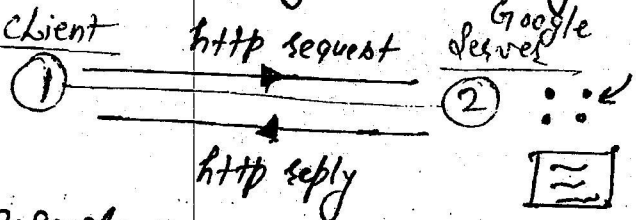
★ Application Layer :-

⇒ "http Protocol" :- (hypertext transfer protocol)



http://www.google.com

URL : uniform resource Locator → T.L. (Transport Layer)

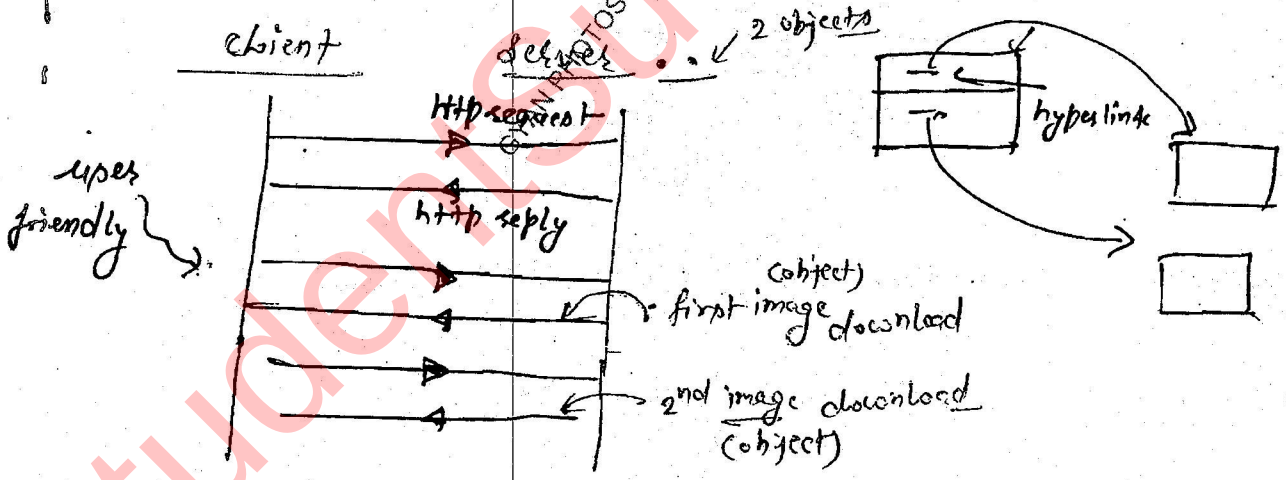
S.Port 65000, D.Port 80 ← http

★ http is a synchronous Protocal because both the clocks of client & server are synchronized.

★ http Connections :-

↳ (i) Persistent http Connection
(ii) Non-persistent http Connection

:- Persistent http :-



★ In case of persistent http Connection will be these only until all objects are accessed.

★ this is for user friendly requirement.

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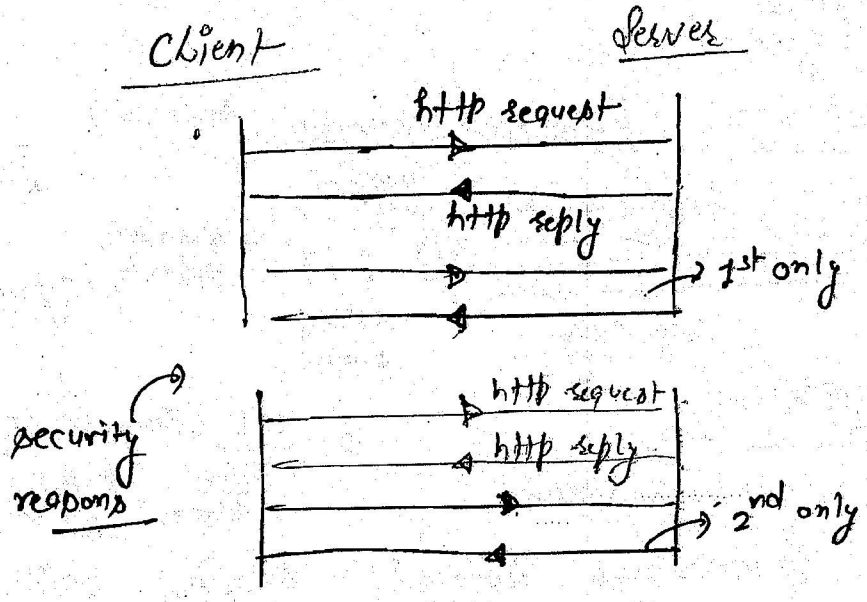
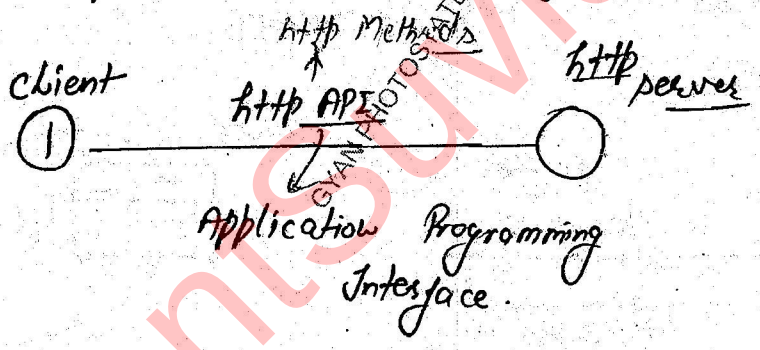


★ In Non-persistent http, a seperate connection is eptablished for ~~ind~~ every individual data transfer. this is provided for security.

http API :-



Methods :- get, post, put, head, trace, connect

★ connect : http ⟶ https
connect

★ get method is used to retrieve the document
★ Post method is used to place the updated document in the server
★ Put method is used to modify the content of the document.
★ head method is used to get the information about the document

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★ Connect method is used to transmit the data in secure channel and that to in encrypted form.

★ http is Stateless protocol.

★ By default IPv6 is stateless but we can make it stateful with the help of DHCPv6 server.

