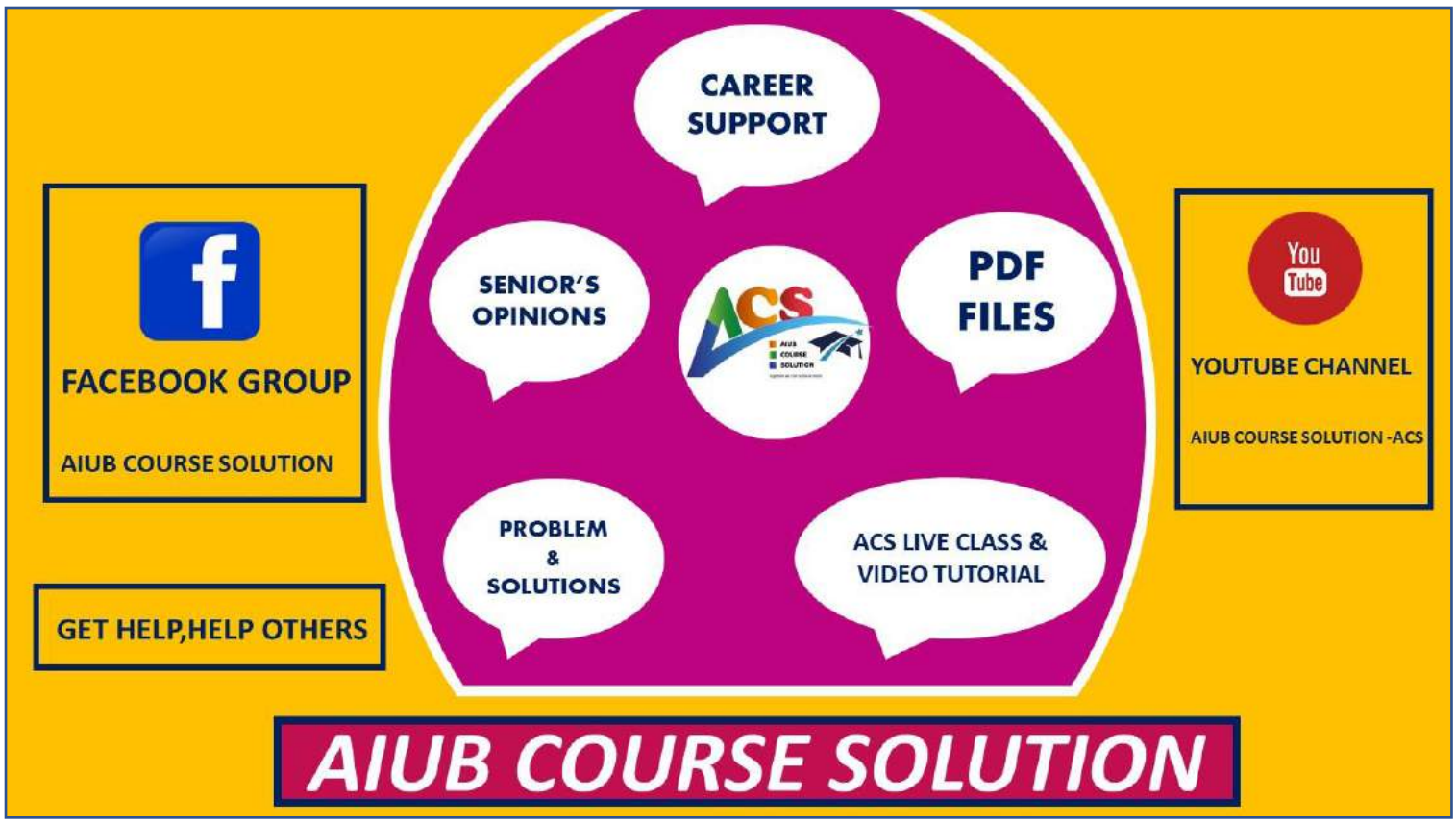

TOGETHER WE CAN ACHIEVE MORE

COURSE NAME: Computer Network

CHAPTER: Networking Basics, IP Addressing, Multiple Access Techniques, VLSM

SOLVED BY

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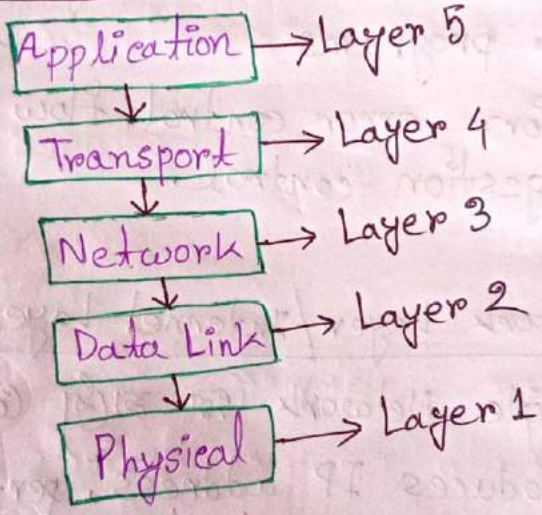
Computer Network
Ch- Networking Basics

* Connecting Devices-
- Repeater
- Hub
- Bridge
- Switch

TCP/IP Protocol:



Application Layer:-
- User application.
- Takes data from users in sending end & provide the data to user in the receiving end.
- Protocols - HTTP, DNS, FTP, SMTP.
- Implemented in source & destination devices only.

Transport Layer:-

- Gets the message from application layer.
- encapsulates the message in a segment & send it to the next step.
- Message delivery can be reliable but slow (TCP) or unreliable but fast (UDP)
- Provide port addressing to application layer programs
- Perform error control, flow control & congestion control.

Network Layer / Internet Layer.

- Multiple Network এর মধ্যে Communication.
- Introduces IP address, perform routing & congestion control.
- Used in end devices & network layer devices (Router, PC, Layer 3 switch etc)
- Protocols - IP, ICMP, RIP, EIGRP, OSPF etc.

Data Link Layer:-

- Network এর মধ্যে communication করে।
- MAC address, perform error control & flow control.
- Encapsulate packet into frame.
- Used all devices.
- Protocols - ALOHA, CSMA, CSMA/CD, CSMA/CA.

Physical Layer:-

- Bit synchronization
- Bit rate control
- Specifies transmission media.
- Network physical topology.

* Physical topology:- Identify the topology type.

* Transmission mode:- Refers to the mechanism of transferring data between two devices.

Repeater :-

- Layer 1 device
