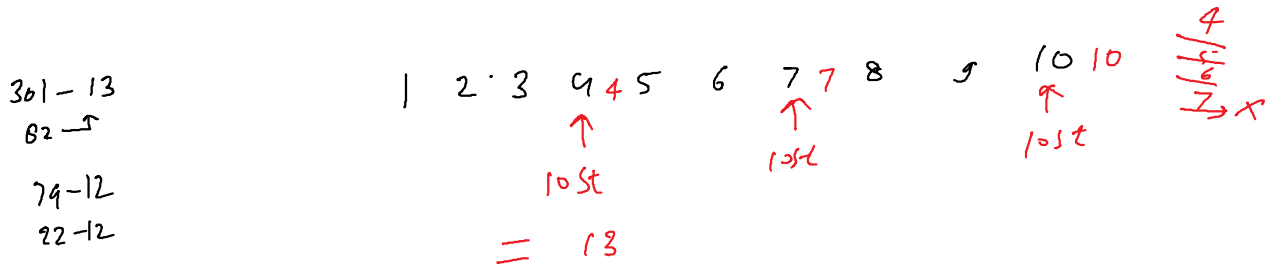
S&w + TO Timer + seq no to the data pkt + Seq to the ACK pkt

problems:-

S&w ARQ

send = 10 pkt, every 4th pkt is lost

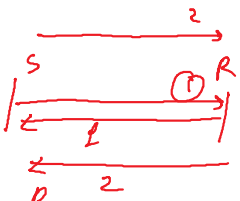
How many total no of pkt sender send ?



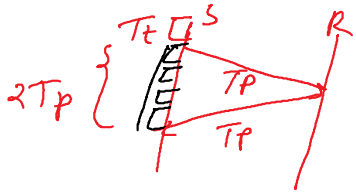
= 13

SLIDING WINDOW PROTOCOL

Monday, February 28, 2022 8:41 AM



dis → S & W



$$\eta \Rightarrow \frac{Tt}{Tt+2Tp}$$

$$\eta \Rightarrow \frac{1}{1+2a}$$

1 Pkt = $Tt + 2Tp$

Tt sec — 1 pkt

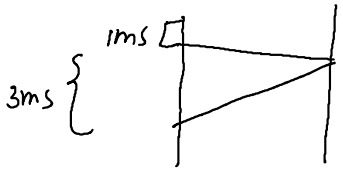
1 sec — $\frac{1}{Tt}$ pkt

$Tt + 2Tp$ — $\frac{Tt+2Tp}{Tt}$ pkt

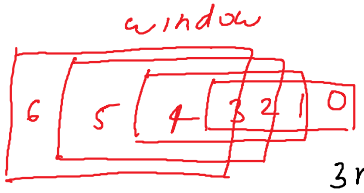
$= \frac{1+2a}{}$ pkt ⇒ where $\frac{Tp}{Tt} = a$

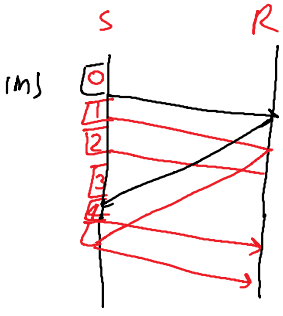
ex. $Tt = 1ms$

$Tp = 1.5ms$



$$\eta = \frac{1}{4}$$





Sliding window protocol

1. Go Back N protocol
2. Selective Repeat protocol

$w = 1 + 2a$

$= 1 + 2 \times \frac{1.5}{1}$

$= 4$

Go Back N

(1) Sender window size = N (N > 1)

protocol :- GB10

$T_t = 1ms$

$T_p = 49.5ms$

$\eta = ?$

$Th = ?$

$B = 40mbps$

$\Rightarrow$

$\eta = \frac{1}{1+2a}$ (SBW)

$\eta = \frac{N}{1+2a}$ (GBN)