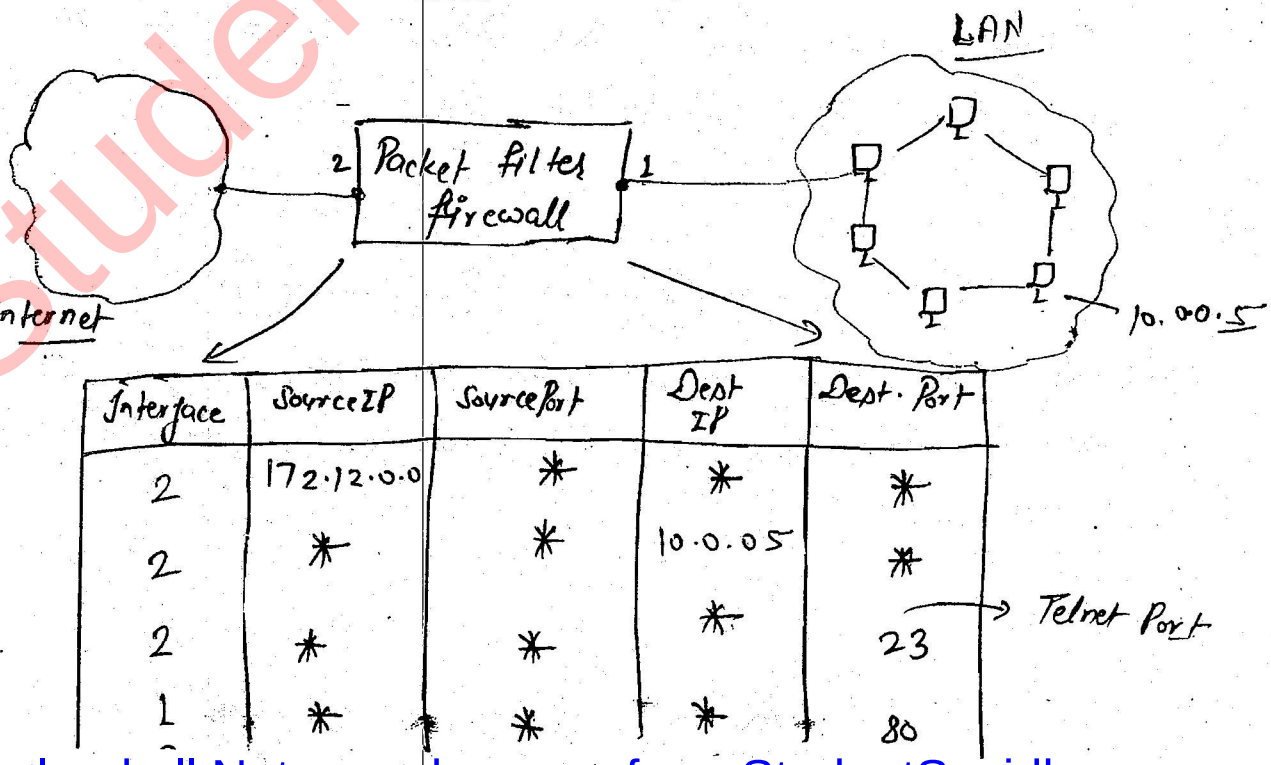
Note:- http is a stateless protocol because client will not store any information about the server once the transaction has been done.

★ cookies is a piece of code that is transmitted from the server to the client Browser.

★ The advantage of cookies is:
(i) faster Response
(ii) Authorization.

★ "Firewall" :-

:- Packet filter firewall :-



Interface	SourceIP	SourcePort	Dest IP	Dest. Port
2	172.12.0.0	*	*	*
2	*	*	10.0.05	*
2	*	*	*	23 → Telnet Port
1	*	*	*	80

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★ Packet filter firewall is a firewall which blocks or forwards the data by observing the transport Layer and Network Layer 'Headers' of the content by comparing with firewall table.

★ There is no ideal firewall, every firewall will work according to its design.

★ Packets coming from a particular source Id i.e. 170.12.0.0 are blocked.

★ Packets destinated to 10.0.0.5 are blocked because this computer is used for internal LAN communication only.

★ Packets destinated to 'port-23' are blocked i.e. "Telnet" service is blocked. (No outside person can communicate directly to the internal LAN).

★ when a malicious software or a virus is placed in the application data then the packet filter firewall can not detect it.

★ Encryption and decryption is done in Session Layer ~~create~~ in OSI Model where as it is done in Application layer in TCP/IP Model.

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①

Calculate how many times data link layer, N.L are visited in this path from source to destination. (TCP/IP)

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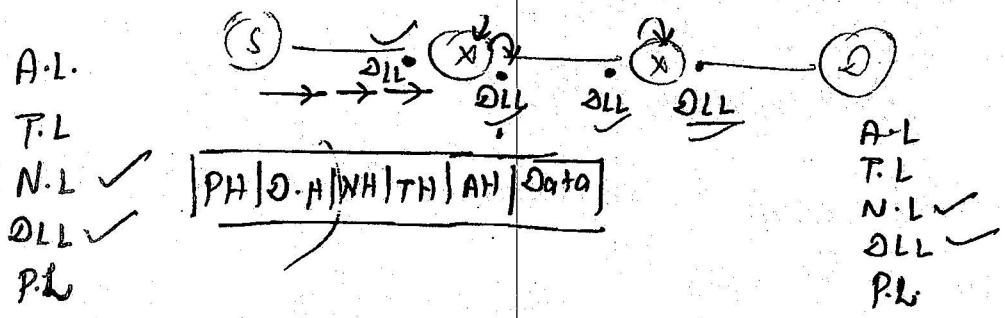
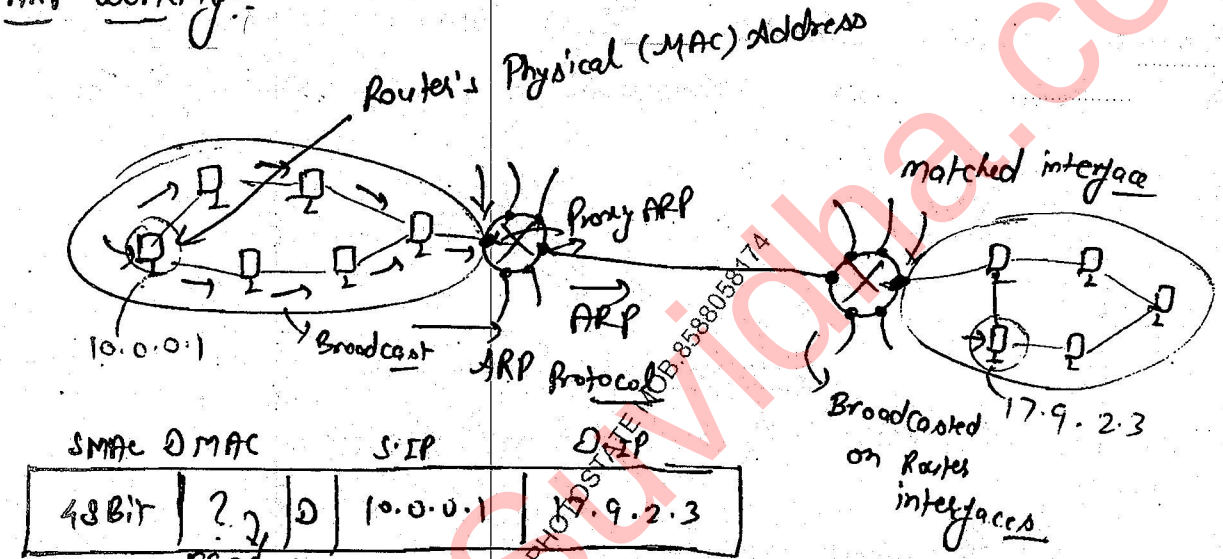


N.L. = 4 times

D.L.L = 6 times

ARP working :-



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* "FTP" :- (file transfer Protocol)

has No flow control at A.L.

has flow control at A.L.

