12/12/2015.

OSI.

Application
Presentation
Session
Transport
Network
Data link
Physical

Imp } Forouzan + Tanenbaum.
Forouzan + stallings.

Application layer :- file transfer, access, mail services, and directory services.

Imp
Transport layer :- Service point addressing.

IP address + Port address
(Local Address)

- The transport layer includes the type of address called service pt. address or port address.

The n/w layer gets each packet to the correct computer. The transport layer gets the entire ~~process~~ message to the current process.

- Segmentation & Reassembly.

A message is divided into ~~transf~~ mitable segments which are reassembled at the destination.

- Flow control and Error control

↳ In case of loss of packet, it resends the packet.

Network layer :- — If you required to transfer data outside network.

— responsible for source to destination delivery of packets across the n/w.

— If two systems are connected to same n/w.

uses :-
① Logical addressing
② Routing

Datalink layer :- — एक Network से दूसरे Network पर पहुँचाना।

— within the network, they tell us the hops.

— framing - The message is made into frames
— physical addressing / MAC address.

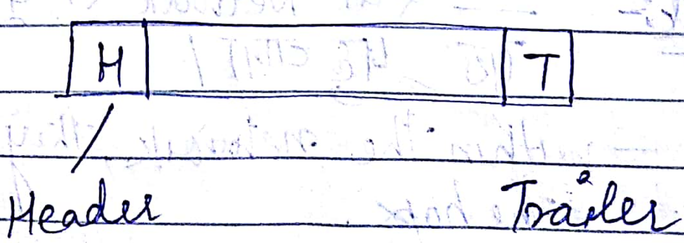
- flow control
- error control
- access control.

If multiple devices are connected to the same link, the data link layer defines which device has control over the link.

Physical layer :-

- representation of bits.
- Data rates / Transmission rates (bit/sec)
- synchronization of the bits.
- physical topology
- Transmission modes — Simplex, duplex, half duplex.

Data link layer has both header & trailer.



Network layer, Transport layer and Application layer has only <u>Header</u>.

H	

Physical layer does not have Header or Trailer. It is in form of 0's & 1's.

<u>HTTP = 80-80 port</u>

If <u>Source</u>.	<u>Destination</u>.
· IP ~~ds~~ address.	- IP address
· Ethernet / MA address	~~[illegible]~~

- Hop by Hop delivery. (~~[illegible]~~ <u>data link layer</u>)
- Source to ~~dest~~ destination delivery. (network layer)
- Port to port delivery (<u>Transport layer</u>)

Transport layer का = Segment
Network layer का = packet
Datalink layer = Frame
Application layer = message

Application	PROCESSES.	→ specific address
Transport	TCP UDP SCTP	— Port address
N/w layer.	IP and other protocols	— logical address
Datalink & physical	Underlying physical n/w	— Physical address.

Scanned by CamScanner

Performance :-

① **Bandwidth** :- represents bit/sec.

no. of bits/sec that a network can transmit.

② **Throughput** :- How fast we can actually send it up.

③ **Latency** :- composition of 4 things -

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

~~A~~ Imp.

Propagation — ~~depends on~~ the speed.

$\propto \frac{D}{S}$ $\frac{\text{distance}}{\text{speed}}$

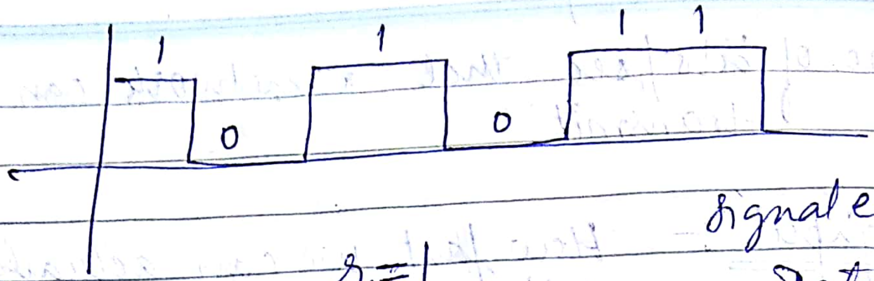
Transmission ~~it is no~~.

— $\frac{\text{message}}{\text{Bandwidth}} = \frac{M}{B}$

queuing time and processing ~~delay~~ time are negligible.

Digital Transmission:-

(i)

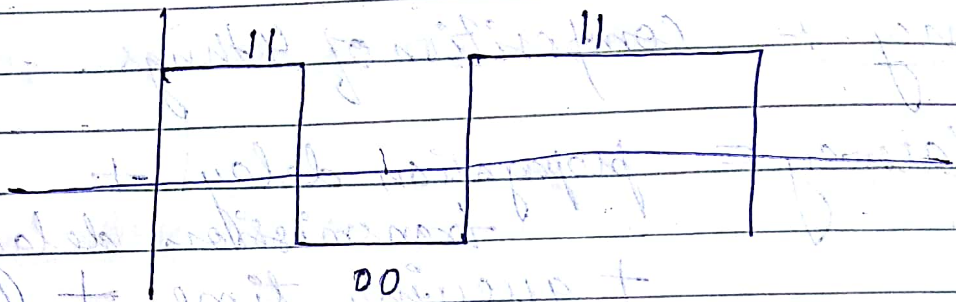


Signal element = 1.

Data elements = 1

$r = 1$

(ii)

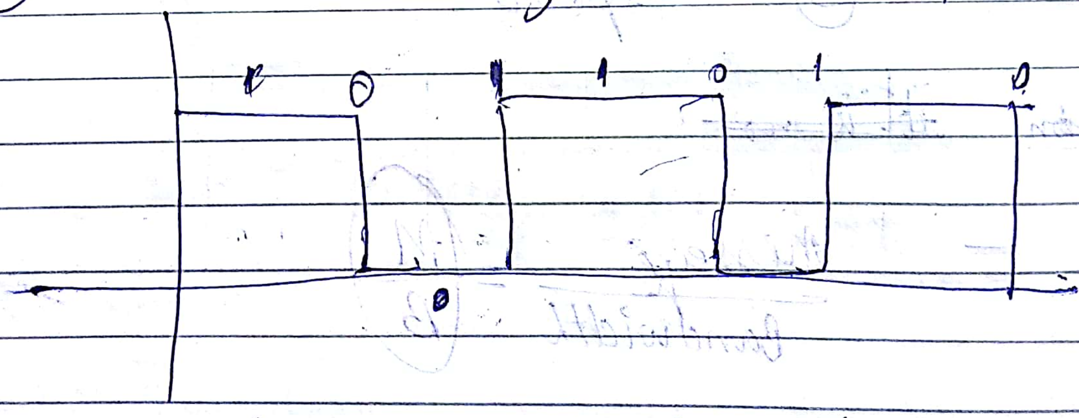


Signal element = 1

$r = 2$

Data elemets

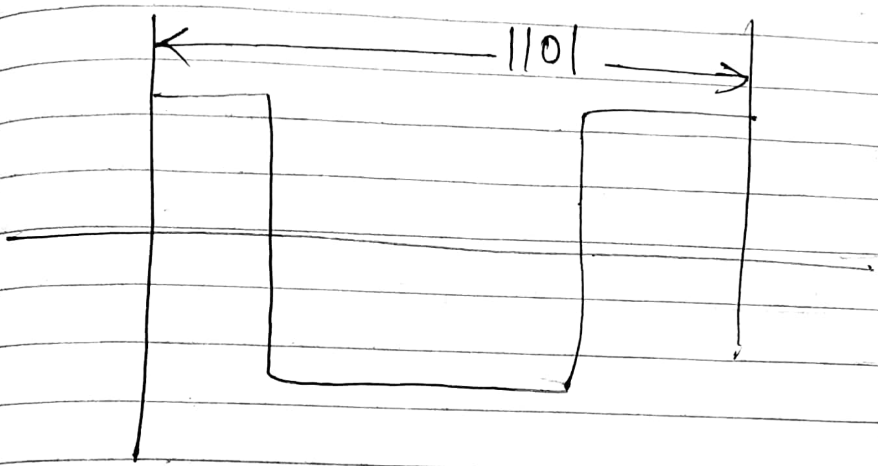
(3) Manchester encoding has $r = 1/2$



$r = 1/2$ Data ele = 1

Signal = 2

'r' is no. of data elements ~~per~~ on signal elements.



signal element = 3

data = 4 $\qquad r = \frac{4}{3}$

data rate :- no. of data elements sent in one sec.

~~bits~~ = bits/sec.

