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GATE CS 2021

Computer Network

Short Notes

ABOUT ME : ANKIT DOYLA

- 8+ years teaching experience.
- AIR 159 in GATE & AIR 119 in NET JRF
- Qualified ISRO, NIELIT & UPPCL
- Area of Expertise :TOC, Compiler Design,

  Operating System, Computer Networks

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Default subnet Mask:

Class A : 255.0.0.0

Class B : 255.255.0.0

Class C : 255.255.255.0

IP Addressing

Class A → 0 → (1 - 126), No. of IP Addresses = 2^{31}

Class B → 10 → (128 - 191), No. of IP Addresses = 2^{30}

Class C → 110 → (192 - 223), No. of IP Addresses = 2^{29}

Class D → 1110 → (224 - 239), No. of IP Addresses = 2^{28}

Class E → 1111 → (240 - 255), No. of IP Addresses = 2^{28}

Private Addresses Range :

10.0.0.0 to 10.255.255.255 — 1 class A Network

172.16.0.0 to 172.31.255.255 → 16 class B Network

192.168.0.0 to 192.168.255.255 → 256 class C Network

IP Address

AND

subnetmask

NID or SID

Class	Number of Networks	Number of hosts
Class A	$2^7 - 2 = 126$	$2^{24} - 2 = 1,67,77,214$ hosts
Class B	$2^{14} = 16,384$	$2^{16} - 2 = 65,534$ hosts
Class C	$2^{21} = 20,97,125$	$2^8 - 2 = 254$ hosts
Class D	No NID and HID, all 28 remaining bits are used to define multicast address	
Class E	No NID and HID, it is meant for research and future purpose	

	NID	HID		
1.	–	0’s	→	Network ID
2.	–	1’s	→	DBA
3.	1’s	1’s	→	LBA
4.	0’s	–	→	Host with in the Network
5.	1’s	0’s	→	Network Mask or Subnet Mask

CIDR Rules:

1. All the IP Address in the Block must be contiguous.
2. Block size must be a power of 2.
3. First IP address of the block must be divisible by size of the block.

Flow control

1. Propagation delay (P_d) = $\frac{\text{distance}}{\text{Velocity}}$ or $P_d = \frac{d}{v}$
2. Transmission delay (T_d) = $\frac{\text{Length of Packet}}{\text{Bandwidth}}$ or $T_d = \frac{L}{B}$
3. $RTT = T_{d(data)} + 2*P_d + T_{d(Ack)} + P_{rd} + Q_d$

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	Stop & wait	GBN	SR
Efficiency	$\eta = \frac{1}{1+2a}$ or $\eta = \frac{\text{useful time}}{\text{Total time}}$ or $\eta = \frac{T_d}{RTT}$	$\eta = \frac{N}{1+2a}$ or $\eta = \frac{\text{useful time}}{\text{Total time}}$ or $\eta = \frac{N * T_d}{RTT}$	$\eta = \frac{W_S}{1+2a}$ or $\eta = \frac{\text{useful time}}{\text{Total time}}$ or $\eta = \frac{W_S * T_d}{RTT}$
Throughput	$\frac{\text{Length of data Pkt}}{RTT}$ or $\eta * B$	$\frac{N * \text{Length of data Pkt}}{RTT}$ or $\eta * B$	$\frac{W_S * \text{Length of data Pkt}}{RTT}$ or $\eta * B$
Buffer	1 + 1	N + 1	N + N
Seq No.	2	N + 1	2N
Seq. No. = K bit		$\underline{W_S}$ $2^K - 1$; $\underline{W_R}$ 1	$\underline{W_S}$ 2^{K-1} ; $\underline{W_R}$ 2^{K-1}

Optimal window size = 1 + 2a

Minimum seq. No required = 1 + 2a

Min no. of bits required = $\lceil \log_2 (1 + 2a) \rceil$ in the sequence No. field

AD steps to solve SWP Problem

1. Calculate RTT
2. Based on the given Bandwidth and RTT calculate No. of bits we are able to transfer with in RTT and Equate it as window in terms of bits (W_{bits})=B*RTT
3. W_{pkt} or W_p $= \dfrac{W_{bits}}{(\text{Packet size})\,\text{bits}}$
4. Minimum sequence No. required = W_p
5. $2^K = W_p$

   Where K = No. of bits required in the sequence number field

Error Control

1. To detect 'd' bit error minimum Hamming distance required = d + 1
2. To correct 'd' bit error minimum Hamming distance required = 2d + 1
3. In Hamming code No. of redundant bit or checkbits or Parity bits:

$$r = (m + r + 1) \leq 2^r \text{ (Lower Limit)}$$

CRC

1. If the generator has more than one term and coefficient of x° is 1, all single bit error can be detected.
2. If a generator cannot divide $x^t + 2$ (t between 0 and n – 1) then all isolated Double error can be detected
3. A generator that contains a Factor of x + 1 and detect all odd numbered errors.