FTP Protocal

Reliable → authenticated user

→ TCP ap T.L.

(i) Internet

(ii) purchasing reliable service

TFTP Protocal

unreliable data

Anonymous user

UDP ap. T.L.

(i) Internet service

(ii) Antivirus Software

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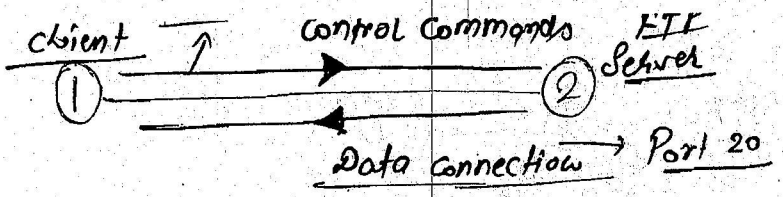
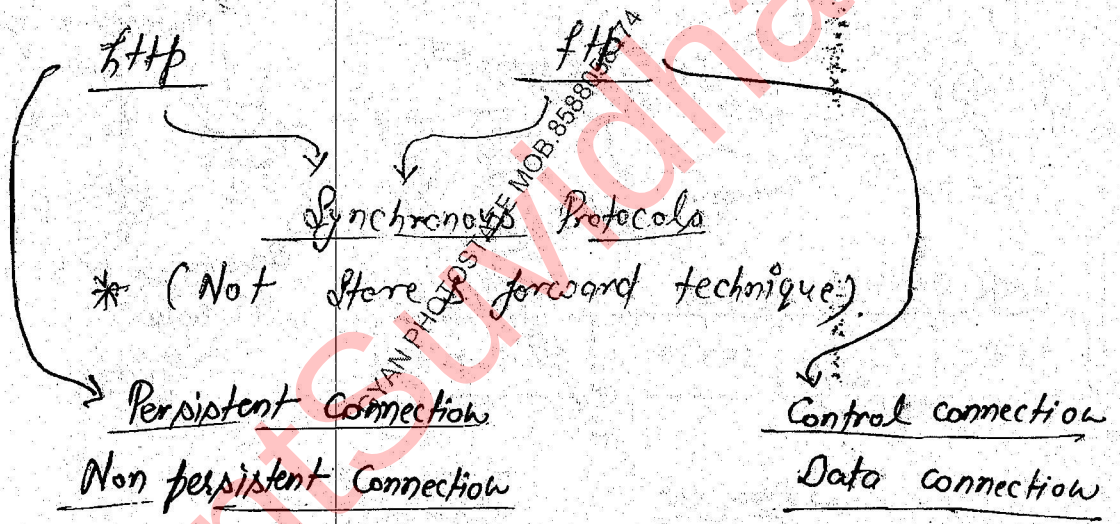


* FTP will send control commands via a control connection on Port - 21.
* When the file is about to download, seperate data connection will be established on Port - 20.
* Once the file is completly downloaded, data connection is closed but control connection will be there, to download some other files.



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FTP :-

i) downloading a large file

ii) Control connection
Data connection

iii) Ports 20, 21 are used

TELNET :-

i) chat operations (Exchange of words)

ii) common connection.

iii) Port 23

Tcp as T.L.

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SMTP :- (Simple Mail Transfer Protocol)

(1) text-baped Protocol

→ Internet → MIME Extension

→ multimedia internet mail Extension

(SMTP + MIME) = all type of data

★ Port - 25 , Base 64 Encoding

→ a-z ⇒ (0-25)
A-Z ⇒ (26-51)
0-9 ⇒ (52-61)
+ ⇒ (62, 63).

11 000 000 | 10 0000

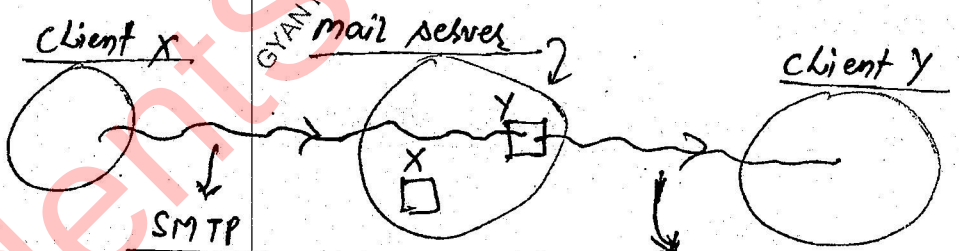
↓

48 10 0

w K a

★ TCP as T.L.

★



SMTP → Push Protocol

(POP3) → Post office Protocol
or
(IMAP4)

★ SMTP is known as 'Push Protocol' because it is used to send the mail into mail servers.

★ POP3 or IMAP4 are known as the 'pull protocols' because they are uped for retrieving the mails from mail servers.

IMAP4 :- (Internet message Access Protocol)

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★ SMTP combined with POP3 ... known as client to client Protocol with the mediation done by mail server.

★ SMTP with POP3 is applying store & forward technique.