Signal ~~elem~~ rate = no. of signal elements in one second.

unit is "baud"

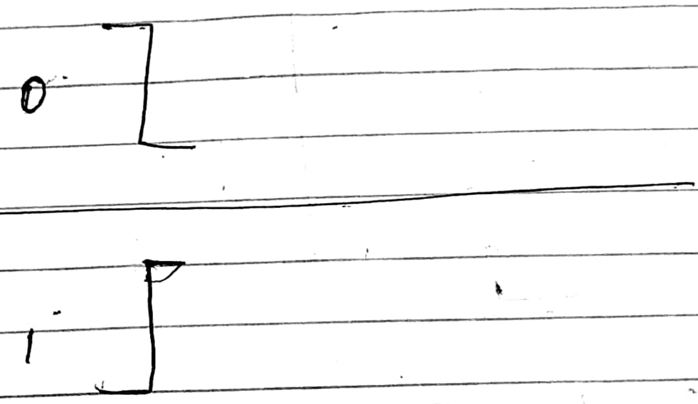
for No. of signal elements

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

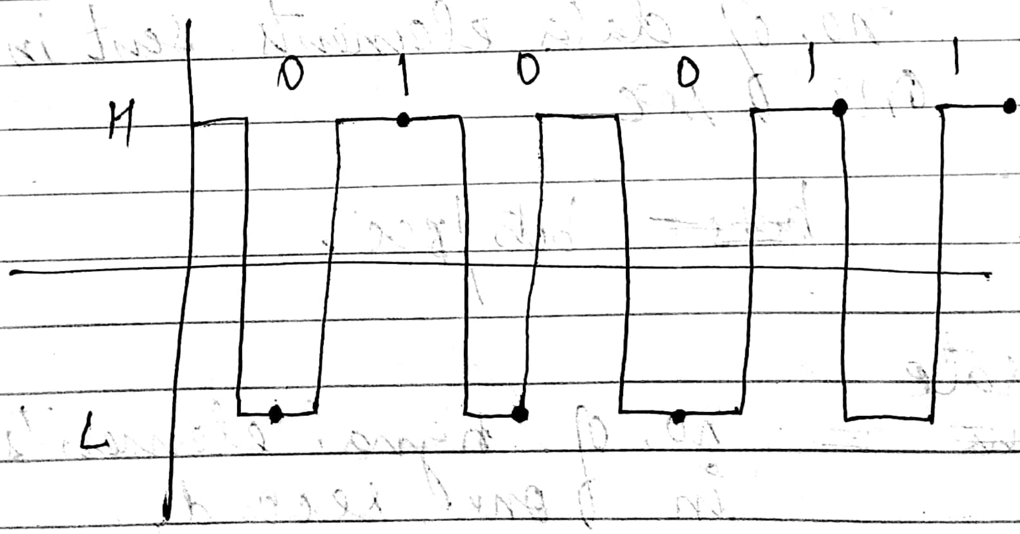
N → data rate

S → signal rate

when $r = \frac{1}{2}$



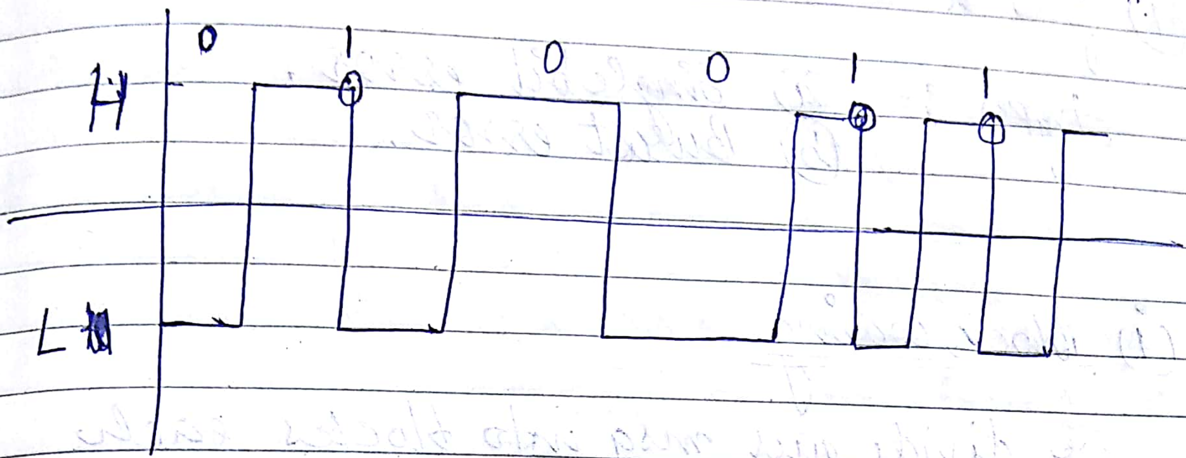
eg:- 010011



Differential Manchester :-

1 – Inversion Not
0 – inversion.

0 → Inversion
1 → no Inversion.



Second half is always opposite of first half.

2007 Ques. In ethernet, when manchester encoding is used, the bit rate is :-

1. half the baud rate
2. twice " " "
3. same as " " "
4. none of the above

Ans :- Half the baud rate

Data link layer:-

① ~~How a~~ Error Detection and correction:-

types :- (a) single bit error.
(b) Burst error.

(i) Block coding

we divide our msg into blocks each of k-bits called data-words.

we add 'R' redundant bits to ~~to~~ each block to make

$$\boxed{N = K + R}$$

Resulting N-bit block is called code word.

K-bits	K-bits	- - - - - - - -	K-bits

2^K data words

$n = k + r$	n	- - - - - - - -	n-bits

2^n codewords

$$\text{waste} = 2^n - 2^k$$ → These are codewords not used.

Hamming Distance:-

HD b/w 2 words is the no. of differences b/w corresponding bits.

eg:-

```
  0100        1010
  0101        0101
  ----        ----
  0001        1111
```

minimum HD is the smallest hamming Dist b/w all possible distance ~~b~~ ~~of~~ in a set of words.

eg:-

Dataword	Codeword	Codeword 2
00	000	00000
01	011	01011
10	101	10101
11	110	11110
$K=2$	$r=1$	$r=3$
100bits	$d_{min}=2$	$d_{min}=3$

00	01	10	11					- -

000 011 101

∴ Total transmitted bits = 100+50 = 150

~~$d_{min} = 2$.~~

Min Hamming distance for error detection

If the code is to ~~dect~~ detect 'S' errors, minimum hamming distance must be 'S+1'.

$$d_{min} = S+1$$

min. dist. for error correction :-

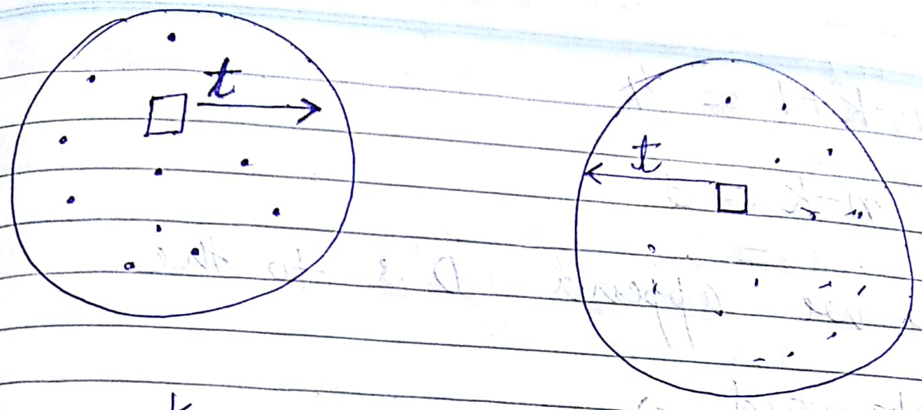
To gaurantee correction of upto t-errors the minimum hamming distance in a block code is $2t+1$.

$$d_{min} = 2t+1$$

eg:-

$$3 = 2t+1$$

$$\therefore t = 1$$



$\leftarrow 2t+1 \rightarrow$

Hamming Code :-

$\rightarrow n = K+1$

If K-bit data, then K+1 codeword.

$d_{min} = 2$

It can detect odd number of errors.

Cyclic Code :- CRC

eg: Dataword $\rightarrow$ = 1001
Divisor = 1011

data word - K-bits
code " - n-bits
we append n-K 0's in data word.
divisor = n-K+1 in length.