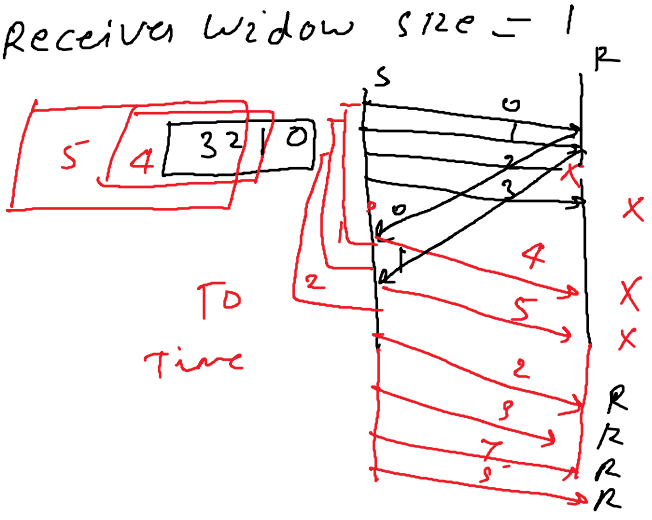
$\eta = \frac{10}{1+99} = \frac{10}{100} = 10\%$

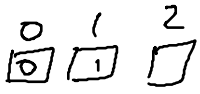
$Th = \eta \times B \Rightarrow \frac{10}{100} \times 40$

$\Rightarrow 4$ mbps

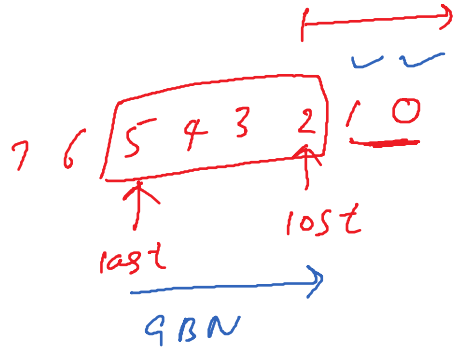
GB4

(2) Receiver window size = 1





discarded

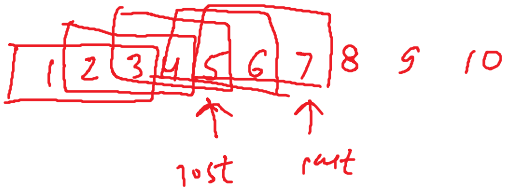


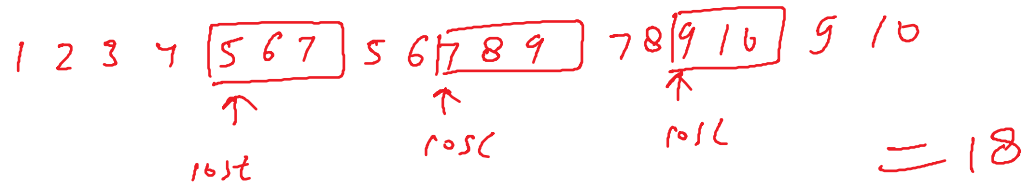
Q- protocol — GB3

every 5th is lost

Send = 10 pkt

Total transmission is Req :- ?





= 18

Q protocol – GBN

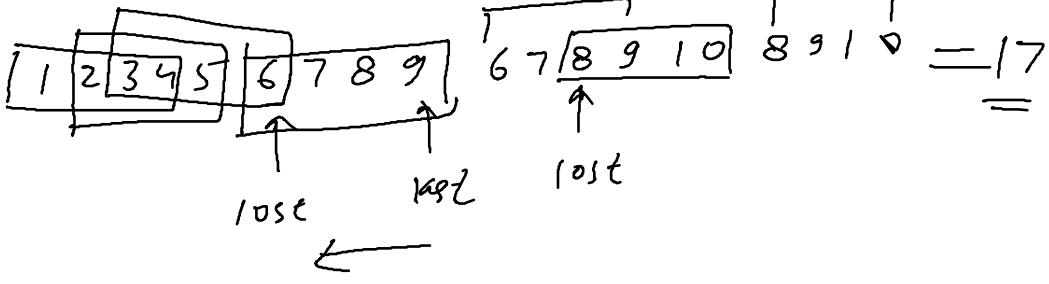
every 6th pkt is lost

total pkt = 10

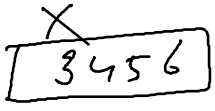
How many transmission = ?