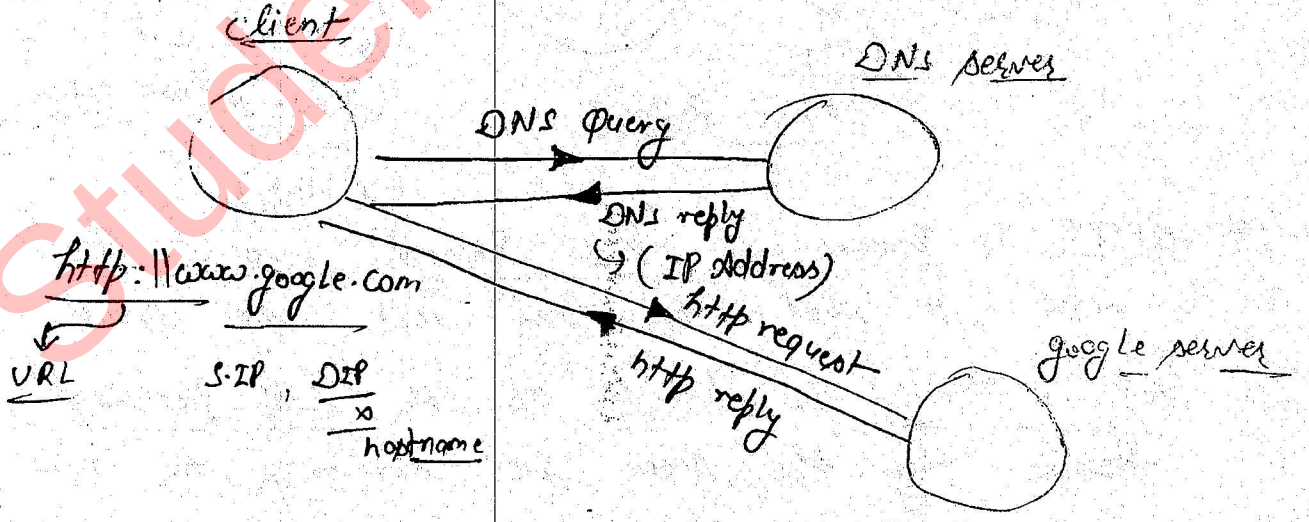
★ SMTP combined with POP3 is a 'asynchronous Protocol' because their clocks need not to be synchronized.

★ In case of SMTP multiple paths are possible when ~~and~~ TCP is used as T.L. because it is a session.

★ In POP3 ~~the~~ all mails are equal whereas in IMAP4 mails are kept in hierarchy.

★ IMAP4 is more secure than POP3, because it will scan for viruses before the file gets downloaded.

DNS : (Domain Name Space)



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★ The purpose of DNS is to find the destination IP Address for the required hostname. Or it is used for mapping hostnames to IP-Addresses.

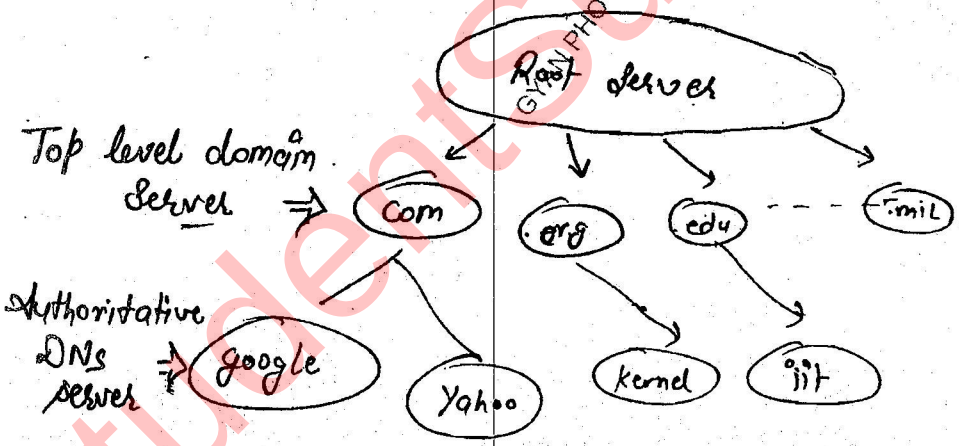
Design of DNS Server :-

(i) DNS servers placed in Heirarchy → Searching time will be less

(ii) DNS servers placed in different geographical Locations. → P.T. will be less

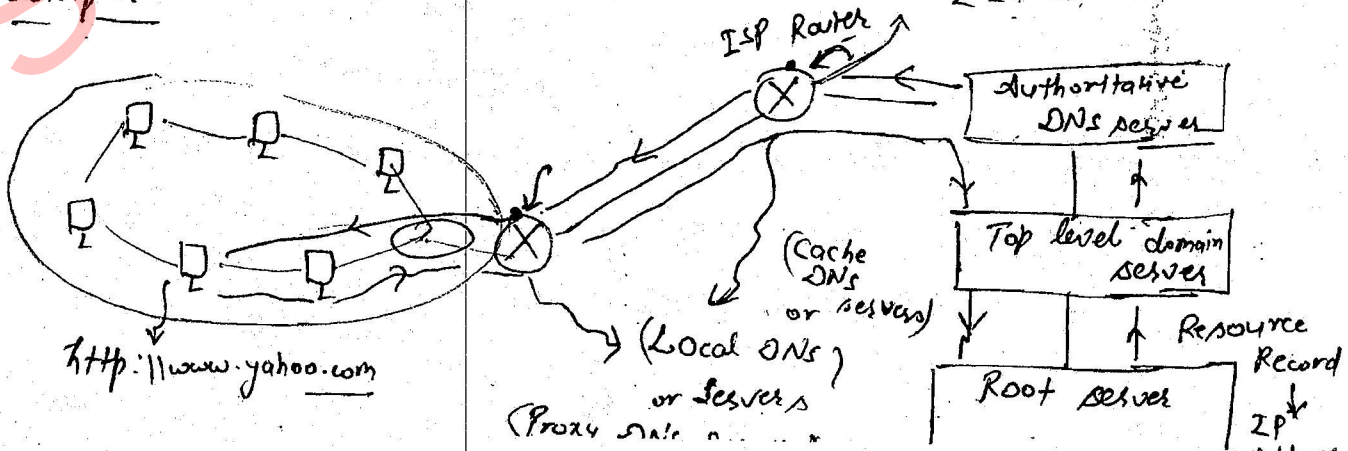
DNS servers

Root Server
Top level domain Server
Authoritative Server
Local DNS Server



Example :-

TTL ≥ 24 hrs, stable record
< 24 hrs, unstable record



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* DNS uses UDP as a transport layer protocol.
* The DNS Reply Record, if it is storing for > 24 hours, it is treated as the stable record.

Que:-

DNS

Query size < 512 Bytes
↳ UDP as T.L.

Query size ≥ 512 Bytes
↳ TCP as T.L.