- ~~Rpt~~ Amplifies the voltage & sends it down the line.
- Used to extend a network.
- The use of three repeater in a row result in an unusable signal transmission because of extreme noise.
- Replaced by hubs, bridges & switches.

Hub :-

- Layer 1 device
- Used to connect devices of a single network.
- For successful transmission, only one station can send data at a time.
- More than one output ~~mode~~ port.

Bridge:-

- Layer 2 device.
- Used to connect devices of a single network.
- Better bandwidth usage.
- Limited ports (2, 4, usually 2 ports)

Switch:-

- Layer 2 device
- Used to connect devices of a single network.
- Hundereds of ports (2 - 100)

Router:-

- Layer 3 device.
- Used to connect multiple networks.
- Most intelligent connecting device.
- Slower than switch because of its routing protocol implementation.

Collision Domain:-

- দুটি signal যখন একই Line দিয়ে যেতে চায় তখন collision domain এর সৃষ্টি হয়।

- Hub:- All ports belong to the same collision domain.

- Bridge, Switch, Router:- Each port belongs to a separate collision domain.

Broadcast Domain:-

- All the devices in the broadcast domain can reach via broadcast at the data link layer.

- All the ports of hub and switch belong to same broadcast domain but all ports of the router belong do different broadcast domain.

* DSSS: Direct sequence spread spectrum.
* FHSS: Frequency hop spread spectrum.
* OFDM: Orthogonal Frequency Division Multiplexing.
* SCFDM: ~~Sign~~ Single carrier frequency domain multiplexing.
* QPSK: Quadrature phase shift keying.
* QAM: Quadrature amplitude modulation.
* MIMO: Multiple input multiple output.
* Beamforming :- Technique of focusing a wireless signal towards a specific receiving device.