$n-k+1 = 4$

$n-k = 3$

now we append 0's to the Data word →

```
         1010
1011 ) 1001000
       1011
       -----
        01000
         1011
         ----
         0110
         0000
         ----
          110  → Remainder
```

Codeword = $\underbrace{1001}_{k}\ \underbrace{110}_{n-k}$

```
         1010
1011 ) 1001110
       1011
       -----
       01011
        1011
        ----
        0000
```

1011

$x^3 x^2 x^1 x^0$

Divisor $= x^3 + x + 1$

Divident

$$(x^5 + x^3 + x^2 + x)(x^2 + x + 1)$$

$$= (x^7 + x^6 + x^5 + x^5 + x^4 + x^3 + x^4 + x^3 + x^2 + x^3 + x^2 + x)$$

$$= x^7 + x^6 + x^3 + x$$

Divisor $= x^3 + x + 1$

↑

generator polynomial.

Dataword $=$ $d(x)$

Codeword $=$ $c(x)$

generator $=$ $g(x)$

syndrome $=$ $s(x)$

error $=$ $e(x)$

Scanned by CamScanner

$$\frac{c(x)}{g(x)} = s(x) = 0$$

- If $s(x) \neq 0$, one or more bits corrupted.

- If $s(x) = 0$, either

  - No bit is corrupted
  - Some bits are corrupted but the decoder failed to detect them.

$$\frac{c(x) + e(x)}{g(x)} = \frac{c(x)}{g(x)} + \frac{e(x)}{g(x)}$$

$$= s(x) + \frac{e(x)}{g(x)}$$

In a cyclic code, those $e(x)$ errors that are divisible by $g(x)$ are not caught.

properties:- → of good generator polynomial

① If the generator $g(x)$ / divisor has more than one term and coeff. of $x^0 = 1$, all single errors can be caught.

② A generator that contains the factor of $(x+1)$ can detect all odd numbered errors.

③ If a generator cannot divide $x^t + 1$, where value of 't' is b/w 0 to $n-1$, then all isolated double errors can be detected.

Checksum:-

- faster to compute but
- not as strong as CRC

Since it is fast, to check error faster it can be used.

Q6 / 141 2007

11001001
$x^7 x^6 x^5 x^4 x^3 x^2 x^1 x^0$

$x^7+x^6+x^3+1$

$x^3+1 \longrightarrow$ divisor = 4 bit 1001

$x^3+1 \overline{) x^7+x^6+x^3+1}$ x^2

```
         11010011
1001 ) 11001001 000
       1001
       ----
        1011
        1001
        ----
        01000
         1001
         ----
        001100
          1001
          ----
           1010
           1001
           ----
            011
```

$\underbrace{11001001}_{K}\ \underbrace{011}_{n-K}$

Ans:- (b)

93/143
2009

$G(x)$

$G(x)$ is a factor of $\underline{(x+1)}$.

2004(IT)

Consider a parity check code of 3 data bits and 4 parity check bits.

3 of the code words are :- 0101011
1001101
1110001

which of the following are code words_:

(I) 0010111 ✓ (II) 0110110
(III) 1011010 ✓ (IV) 0111010

✓(a) I & III (c) I & II.
(b) I, II & III (d) I, II, III & IV.

[In linear block codes, the XOR of any 2-code words creates a new codeword.]

1110001
1100110

(1011010) ✓

0010111 1011010

Ans:- $\underline{(a)}$

2005(IT) Consider the msg 'M' = 1010001101

Divisor = $x^5 + x^4 + x^2 + 1$

CRC = ?

5 4 3 2 1 0

110101 ⟶ 6 bits

∴ append 5 0's.

```
                     1101010110
         ____________________
 110101 ) 101000 1101 00000
          110101
          ------
           111011
           110101
           ------
             111010
             110101
             ------
               111110
               110101
               ------
                 101100
                 110101
                 ------
                  110010
                  110101
                  ------
                   [01110]
```

$\underbrace{1010001101}_{K}\ \underbrace{01110}_{n-K}$

2006(IT)

0000 0

0000 1

0101 0

1010 1

1111 0

Soln

01/01

2006 (IT). An error correcting code has following code words.

0000 0000
0000 1111
0101 0101
1010 1010
1111 0000

min no. of errors corrected.

Sol^n

$S+1 = d_{min}$

$d_{min} = 4$

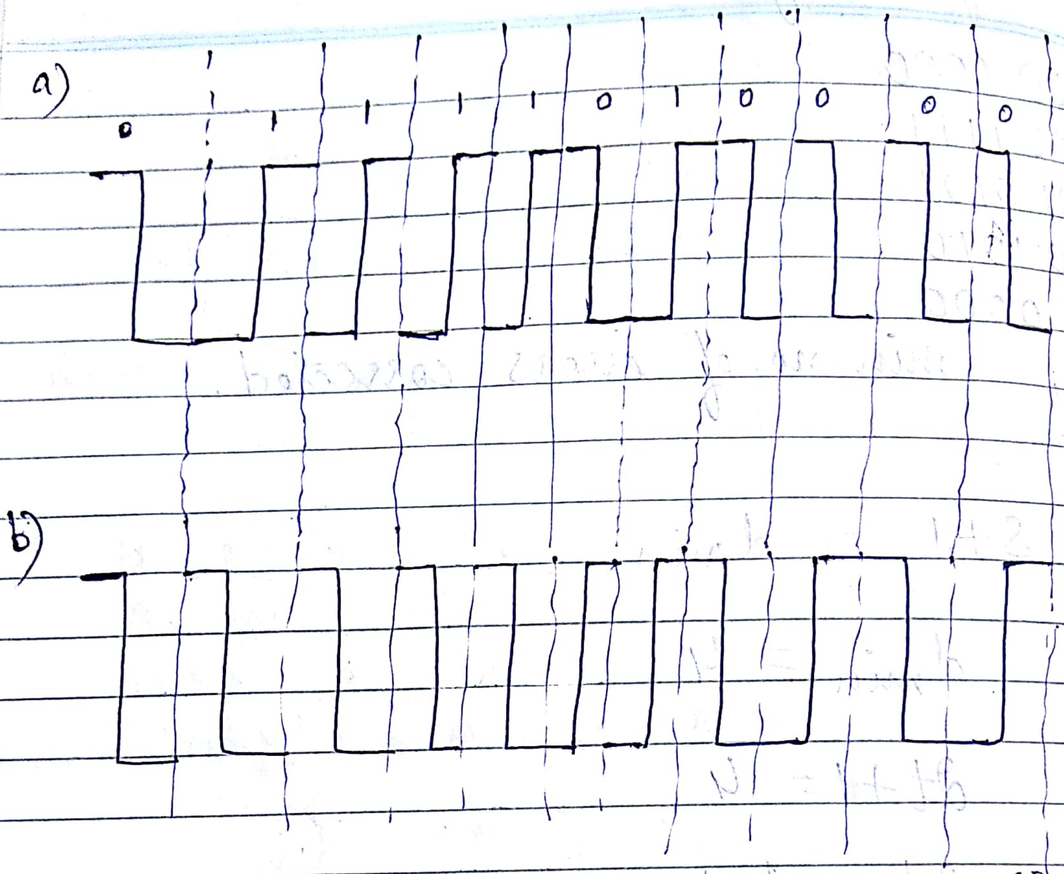
$2t+1 = 4$

$2t = 4-1$

$t = 3/2$

$t \approx 1$

2007 (IT)



(A) 1000010111 & Differential Manchester

(B) 01111010000 & " "

(C) 1000010111 & Integral "

(D) 01111010000 & Integral Manchester.

Ans:- (B) (D)

Integral M

0 →

1 →

2008 (IT)

2-D

Each

in L

	d
r_0	0
r_1	1
r_2	0
r_3	0
r_4	1

The f

n- c

val

a) 1

b) 2

c) 3

d) 4

Integral Manchester | Differential

0 → No Inversion | 0 → Inversion

1 → Inversion. | 1 → No Inversion

208 (IT) Data Transmitted on a link uses a 2-D parity scheme for error detection. Each sequence of 28 bits is arranged in 4X7 matrix using even parity.

	d_7	d_6	d_5	d_4	d_3	d_2	d_1	d_0	
r_0	0	1	0	1	0	0	1	1	
r_1	1	1	0	0	1	$\boxed{1}$	1	0	← non-even.
r_2	0	0	0	1	0	1	0	0	
r_3	0	1	1	0	1	0	1	0	
r_4	1	1	$\boxed{0}$	0	0	1	1	0	
			↑			↑ non-even.		↑	

The table shows data recieved by reciever has n- corrupted bits. what is the possible value of 'n'?

a) 1
b) 2
c) 3 ✓
d) 4

Ans: 3

framing :-

F	H		T	F

flag

flag is added at beginig & end of frame to seperate ~~only~~ one frame from next.

types :- (1) Bit Stuffing
(2) Byte Stuffing

1- bit stuffing :-

Sender adds 0 after 5 1's.

bit stuffing is process of adding 1 extra zero whenever 5 continous 1's follows a 0 in the data so that the zero doesnot mistake the pattern 01111110 as a flag.