* In the DNS Server, there are two zones :- 'Forward Lookup Zone', 'Reverse Lookup Zone'.
* 'Forward Lookup Zone' is used for mapping HostNames to IP-Addresses.
* Reverse lookup zone is used for mapping IP Addresses to Host. Name

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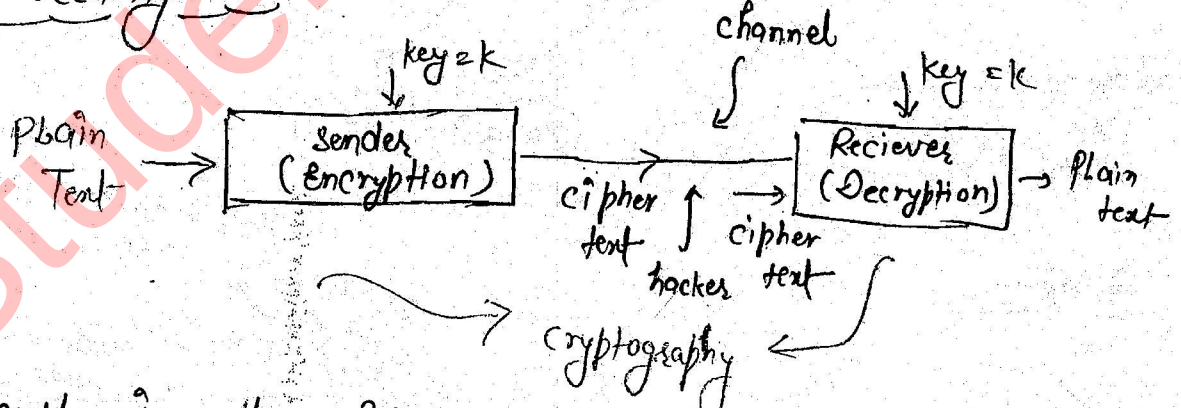
Dated :- 21/06/2017

Basic Security :-



⇒ "Cryptography is the science or art of converting one form of data into other form, for providing security to the data is known as Cryptography."

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★ Converting Plain text to cipher text is known as Encryption.

★ Converting the ciphertext into plain text is known as Decryption.

★ "Steganography is the science of hiding the data behind an image or a video."

★ "The key is transmitted on the channel and later it is used for Encryption & decryption, it is treated as Public key."

★ "If the key is kept as secret and later it is used for Encryption and decryption, it is known as Private key."

"Cryptography"

- Symmetric key Cryptography
  - Ex: "Diffie Hellman key Exchange"
- Asymmetric key Cryptography
  - Ex: "RSA Algorithm"

★ In Symmetric key cryptography "same key" is used for both Encryption and decryption.

★ In Asymmetric key cryptography "different keys" are used for encryption & decryption.

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Challenges of cryptography :-

(i) Authentication → authentication of user
authentication of data.

(ii) Confidentiality

* Proving user's identity is known as 'authentication'.
* Providing secrecy to the data is known as 'confidentiality'.

:- Key features of cryptography :-

1. Prime Numbers
2. challenges (Random number)
3. key values (Public key & Private key).
4. Timestamp.

* RSA Algorithm :-

Sender

Plain text P → encryption → C (cipher text)

hacker

Sender ← n, e

$C = P^e \bmod n$ → C

e = Public key

Reciever

P, q are Prime Numbers

$n = p * q$

$\phi(n) = (p-1)*(q-1)$

$(d * e) \bmod \phi(n) = 1$

Decryption

d = Private key

$P = C^d \bmod n$

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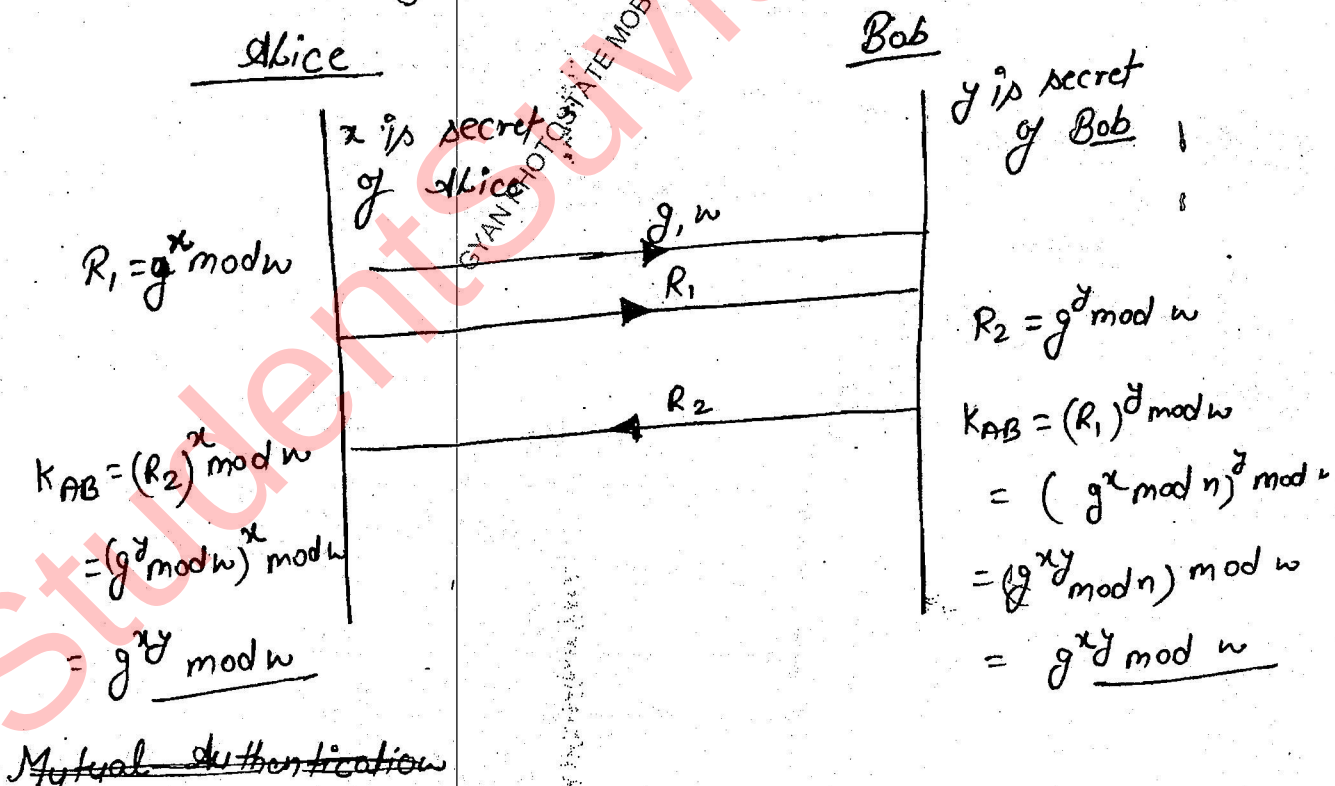
Confidentiality.

* In RSA Algorithm, If Sender is encrypted with Reciever's public key & Reciever is decrypted with his own private key then it is used to provide Confidentiality.