A good polynomial generator needs to have the following characteristics:

1. It should have at least two terms.
2. The coefficient of the term x^0 should be 1.
3. It should not divide $x^t + 1$, for t between 2 and n – 1.
4. It should have the factor x + 1.

Access control

1. Minimum size of Frame to dectect the collision in Ethernet (CSMA/CD)

$$T_d \geq 2 * P_d + T_{d(Jam\,signal)}$$

2. Backoff Algorithm

Waiting time = K * Slot duration

= K * RTT

= $K * 2 * P_d$

↳ 0 to 2^{n-1}, where n is the collision Number

K * 51.2 μsec

standard RTT

3. Efficiency in Ethernet (CSMA/CD)

$$\eta = \frac{1}{1+6.44a} \quad \text{or} \quad \eta = \frac{\text{useful time}}{\text{Total time}}$$

$$= \frac{T_d}{\text{Collision time}+T_d+P_d}$$

Contension slot * slot duration

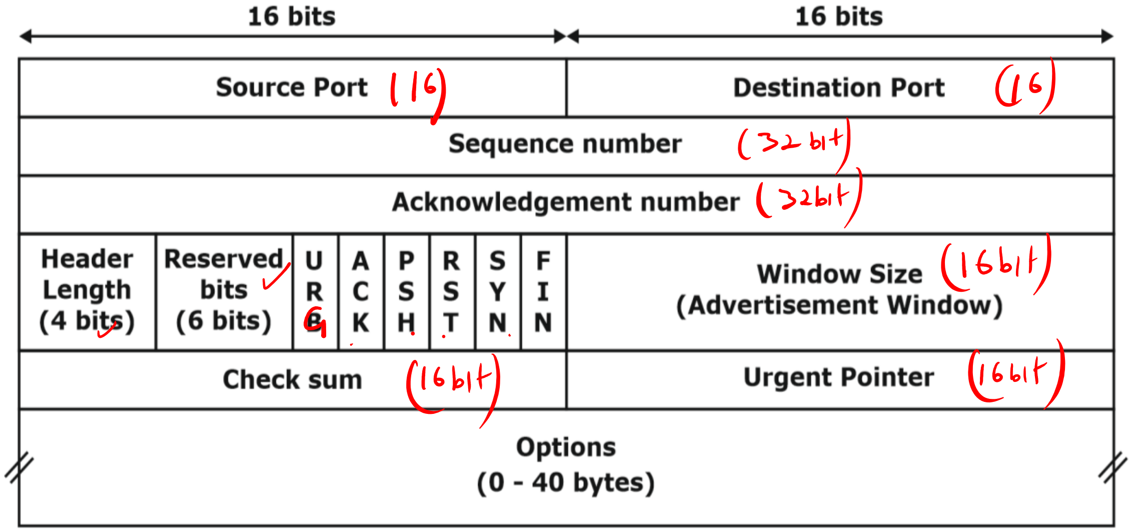
4. $P(1-P)^{N-1}$ → Probability of success for single station

$N(1-P)^{N-1}$ → Probability of success for any station Among all station [Throughput of channel]

5. Ethernet [Packet size]

Min size	Max size
46	1500 [Data]
64	1518 [Frame]

TCP header


16 bits
16 bits
Source Port (16)
Destination Port (16)
Sequence number (32 bit)
Acknowledgement number (32bit)
Header Length (4 bits)
Reserved bits (6 bits)
URG
ACK
PSH
RST
SYN
FIN
Window Size (Advertisement Window) (16bit)
Check sum (16bit)
Urgent Pointer (16bit)
Options (0 - 40 bytes)

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SYN = 1 → 1 seq No

Ack = 1 → 0 seq No

FIN = 1 → 1 seq. No

1 Data byte → 1 seq. No

SYN	Ack	Meaning
1	0	request
1	1	reply
0	1	Ack
0	0	Data

Part No.	Name
0-1023	Well known port No.
1024-49151	Registered Port No.
49152-65535	Dyanamic

$$\text{Wrap Around time (WAT)} = \frac{\text{Total sequence No.}}{\text{Bandwidth}\left[\frac{\text{Byte}}{\text{sec}}\right]}$$