IP Addressing II

Classification of Address

→ Physical Address → MAC Address

→ Logical Address → IP Address

→ Port Address →

Physical Address:

- The address of a node as defined by its LAN.
- The lowest level address.
- Size 48-bits. (6 bytes × 8). $\frac{48}{4}$ = 12 Hex digits.
- Imprinted on Network Interface Card (NIC).
- Medium Access Control (MAC) Address.
- No two NICs ever share same MAC address.
- Either imprinted on the surface or burnt into a ROM chip.
- $d_1 d_2 : d_3 d_4 : d_5 d_6 : d_7 d_8 : d_9 d_{10} : d_{11} d_{12}$

$d_1 d_2 : d_3 d_4 : d_5 d_6$ → Organizationally Unique Identifier

$d_7 d_8 : d_9 d_{10} : d_{11} d_{12}$ → Device Id

Logical Address:-

- Not suitable for internetwork as different networks can have different address formats.
- Can be changed depending on the network.
- Known as Internet Protocol (IP)
- 32-bits.

Port Address:-

- Used to identify a process (Email, FTP)
- 16 bits

Binary-to-Decimal Conversion

Digit	x_8	x_7	x_6	x_5	x_4	x_3	x_2	x_1
Position of digit	8	7	6	5	4	3	2	1
Contribution of the digit (2^{i-1})	2^{8-1}	2^{7-1}	2^{6-1}	2^{5-1}	2^{4-1}	2^{3-1}	2^{2-1}	2^{1-1}
Decimal Contribution	128	64	32	16	8	4	2	1

Example :- 10011001

Digit	1	0	0	1	1	0	0	1
Position	8	7	6	5	4	3	2	1
Contribution of digit	2^{8-1}	0	0	2^{5-1}	2^{4-1}	0	0	2^{1-1}
Contribution	128	0	0	16	8	0	0	1

$128+0+0+16+8+0+0+1 = 153$

$\therefore (10011001)_2 = (153)_{10}$.

IP Address:-

- IP = Internet Protocol
- Unique & universal
- 32-bit binary address
- Divided into 4 octets.
- Octets are separated by dot (.) sign.

IP Addressing II

- No of Networks = $2^{\text{No of bits in the network ID}}$
- No of hosts = $2^{\text{No of bits in the host ID}} - 2$

Broadcast :-

-Sending packet to all hosts of a network.

*Limited Broadcast –

-When a host of a network sends packet to all hosts of the same network.

-Sends packet to 255.255.255.255 IP address

*Direct Broadcast –

-When a host of a network sends packet to all hosts of another network.

-If the network address of the target network is 20.0.0., the packet is sent to 20.255.255.255.

-In most cases, a router is configured to block direct broadcast.

* A network has 3 kinds of IP address-

1. Network IP address
   - Lowest IP address of the network.

2. Broadcast IP address
   - Highest IP address of the network.

3. Host IP address
   - All IP addresses of the networ ~~expe~~.
     except the lowest and hight IP address.

* Network IP address: Replace all host bits by zeroes(0) of any IP address of the network.

* Broadcast IP address: Replace all host bits by Ones of any IP address of the network.

Network Mask/Subnet Mask:- A network mask or a default mask in classful addressing is a 32-bit number with n leftmost bits all set to 1s and (32-n) rightmost bits all set to 0s.

Multiple Access Techniques

- 2 Sublayers -

1. LLC → Logical link Control
2. MAC → Medium Access Control.

- The LLC is responsible for flow and error control, and the lower sublayer.
- The MAC is responsible for resolving access to the shared media.
- Multiple Access Network – multiple sending & receiving station share the same.

*Advantage:-

- Low cost infrastructure
- All stations attached to the medium hear.
- Transmission from any other station ⇒ routing not necessary.

* Disadvantage :-

- Access of multiple sending and receiving nodes to the shared medium must be coordinated.
- Stations should not be transmitting ~~simulat~~ simultaniously or interrupting each other.
- Stations should not be able to 'monopolize' the transmission /shared medium.
- Example - LAN, cellular and ~~st~~ satellite networks.

* Channelization Protocols :-

- Multiple access method in which the available bandwith of a link is shared in time, frequency or code between different station.
- Three basic channelization protocols -

1. Frequency Division Multiple Access (FDMA)
   - Available bandwith is divided into frequency band.
   - Each station is allocated a band to ~~station~~ send its data.

- Band is reeeived for that station all the time.
- ~~Unused~~ The frequency bands of different stations are separated by small bands of unsaved frequency, called guard bands.

2. Time Division Multiple Access (TDMA):
- The bandwidth of channel is divided among various station.
- Each station is allocated a time slot during which send data.
- Requires synchronization between different stations.