Que:- In RSA Algorithm sender is encrypting with Reciever's Private key. false

Que:- In RSA Algorithm, sender is encrypting with his own private key. True

⇒ Diffie-Hellmann key Exchange :-



~~Mutual Authentication~~

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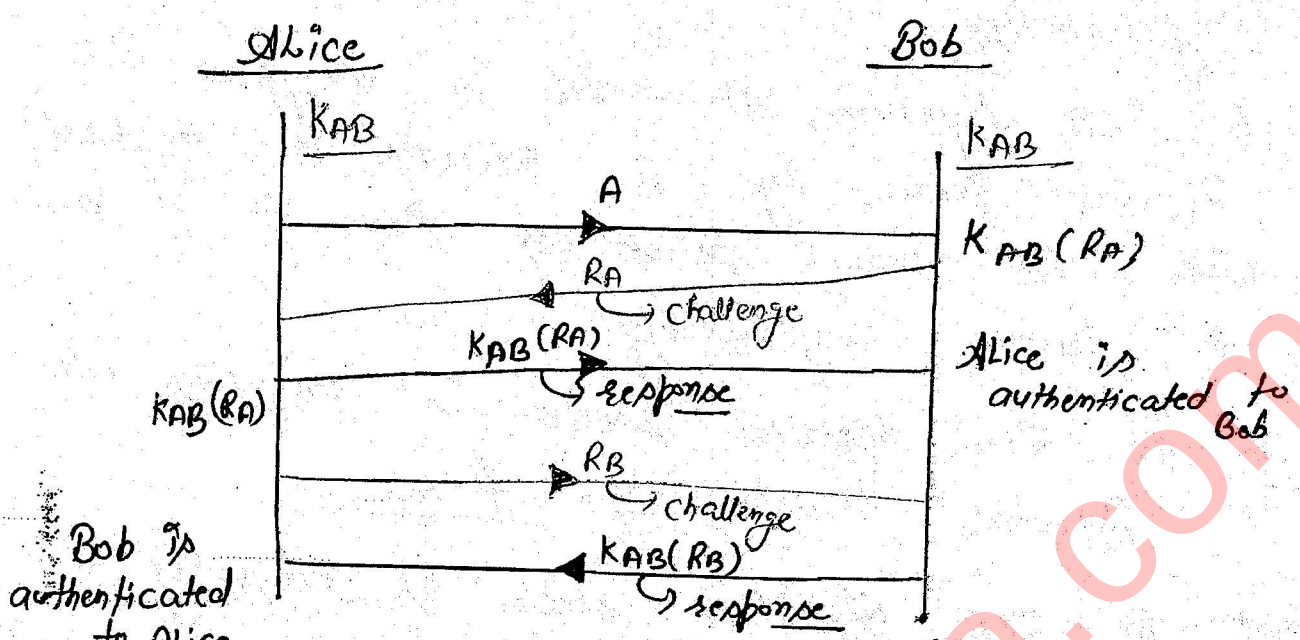
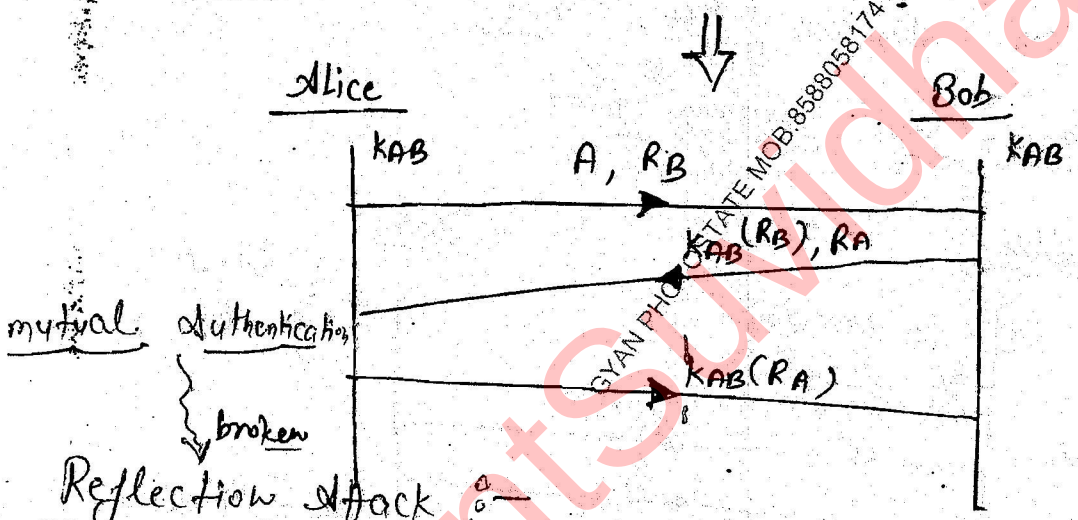
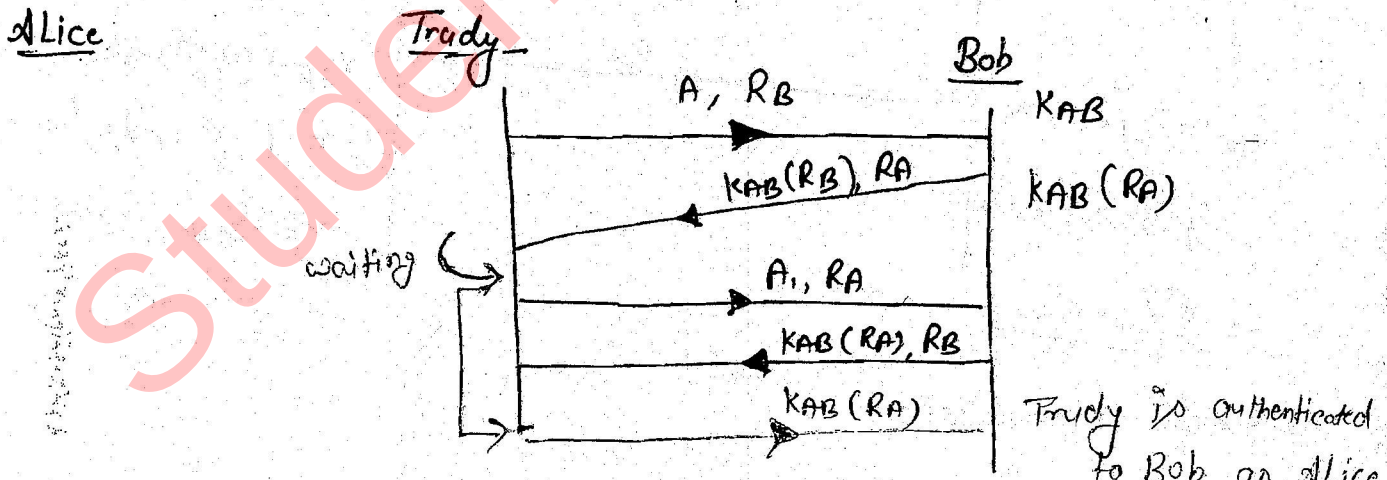
Mutual Authentication using Diffie-Hellman key exchange:





Reflection Attack :-



★ Mutual Authentication can be broken using Reflection attack.