Data :- 00011111·1111 0011111,01000

bit stuffing :- 00011111 0 1111 00 0 11111 0 01000

Here flag is having 6 1's.
i.e. bit stuffing is with 5 1's.

(2) Byte Stuffing:- we use "Esc"

the process of adding 1 extra byte whenever there is a "flag" or "Esc" character in the text.

F H - - E F (E = escape)

→ means include Flag to the data

ch-10, 11, 12 → forozan book.

Q 2014 (delimiter)

A bit stuffing based framing uses 8 bit flag pattern of 01111110. if the output bit stream after stuffing is 01111100101, then input bit is →?

01111110101 Ans:-

Q 2004(IT)

In a data link protocol, the frame delimiter flag is given by 0111. Assuming that bit stuffing is employed, the transmitter sends data sequence 01110110 as ___

Ans:- 011010111 00

flow Control

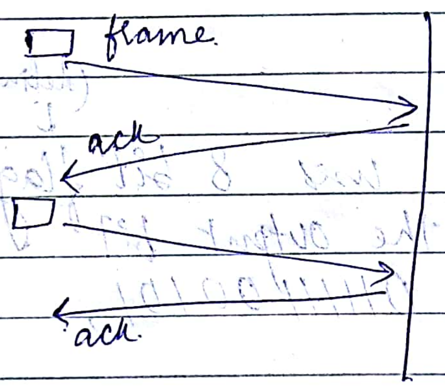
Noiseless channels

- Simplest
- Stop and wait

Noisy channels

- Stop & wait
- Go back N
- Selective Repeat ARQ

Sender Reciever



① Stop and

Sender

error correct
a copy of
of the

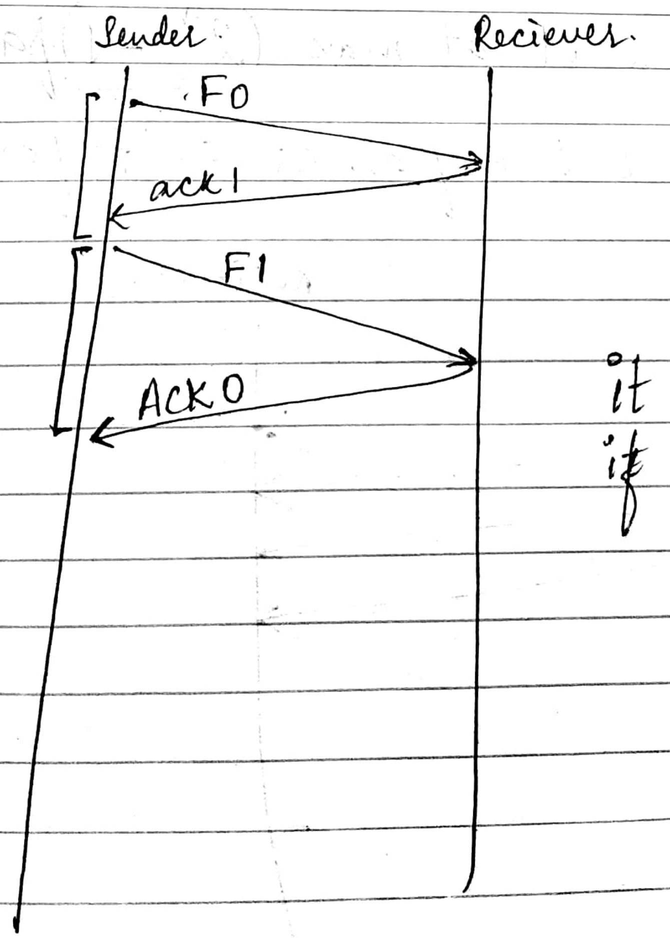
~~Sequen~~
num
They
alwa
of th

(1) Stop and wait ARQ (Automatic Repeat Request)

Sender Reciever

error correction in stop & wait is done by keeping a copy of the send frame and retransmitting of the frame when timmer expires.

~~Sequen~~ In stop & wait, we use sequence numbers to number the frame. They are based on mod 2 arithematic. The acknowoledgement number always announces the sequence no. of the next frame expected.



it is best case if we use 0, 1 as packet no.

mod-2 arithematic because it has either 0 or 1.

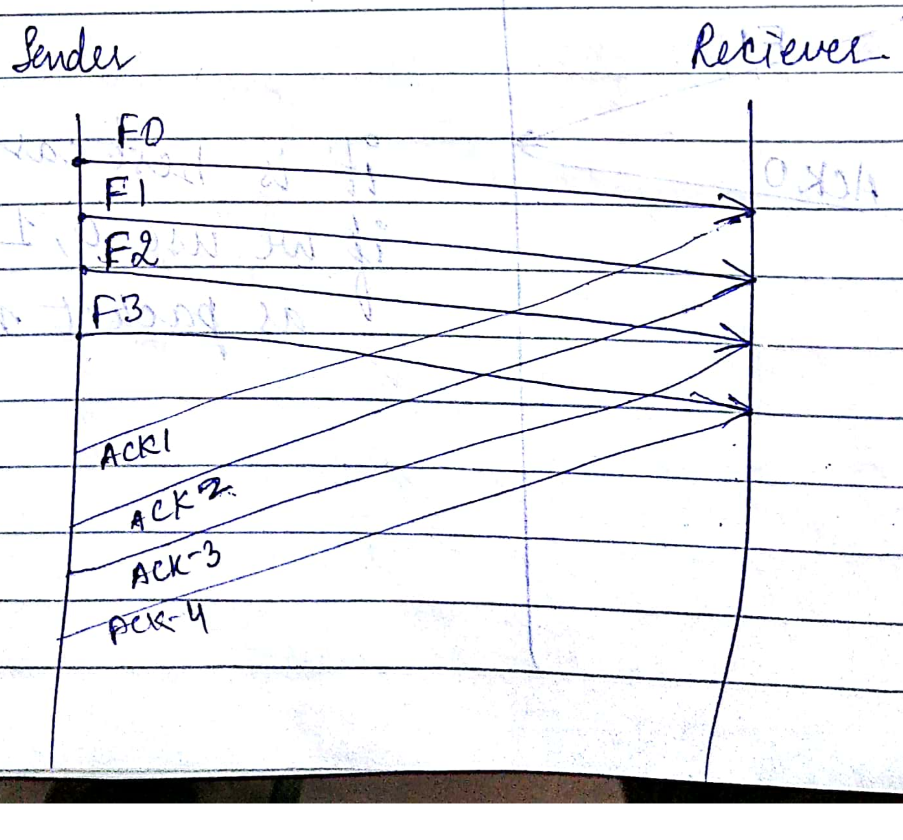
(2) Go Back N ARQ :-

In Go Back 'N', the sequence numbers are modulo 2^m where 'm' is the size of sequence number field.

eg :- $m = 3 \Rightarrow 2^3 = 8$ frames.

- Sender can send at max $(2^m - 1)$ frames

i.e. 0 to 6 frames = 7 frames



Sender window of size $= 2^m - 1$
and reciever ~~se~~ of size $=$ ~~sz~~ 1

There can be a timer for each frame that is sent, but we use only for 1^{st} frame.

The reciever sends an acknowledgement if the frame has arrived safe & in order.

If the frame is damaged or out of order, the reciever is silent and will discard all the subsequent frame.