lost

Shortcut methods :-

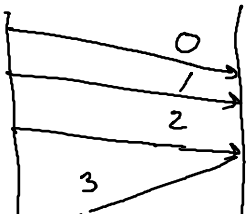


= 17

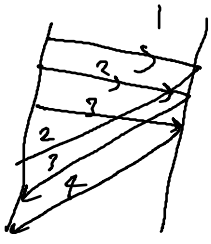


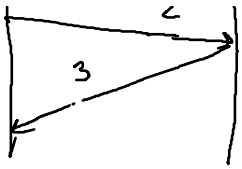
3) Ack :-

commulative



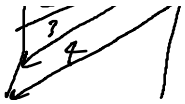
independent





adv:— less traffic

dis — less Reliable



adv:— more Reliable

dis— more traffic

Selective Repeat Protocol

Wednesday, March 2, 2022 9:17 AM

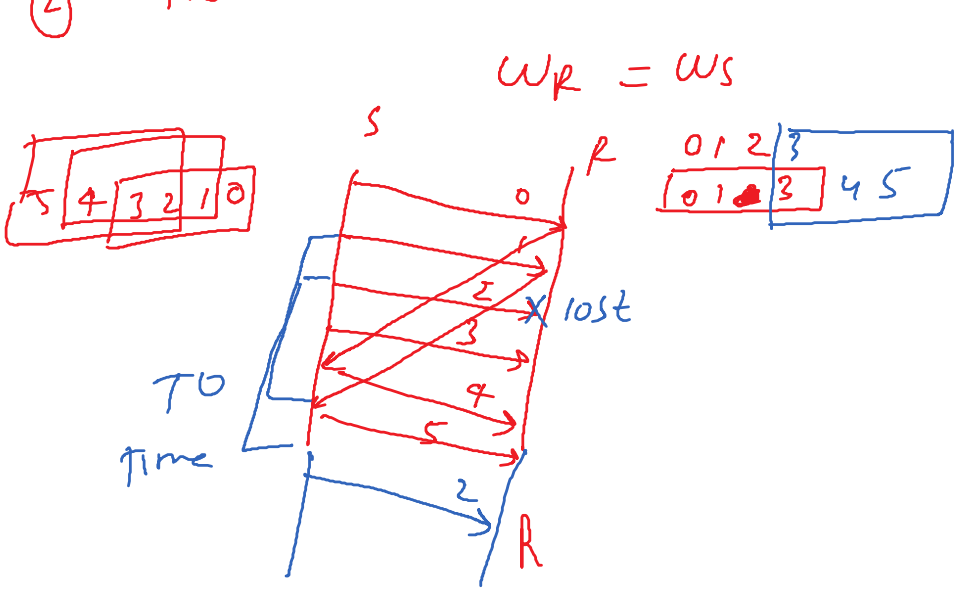
① Sender window size :- $W_S = N \ (N > 1)$

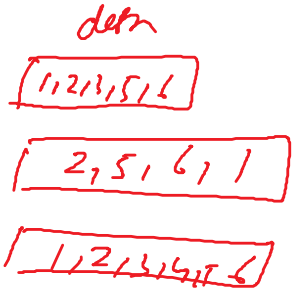
$T_t = 1ms$, $T_p = 49.5ms$, $W_S = 50$, $B = 4 mbps$

$\eta = \frac{N}{1+2a} = \frac{50}{100} = \frac{1}{2}$, $T_h = \eta \times B = 2 mbps$

② Receiver window size = Sender window size

$W_R = W_S$





Q. $W_S = 3$, 10 pack, 5th packet is lost, SR transmission = ?

Shortcut method :-

1 2 3 4 5 5 6 7 8 9 9 10 = 12

↑ lost ↑

(5) Ack is Independent

2 bit $= 2^2 = 4 = 0, 1, 2, 3$

seq no - 0, 1, 2, 3

3 bit $= 2^3 = 8 = 0 - - 7$

0, 1, 2, 3, 4, 5, 6, 7

~~0, 1, 2, 3~~

0, 1, 2, 3 0, 1, 2, 3 0, 1, 2, 3