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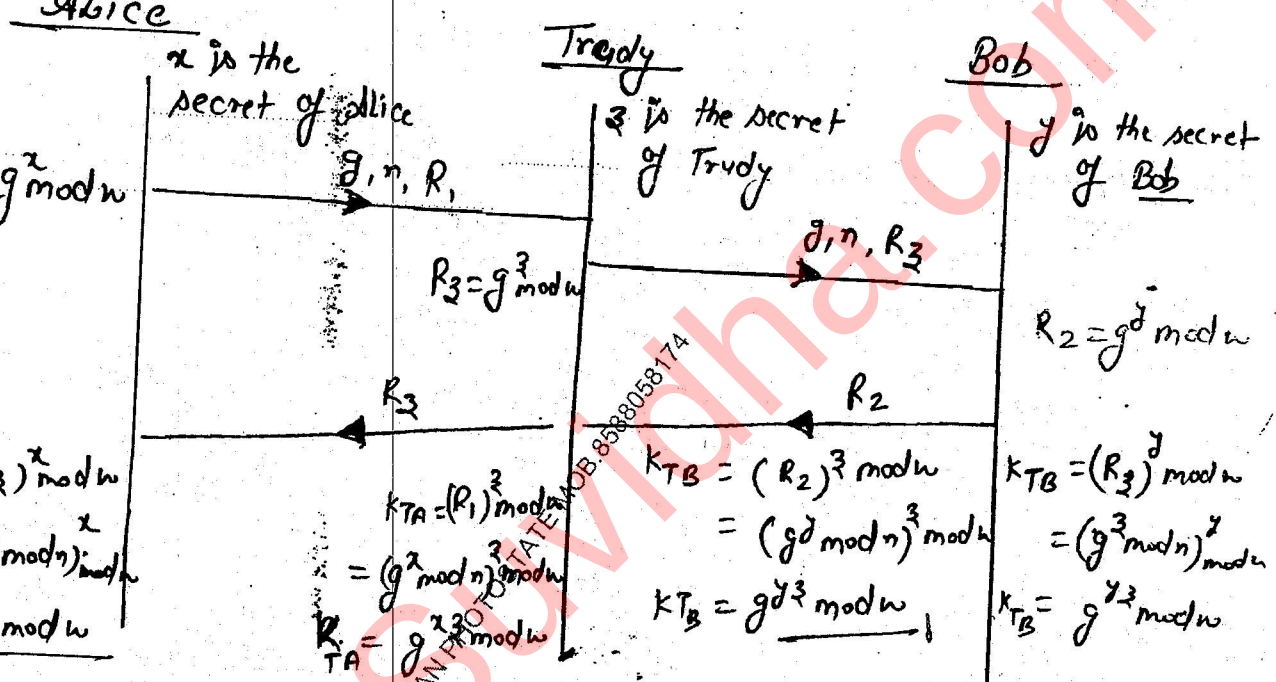
Man in middle attack :-

K_{AB} ↓ broken

★ whenever the packets are transmitted, If Hacker has modified the source IP then the request will go to the destination but the reply will come to Hacker.



★ Diffie Hellmann key itself can be broken using MAN in middle attack.

★ Drawback of Diffie Hellmann Exchange :-

X	y	for n' people
K_{xy}	K_{xy}	
X	z	n keys required.
K_{xz}	K_{xz}	
X	w	
K_{xz}	K_{xw}	

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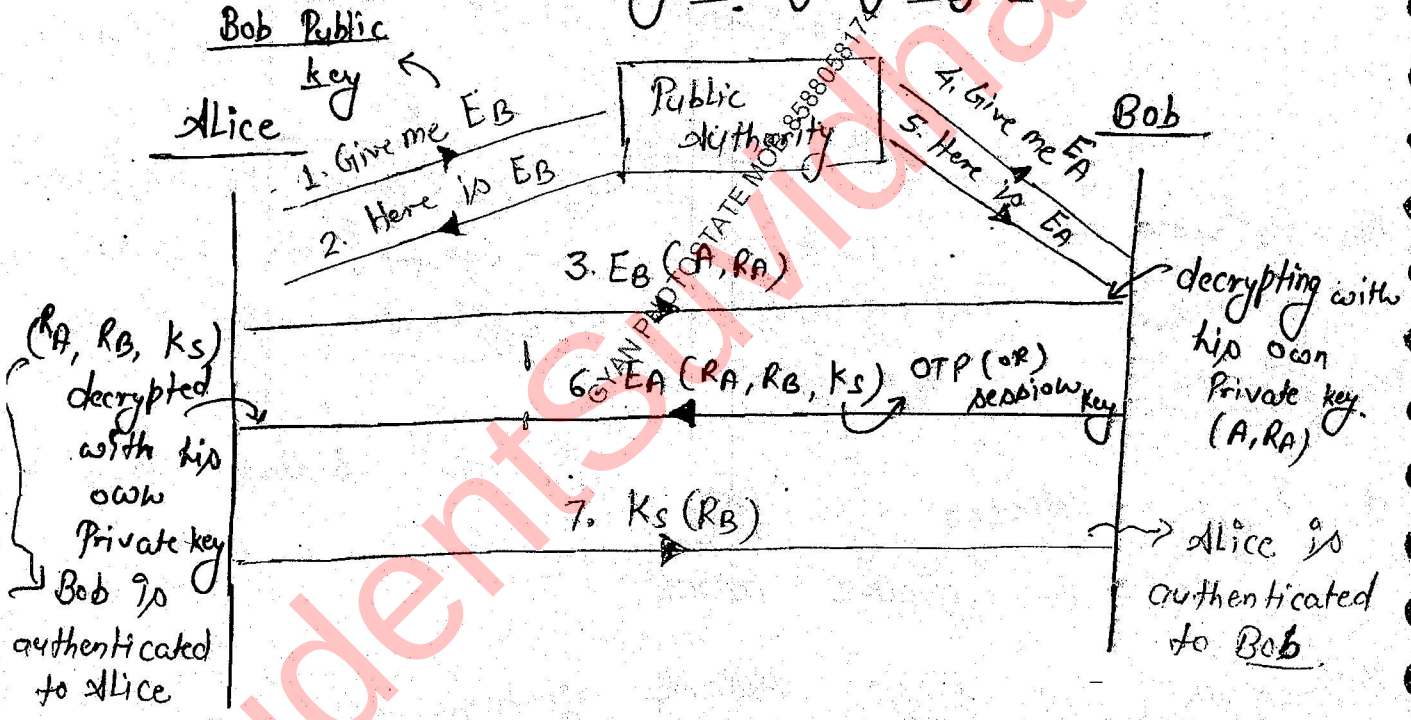
* The drawback of Diffie Hellmann key is, if we want to communicate with n people then n keys are required.