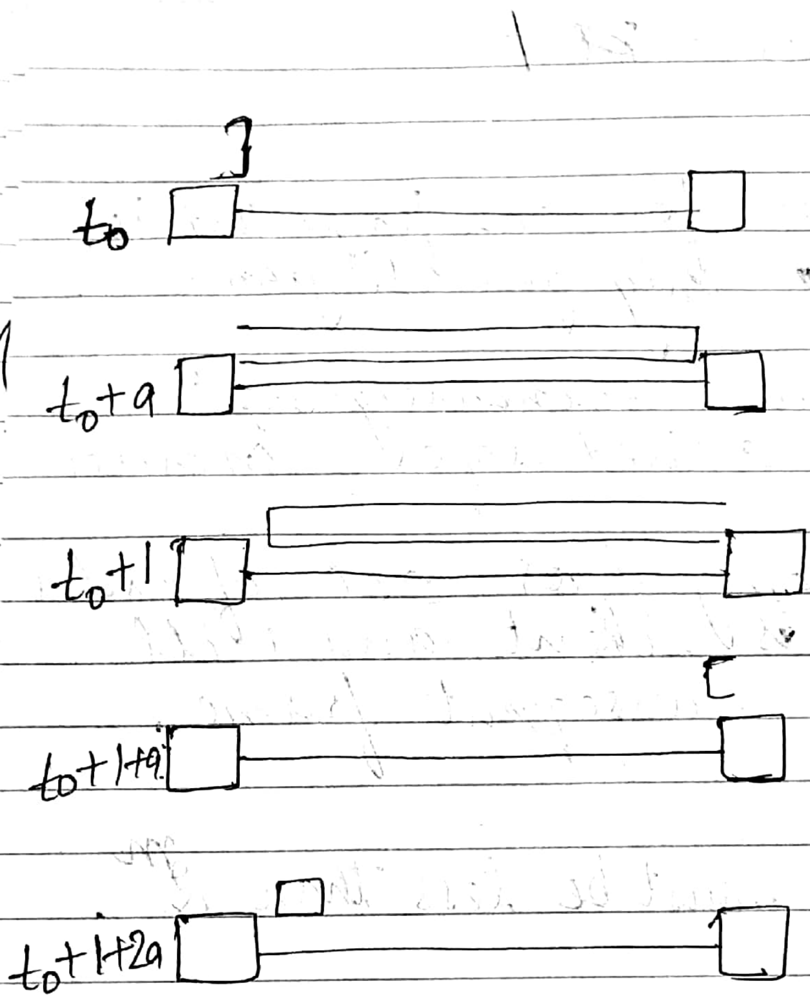
Size of sent window must be less than 2^m.

(3) Selective Repeat ARQ :-

- Sender window ~~ttr~~ size $= 2^{m-1}$
- Reciever " " $= 2^{m-1}$

It is cumulatively acknowledging the frames in the window.
cumutative acknowledgement is required.

Stop & wait Utilization :-



$$a < 1$$

$$a = \frac{t_p}{t_{fr}} = \frac{D/S}{M/B}$$

If $a < 1$

$\therefore \quad \frac{t_p}{t_{fr}} < 1 \Rightarrow t_p < t_{fr}.$

we say t_p = 'a' and t_{fr} = '1'.

$$\frac{a}{1} = \frac{t_p}{t_{fr}}$$

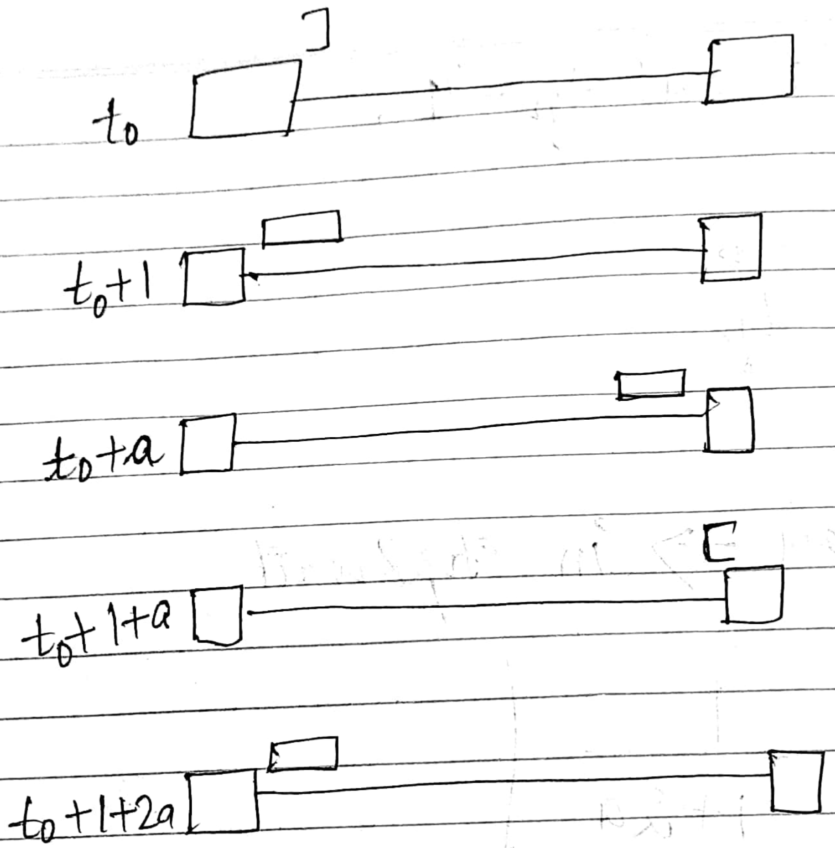
Utilization ⟹ in Stop & wait

$$\boxed{U = \frac{1}{1+2a}}$$

where $a = \dfrac{t_p}{t_{fr}}$

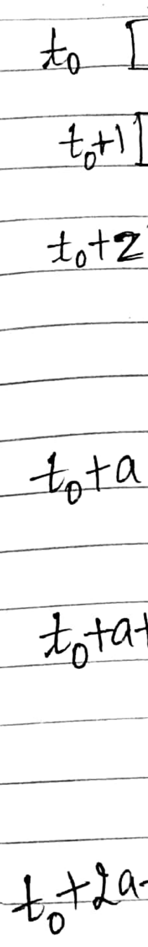
$$t_p = \frac{\text{Dist}}{\text{Speed}}$$