Min. seq. No. required to Avoid wrap Around time with in Life time

$= B \times LT$

Min. No. of bits required to Avoid wrap Around time with in LT

$= \lceil \log_2 B * LT \rceil$

Time out timer in TCP

Basic Algorithm	Jacobson's Algorithm
TO = 2 * RTT	TO = 4 * ID + RTT
NRTT = α(IRTT) + (1 –α) ARTT	NRTT =α (IRTT) + (1 – α) ARTT
0 ≤ α≤ 1	0 ≤ α≤ 1
	AD = |IRTT - ARTT|
	ND =α (ID) + (1 –α)AD

Congestion Control

1. $W_S = \min(W_C, W_R)$

Slow start	Congestion Avoidence	Congestion Detection
1. If Ack Arrives $W_c = W_c + 1$	1. IF Ack Arrives $W_c = W_c + \frac{1}{W_c}$	1. Time out NTH = $\frac{1}{2}$ wc slow start
2. After one RTT $W_c = 2 * W_C$	2. After one RTT $\boxed{W_c = W_c + 1}$	2. 3 duplicate Ack NTH = $\frac{1}{2}$ wc

NTH (CA phase)

Token Bucket :

Maximum Avg rate for Token Bucket (m) = $\frac{c+rt}{t}$

$$\frac{m}{1} = \frac{c+rt}{t}$$

$mt = c + rt,$

$mt - rt = c$

$(m - r)\, t = c$

$$t = \frac{c}{m-r},$$

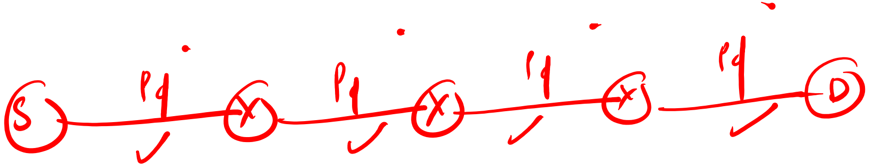
$c \rightarrow$ token Bucket capacity

$r \rightarrow$ Token Arrival rate

Switching

- Circuit switching
- Packet Switching

Circuit switching	Packet Switching
Total time $= \underset{(S)}{\text{Setup time}} + T_d + P_d + \underset{(T)}{\text{Tear down time}}$ $TT = S + \frac{L}{B} + X.\frac{d}{v} + T$	$X \rightarrow \text{Hop}, N \rightarrow \text{Packet}$ Total time $= X[T_d + P_d] + X - 1\,[Prd + Qd] + N - 1\,(T_d)$



Application	Port No	Transport Protocol
DNS	53	UDP
HTTP	80	TCP
FTP	20 (Data connection) 21 (Control connection)	TCP
SMTP	25	TCP
POP	110	TCP
SNMP	161, 162	UDP
TFTP	69	UDP
IMAP	143	TCP
Telnet	23	TCP

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SHOT TRICK TABLE

SHORT TRICK	DNS	HTTP	SMTP	POP	IMAP	FTP
Stateful/ Stateless	Stateless	Stateless	Stateless	Stateful	Stateful	Stateful
Transport Protocol Used	UDP	TCP	TCP	TCP	TCP	TCP
Connectionless/ Connection oriented	Connection less	Connection less	Connection oriented	Connection oriented	Connection oriented	Connection oriented
Persistent/Non-persistent	Non-persistent	HTTP 1.0 is non persistent HTTP 1.1 is persistent.	Persistent	Persistent	Persistent	Control connection is persistent. Data connection is non-persistent.
Push/Pull	-	-	Push	Pull	Pull	Can't
Port Number Used	53	80	25	110	143	20 for data connection. 21 for control connection.
In band/ Out-of-band	In band	In band	In band	In band	In band	Out-of-band

IPv4 Header

VER (4)	HL (4)	Services (8)	Total Length (16)
Identification No. (16)		Flags (3)	Fragment offset (13)
Time to Live (8)		Protocol (8)	Header checksum (16)
Source IP Address (32bit)			
Destination IP Address (32bit)			
Option 0-40 Byte			

Hlioopy

Too

Numbers of Days left for GATE CS 2021 - 21

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