* Remembering all the key values or maintaining a database of all the key values is difficult.

* So, the generation of the key is taken care by third party or certified Authority.

⇒ Mutual Authentication using RSA Algorithm :-
(or Public key Cryptography)



* Mutual Authentication using RSA Algorithm is better than mutual Authentication using Deffie hellman in terms of security.

* Mutual Authentication using diffie hellman key is better than mutual Authentication using RSA in terms of time.

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★ Alice

RSA Algo
(i) Private key of Alice
(ii) Public key of -

Bob → RSA Algo → Private key, Public key

Private key of Alice (Sender) → (A, E_B(A, R_A)) → Public key → decrypting with his own Private key A, R_A

Better than above: E_B (A, Private key of (A, R_A)) ✓
Alice

Que. ★★ (1)

A and B are only two stations on Ethernet. Each has a steady queue of frames to send. both A and B attempt to transmit a frame, collided and A wins the 1st back-off race. At the end of successful transmission by A both A and B attempt to transmit and collide. The probability that A wins the second Back-off race is : ?

A B

* A wins the Back-off race

A

new frame k = 1 ← * → same frame k = 2

$w.T_1 = (0,1) * P.T$

$w.T_2 = (0,1,2,3) * P.T$

A	B
0	0
P.T	P.T
	2 P.T
	3 P.T

$\Rightarrow \frac{3+2}{8} = \frac{5}{8}$

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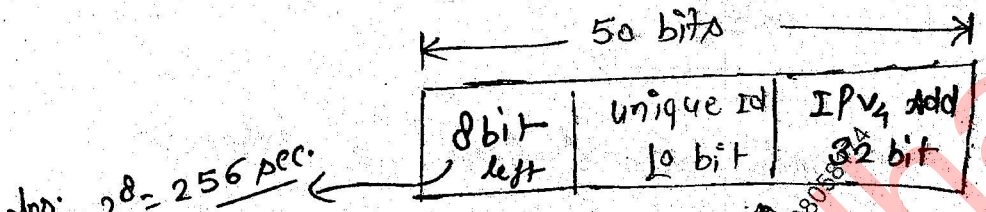
(2) Every Host in IPv4 network, has 1 sec. resolution real time clock with battery backup. Each host needs to generate upto 1000 unique identifiers per second. Assume that Each host has global unique IPv4 Address. Design a 50 bit global unique Id for this purpose. After what period (in sec.) will the identifiers generated by a host wrap around



Ans. $2^8 = 256$ sec.

1000 unique ~~genere~~ Identifier = 2^{10} ← 10 bits

$2^9 = 512$ not sufficient

Note :-

For Stop & wait Protocol $L.U. = 1 * \frac{T.T.}{T.T. + 2 * P.T.}$

For GBN Protocol $L.U. = \frac{N}{\text{No of frames}} * \frac{T.T.}{T.T. + 2 * P.T.}$

N ← window size

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Que:- Consider store & forward packet switched network. The B.w. of each link is 10^6 bits/sec. User on host A sense a file of size 10^3 Bytes to host B. in three different ways:-

Case:- (i) A single packet containing the complete file is transmitted from A to B.

(ii) The file is split into 10 equal parts. & these packets are transmitted from A to B.

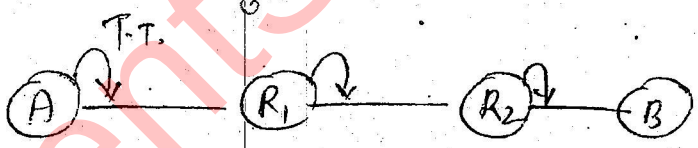
(iii) the file is split into 20 equal parts. (Each packet contains 100 Bytes of header along with the user data.) (Consider only transmission time & ignore Processing, Propagation delay)

Sol^n:-

File = 10^3 bytes

B.w. = 10^6 bits/sec.

$$\text{T.T. of Packet} = \frac{\text{Data size}}{\text{B.w.}} = \frac{(1000+100)*8}{10^6 \text{ bits/sec}} = \frac{8800}{10^6} = 8.8 \text{ millisec}$$

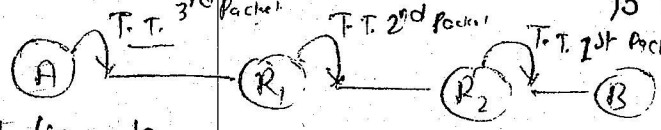


(i) A to B = 3 * 8.8 millisec = 26.4 millisec

(ii) $\frac{1000 \text{ bytes}}{10}$ = 100 bytes → Each packet size

100 bytes + 100 bytes header = 200 bytes

$$\text{T.T. Packet} = (100+100) = \frac{200*8}{10^6 \text{ bits/sec}} = 1.6 \text{ millisec}$$



Total time to reach B of TT1 = 3 * T.T. = 3 x 1.6 = 4.8 millisec

2nd Packet = 4.8 + 1 x 1.16 =

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10^{th} Packet $= 4.8 + 9 * 1.6$

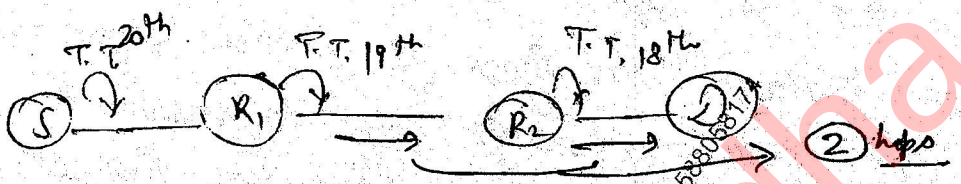
$= 19.2$ milli sec.

(iii)

$$\frac{1000 \text{ Bytes}}{20} = 50 \text{ Bytes} + \underbrace{100 \text{ Byte}}_{\text{Header}} = 150 \text{ Bytes}$$

↑ Each Packet size

$$\text{T.T.}_1 \text{ of Each Packet} = \frac{150 * 8}{10^6 \text{ bit/sec.}} = 1.2 \text{ milli sec.}$$



20 Packets $= 20 * 2 = 24$ milli sec.

~~19th Packet~~ $\Rightarrow 24 + 2 * 1.2 = 26.4$

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