and $t_{fr} = \dfrac{\text{msg}}{\text{Bandwidth}}$

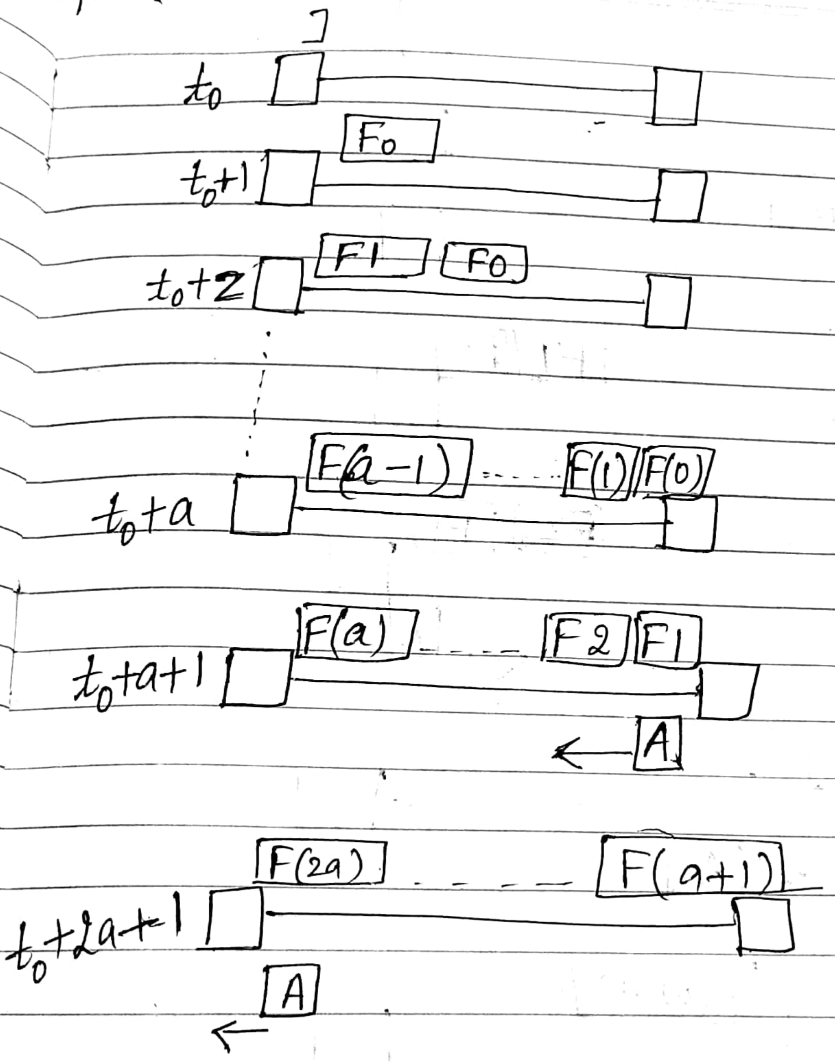


$a > 1$

Utilizatio



Utilization in Go back N

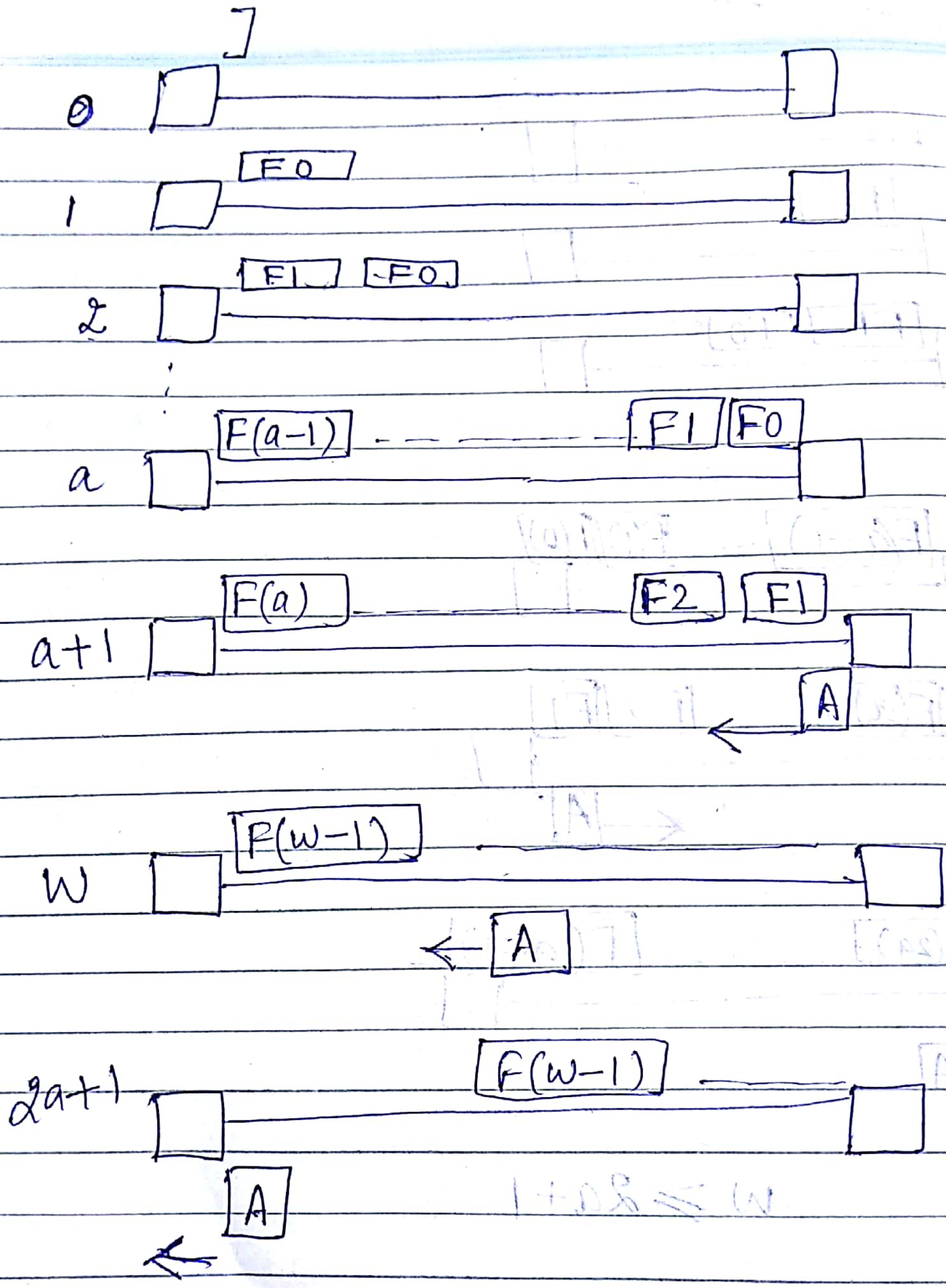


$$w \geq 2a+1$$

Q3 2005
140

Q4
2006

Pg-1



$$W < 2a+1$$

$$\boxed{U = \frac{W}{1+2a}}$$

Q3 2005
140

Ans : 2^{m-1}

Q4
2006

Pg-140

$\boxed{0\ 1\ 2}$

$\cancel{2^m}$

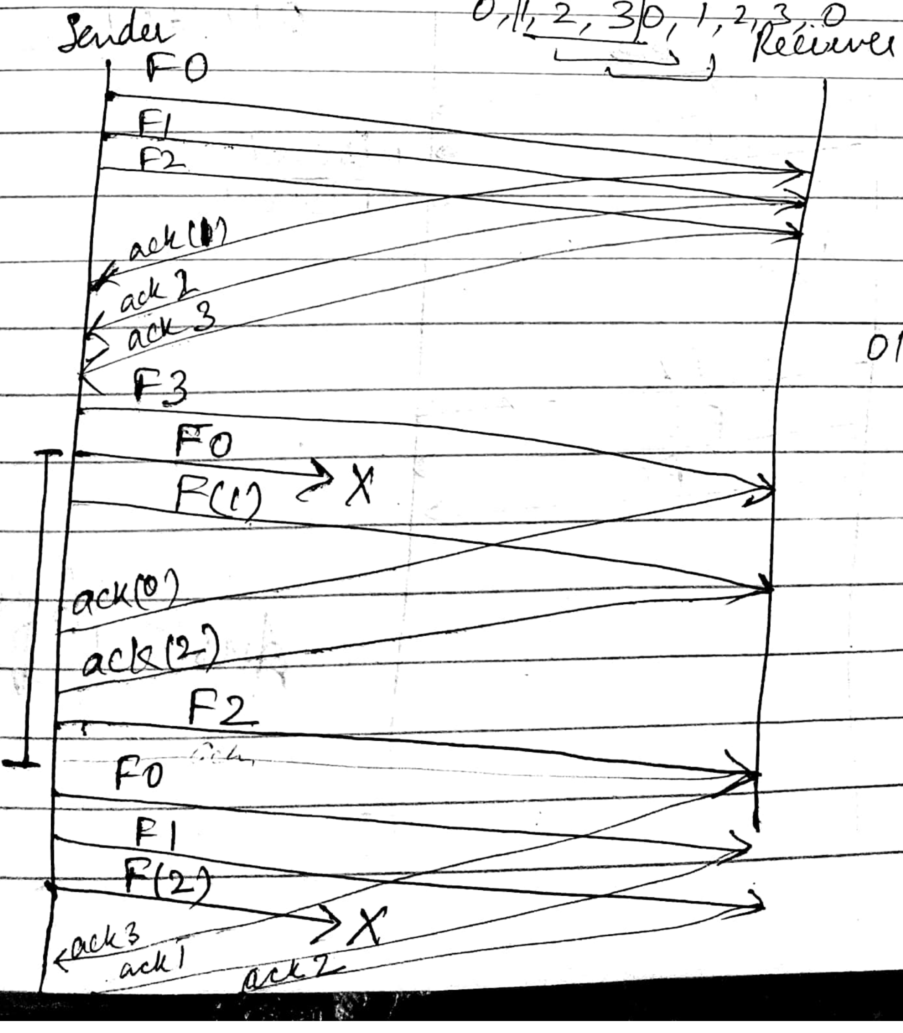
$2^m - 1 = 3$

$2^m = 4$

$\therefore m = 2$

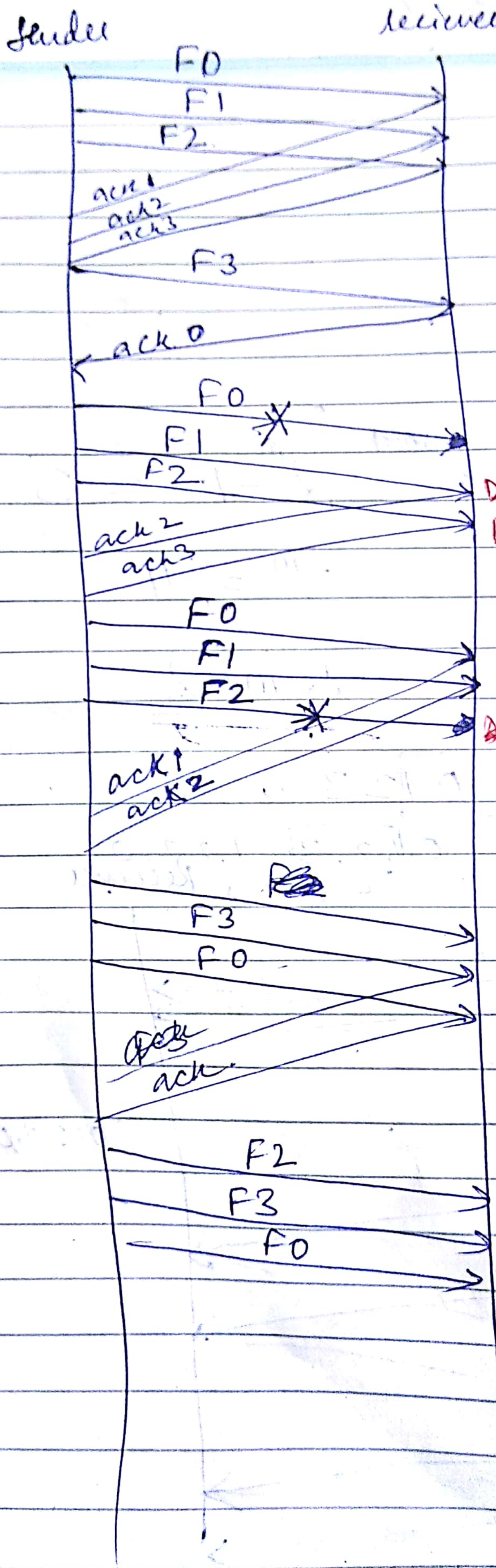
$\boxed{0, 1, 2}, \boxed{3\ 0\ 1} 2\ 3\ 0$

0, 1, $\boxed{2, 3}$ 0, 1, 2, 3, 0



0 1 2 3 0 1 $\boxed{2\ 3\ 0}$

Q2 2006



$\boxed{0\,1\,2}\,3\,0\,1\,2\,3\,0$

$0\,\boxed{1\,2\,3}\,0\,1\,2\,3\,0$

$0\,1\,2\,3\,\boxed{0\,1\,2}\,3\,0$

Discard F'0' is lost

Discard So again 0,1,2.