3. Code Division Multiple Access (CDMA)
- Can transmit data simultaneously all station.
- Each user is given a unique code sequence

$H_1 = [1]$

$H^2 = \begin{bmatrix} H^1 & H^1 \\ H^1 & -H^1 \end{bmatrix}$, $H^2 = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

$H^4 = \begin{bmatrix} H^2 & H^2 \\ H^2 & -H^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$

* If you multiply any two codes of rows, then the result will be 0.

From H_4, row 1 & 4 are multiplying -

$\Rightarrow \begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \end{bmatrix} = (1\times1) + (1\times(-1)) + (1\times(-1)) + (1\times1)$

$= 1 - 1 - 1 + 1 = 0.$

* Controlled Access:- The stations consult one another to find which station has the right to send.

→ Three controlled-access methods -

1. Reservation Technique:- A station needs to make a reservation before sending data.

* N stations in a system, then N reservation minislot in the reservation frame.

2. Polling :- It works with topology.

* One primary device and other secondary device.

* Select :- The select function is used whenever the primary device has something to send.

* Poll :- The poll function is used by the primary device to solicit transmissions from the secondary device.

3. Token Passing :- The stations in a network are organized in a logical ring.

* For each station, there is a predecessor and a successor.

Ch → Multiple Access Techniques II

ALOHA :-

- The earliest random-access method.
- Receiver ACKs data.
- If ACK not receiving within timeout (2* propagation delay).

- **Throughput:-** The throughput is the fraction of time, the channel caries useful information, namely non-colliding packets.

$S = GP$ → Probablity.

S → The throughput

G → Average number of frames.

CSMA:- (Carrier Sense Multiple Access)

- Was developed to overcome the problems of ALOHA.
- Based on the principle of carrier sense
- The station sense the carrier or channel before transmitting a frame.
- The chances of collision still exists because of propagation delay.

← Three methods of CSMA-

1. 1-persistent method
2. non-persistent method
3. P-persistent method.

→ 1-persistent method:-

- Simple & straightforword.
- Sends its frame immediately.
- has the highest chance of collision.

→ Non-persistent method:-

- has a frame to send senses the line.
- reduces the chance of collision.
- reduces the efficiency of the network.

→ P-persistent method:-

- Is used if the channel has time slots with a slot duration equal to or greater than the maximum propagation time.

- the station finds the line idle it follows this steps:-

1) With probablity p, the station sends its frame.

2) With probablity $q = 1 - p$, the station waits for the beginning of the next time slot & checks the line again.

3) a) If the line is idle, it goes to step 1.

b) If the line is busy, it acts as though a collision has occurred & uses the back off procedure.

~~CDMA~~

CSMA/CD

- sends data on the channels, continues to sense the channel even after data transmissio
- If collision is detected, the station aborts its transmission.
- Jam signal.
- Jam signal alerts other station.

CSMA/CA

- used in wireless network.
- Worked based on three strategies -

i) Inter Frame Space
ii) Contention Window
iii) Acknowledgement

*VLSM (Variable Length Subnet Mask)

Example:-

Suppose that we have three networks: A, B & C with IP requirements 50, 4 & 28. If you are given an IP block 130.3.0.0 allocate IPs performing subnetting.

Subnet	No of IPs required	How many bits of borrow	No of allocated IP	No of host bit No of net bit	Subnet mask	Allocated IP range
A	50	$2^6 > 50 > 2^5$	64	$x = 6$ $y = 32-6 = 26$	255.255. 255.192	130.3. 0.0 – 130.3.0 .63/26
C	28	$2^5 > 28 > 2^4$	32	$x = 5$ $y = 32-5 = 27$	255.255. 255.224	130.3.0. 64 – 130. 3.0.95/27
B	4	$2^2 = 4$	4	$x = 2$ $y = 32-2 = 30$	255.255. 255.252	130.3.0. 96 – 130. 3.0.99/30

No of alloeated IPs : 64+32+4 = 100
No of IPs required : 50+28+4 = 82
Percentage of unused IP = $\left(\frac{100-82}{100}\right) \times 100$

= 18%

Classful address

No of alloeated IPs : 64x3 = 192
Required IP = 50+28+4 = 82

∴ Percentage of unused IP = $\left(\frac{192-82}{192}\right) \times 100$

= 58%