~~Discard~~ F'2' is lost.

$0\,1\,2\,3\,0\,1\,\boxed{2\,3\,0}$

Discard

Discard.

Ans:- 16 frames

Q2 (2006) 140

$$U = \frac{W}{1+2a}$$

$W = ?$

optimal window means $U = 1$

$$a = \frac{t_p}{t_{fr}}$$

$2 \cdot t_p = 80\ ms \Rightarrow t_p = 40\ ms = 40 \times 10^{-3}$

$M = 32\ byte = 32 \times 8\ bits$

$B = 128\ Kbps = 128 \times 10^{3}\ bps$

$$U = \frac{W}{1 + 2\frac{t_p}{t_{fr}}}$$

$$1 = \frac{W}{1 + 80}$$

$$W \geq 1 + 2a$$

$$\geq 41$$

Ans: 40

0 1 2 3 0

0 1 2 3 0

$\boxed{1\ 2}$ 3 0

t

0, 1, 2

t.

3 0

mes

Q 2014

Consider a selective repeat sliding window protocol that uses a frame size of 1KB to send data on a 1.5 Mbps link with a one-way delay of 50 msec.

To achieve a link utilization of 60%, the minimum no. of bits required to represent the sequence number field is ____ ?

Soln:-

$t_p = 50$ msec. $= 50 \times 10^{-3}$ s.

$M = 1KB \quad = 10 \times 8$ Mb

$B = 1.5$ Mbps $=$

$$t_{fr} = \frac{M}{B} = \frac{\cancel{10}^{2} \times 80}{\cancel{15}\ 3}$$

$$t_{fr} = \frac{160}{3}$$

$$a = \frac{t_p}{t_{fr}} = \frac{\frac{50 \times 10^{-3}}{1}}{\frac{160}{3}}$$

$$a = \frac{50 \times 3}{160 \times 10^{3}} = \frac{15}{16 \times 10^{3}}$$

$$V = \frac{W}{1+2a}$$

$$\frac{60}{100} = \frac{W}{1+\cancel{2}\times\frac{15}{\cancel{16}\times10^3}}$$
8

$$\frac{60}{100} = \frac{W}{\frac{8+15}{8\times10^3}}$$

$$\frac{W}{\frac{23}{8\times10^3}} = \frac{60}{100}$$

$$W = \frac{\cancel{6}^{3}}{10}\times\frac{23}{\cancel{8}_{4}\times10^3}$$

$$= \frac{69}{4\times10^4}$$

~~W = 17..~~

1 KB = 10^3

$$\frac{W}{1+2\cdot\frac{\frac{50\times10^{-3}}{1\times10^{-3}\times8}}{1.5\times10^{6}}}$$

$W = 11.85$

$2^{m-1} = 11.85$

$\therefore m = 5$

Ans

Q Suppose that a stop n wait prot used bit rate on 64Kbit/sec and 20msec prog delay, assume that transmission time for the acknowledgement and processing time at nodes is negligible.

Then min. frame size in bytes to achieve 50% utilization? ?

Solⁿ:

$t_p = 20\,msec = 20\times10^{-3}\,sec$

$B = 64\,Kbit/sec = 64\times10^{3}\,bit/sec$

$U = 50\%$

$M = ?$

$$U = \frac{1}{1+2a}$$

$$\frac{50}{100} = \frac{1}{1+2\cdot\frac{t_p}{t_r}}$$

$$= \frac{1}{1+2\cdot\frac{20\times10^{-3}}{\frac{M}{64\times10^{3}}}}$$

10^6 bps per sec

$$a = \frac{t_p}{t_r} = \frac{20 \times 10^{-3}}{\frac{1}{\frac{M}{64 \times 10^3}}}$$

$$a = \frac{20 \times 64 \times \cancel{10^3} \times \cancel{10^{-3}}}{M}$$

$$a = \frac{20 \times 64}{M}$$

$$U = \frac{1}{1+2a}$$

$$\frac{\cancel{50}}{\cancel{100}\ 2} = \frac{1}{1 + 2\left(\frac{20 \times 64}{M}\right)}$$

$$1 + 2\left[\frac{20 \times 64}{M}\right] = 2$$

$$2\left[\frac{20 \times 64}{M}\right] = 1$$

$$\frac{20 \times 64}{M} = \frac{1}{2}$$

$$M = 2(20 \times 64)$$

$$= 2(1280)$$

$$M = \cancel{3560} \ \cancel{bits} \ 2560$$

$$\frac{2560}{8} \text{ bytes}$$

$$M = \cancel{445 \text{ bytes}} \ 320 \text{ bytes}$$

1

2015 set 2 A lin
It ~~...~~
1000 b
protocol
One wa

Sol^n :-

(2015 set 2) A link has transmission speed of 10^6 bits per sec. It ~~reduces~~ uses data packets of size 1000 bytes. Efficiency of stop & wait protocol in this set up is exactly 25%. One way t_p = ______ ? in msec.

Sol^n:-

$$B = 10^6 \text{ bit/sec.}$$

$$M = 1000 \text{ bytes} = 8000 \text{ bits}$$

$$t_x = \frac{M}{B} = \frac{8000}{10^6}$$

$$= 8 \times 10^3 \times 10^{-6}$$

$$= 8 \times 10^{-3}$$

$$t_p = ?$$

$$U = \frac{1}{1+2a} \Rightarrow \frac{\cancel{25}}{\cancel{100}}_{4} = \frac{1}{1+\cancel{2} \cdot \frac{t_p}{\cancel{8} \times 10^{-3}}_{4}}$$

$$\frac{1}{4} = \frac{1}{1+\frac{t_p}{4 \times 10^{-3}}} \Rightarrow 1+\frac{t_p}{4 \times 10^{-3}} = 4$$

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$$\frac{t_p}{4 \times 10^{-3}} = 3$$

$$t_p = 12 \times 10^{-3} \text{ sec}$$

$$t_p = \underline{12 \text{ msec}} \quad \underline{\text{Ans}}$$

Set 3 / 2015

Consider a network ~~consisting~~ connecting 2 systems located 8000 Km apart.

$B = 500 \times 10^6$ bits/sec.

Speed $= 4 \times 10^6$ m/sec

It is needed to design go back N sliding window protocol.

avg. packet size is 10^7 bits.

n/w is to be used to its full capacity.

then min. size in bits of sequence no. fields is ____?

Soln:- t_p

Solⁿ:-

$$t_p = \frac{D}{S_p} = \frac{8000\ km}{4\times10^6\ m/s}$$

$$= \frac{\cancel{8000}^{2000} \times 10^3}{\cancel{4}\times10^6}$$

$$= 2\times10^6\times10^{-6}$$

$$t_p = 2$$

$$t_{fr} = \frac{M}{B} = \frac{10^7}{500\times10^6}$$

$$= \frac{1}{5}\times\frac{10^7}{10^8}$$

$$\frac{1}{50}$$

$$t_{fr} = \cancel{2}$$

$$a = \frac{2}{\frac{1}{50}} \Rightarrow a = 100$$

$$V = \frac{W}{1+2a} \Rightarrow 1 = \cancel{\frac{W}{1+2\cdot2}}$$

$$1 = \frac{W}{1+200}$$

$$201 = W$$

$$\cancel{W = \frac{1}{3}} \Rightarrow W = 3$$

$$2^{w} - 1 \geq 201$$

$$2^{w} \geq 200$$

$$\boxed{w = 8}$$ Ans:-

2014

Consider a source (S) transmitting a file of size 10^6 bits to destination (d).

S —— R1 —— R2 —— D

L1   L2   L3

let each link be of length 100 km and assume signals travel @ speed of 10^8 m/sec.

Assume that B ~~on~~ each link is 1 mbps. let file be broken down into 1000 packets each of size 1000 bits. find the total sum of transmission and propagation delay in transmiting file from S to D.

a) 1005 b) 1010 c) 300

Solⁿ:- $t_p =$

t_{fr}

a

1st file

99

a) 1005 (b) 1010 (c) 3000 (d) 3003

Solⁿ:-

$$t_p = \frac{D}{S} = \frac{100 \times 10^3}{10^8}$$

$$= \frac{10^5}{10^8}$$

$$t_p = 10^{-3} \cancel{m/s} \text{ sec}$$

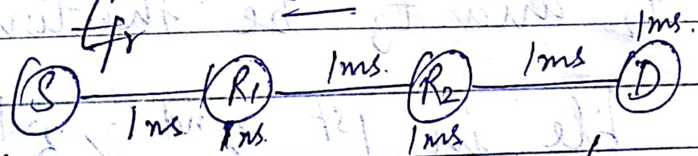
$$t_p = 1 \text{ msec}$$

$$t_{fr} = \frac{M}{B} = \frac{1000 \text{ bits}}{1 \times 10^6 \text{ bps}}$$

$$= 10^{-3} \text{ sec}$$

$$t_{fr} = 1 \text{ msec}$$

$$a = \frac{t_p}{t_{fr}} = 1$$



1st file/frame takes = 6 msec.

999 frams 1ms each i.e. 999 ms

999 + 6 = 1005 msec

Q 2014 ☆☆

V.V. Imp

A —— R1 —— R2 —— B

$B = 10^6$ bytes/sec.

each.

user at A sends file 10^3 bytes to Host B through routers R1 & R2 in 3 diff. ways.

case 1 (i) A single packet containing complete file is transmitted from A to B.

case 2 (ii) A file is split into 10 equal parts.

(iii) A file is split in 20 equ-

Each packet contains 100 bytes of header information along with the user data.

Consider only transmission time.

let t_1, t_2 and t_3 be the times to transmit file in 1^{st}, 2^{nd} & 3^{rd} case.

which of the following is correct?

(A) $T1 < T2 < T3$

(B) $T1 > T2 > T3$

(C) $T2 = T3$, $T3 < T1$

(D) $T1 = T3$, $T3 > T2$

Soln:

$T_{fr} =$

case-1

t_1

$t_2 =$

$t_3 =$

total tim

case-2

B

Solⁿ:

$T_{fr} = \frac{M}{B} = \frac{1100}{10^6}$

case-1

$t_1 = 1.1\ msec$

$t_2 = 1.1\ msec$

$t_3 = 1.1\ msec$

total time = 3.3 msec

case-2

$\cancel{\frac{1100}{10}} = \cancel{110\ M}$

$\frac{110}{10^6} = 110$

Header

$\frac{1000}{10} = 100 + 100$

$= 200$

$\frac{200}{10^6}$

$t_1 = 0.2\ msec$

$\times 3$ steps

0.6 msec

through
ays.
nplete
to B.
parts.
header
ata.
to
re.

2007/Q7/141

time $= 0.2 \times 3 + 0.2 \times 9$

$= 0.6 + 1.8$

time $=$ 2.4 msec.

case-3 $t_{fr} = \frac{150}{10^6} = 0.15$ msec

$= 3 \times 0.15 + 19 \times 0.15$

$t_{fr} =$ 3.3 msec.

$T1 = T_3$ and $T_3 > T_2$

Ans:- D

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2007/Q7/141

M —— L kms —— N

msec

Dist = L Km

$M = \frac{K \text{ bits long}}{R}$

$t_p = Lt$ seconds

$U = 1$

$$U = \frac{W}{1 + 2\frac{t_p}{t_f}} = \frac{W}{1 + 2 \cdot \frac{Lt}{\frac{K}{R}}}$$

$$1 = \frac{W}{1 + \frac{2Lt}{\frac{1}{\frac{K}{R}}}} = \frac{W}{1 + \left(\frac{2Lt}{K}\right)R}$$

$$1 = \frac{W}{\frac{K + 2LtR}{K}}$$

$$\frac{K + 2LtR}{K} = W$$

$$2^m \geq \frac{K + 2LtR}{K} \Rightarrow \log_2\left[\frac{K + 2LtR}{K}\right]$$

2009.
Pg=143

$M = 1000$ bits
$B = 10^6$ bps.

(A)

$t_p = 25$ ms.

$t_{fr} = \frac{M}{B} = \frac{1000}{10^6} = 10^{-3}$ sec

$t_{fr} = 1$ msec

$1 + 2a$

$1 + 2\frac{t_p}{t_{fr}}$

$1 + 2 \cdot \frac{25}{1}$

$1 + 50 = 51$

$W \geq 51$

$2^m \geq 51$ $\qquad 2^6$

(4)

$m = 6$ $\quad$ taking $m = 5$ ✓. Ans (d)

Linked Qu

95
143

$t_0 + 32$

$t_0 + 51$

ack

Linked Qu

85
143

~~W~~

$$U = \frac{W}{1+2a}$$

t_0+32

t_0+51

$$2^5 = 32$$

$\therefore$ at $t_0+51 \rightarrow 1^{st}$ ackn.

$t_0+32 \rightarrow$ Last frame

$$\begin{array}{r} 51 \\ -32 \\ \hline 19 \end{array}$$

acknowledg का $t_{fr}=0$ always
only 't_p' exists.

-3 sec

Scanned by CamScanner

$$S = \frac{n t_n}{k t_p + (n-1) t_p}$$ → pipeline speedup

2004(IT).

25 Kbps satelite link has a plopagation delay of 400 ms.

The transmiter employees go back n scheme with n=10.

Assume each fame is 100 bytes long, then what is the max. data rate possible?

options: 5, 10, 15, 20 Kbps

Solⁿ:

$t_p = 400$ ms. $= 400 \times 10^{-3}$ sec

$B = $ Kbps. $= 10^3$ bps.

$W = 10$

$M = $ 100 bytes long $= 100 \times 8$ bits.

$$t_{fr} = \frac{M}{B} = \frac{800}{10^3} = \frac{8}{10} = 0.8 \text{ sec}$$

$$U = \frac{W}{1+2a}$$

$$a = \frac{t_p}{t_r} = \frac{\overset{50}{\cancel{400}} \times 10^{-3} \times 10}{\cancel{0.8}}$$

→ pipelining speed

as
ns.
ck n
long,
its.
sec.

$$U = \frac{10}{1+2(500\times10^{-3})}$$

$$= \frac{10}{1+\cancel{2}\left(\frac{\cancel{5}}{\cancel{10}}\right)}$$

$$= \frac{10}{2}$$

$$U = 5$$

$$1+2\left[\frac{400\times10^{-3}}{\frac{100\times8}{25\times10^{3}}}\right]$$

$$U = \frac{10}{26}$$

throughput = U × Bandwidth

$$= \frac{10}{26}\times 25$$

$$\approx \underline{10\ \text{kbps}}$$

Qus

In a sliding window ARQ scheme the transmitter's window size is N and reciever window size = M.
The min. no. of distinct sequence numbers required to ensure the correct operation of the ARQ scheme is :-

a) Min (M, N)
b) Max (M, N)
c) m+n ✓
d) m*n

Soln :-

	Go back ARQ	Selective ARQ
Sender :	2^{m-1}	2^{m-1}
Reciever : (+)	1	(+) 2^{m-1}
Sequence no. ←	2^m	2^m

Ans :- (C)

2005 (IT)

A channel ...
pr 20m...
stop & ...
to get ch...
minimum ...

V = ...

tp ...

B ...

2005 (IT)

A channel has bit rate of 4 Kbps and one way pr 20ms.
stop & wait protocol.
~~to~~ get channel efficiency of 50%, minimum frame size should be ______?

$U = 50\%$ $\qquad U = \frac{1}{1+2a}$

$t_p = 20ms$

$B = 4 Kbps$

$$\frac{\cancel{50}}{\cancel{100}_{2}} = \frac{1}{1+2\left[\frac{20\times10^{-3}}{\frac{M}{4\times10^{3}}}\right]}$$

$$\frac{1}{2} = \frac{1}{1+2\left[\frac{20\times4}{M}\right]}$$

$$1+2\left(\frac{80}{M}\right) = 2$$

$$\frac{160}{M}$$

$\Rightarrow$ $\underline{\underline{M = 160 \text{ bits}}}$