Multicast Routing:- Moving Multicast Packet to its destination.

Multicast Address:- An Address used for multicasting

Multicast Router:- A router with a list of loyal members related to each router interface that distributes the multicast packets

Multicasting:- A Transmission method that allows copies of a single packet to be sent to a selected group of receivers.

(OR)

Sending a message to each group is called a multicasting and its routing algorithm is called multicast routing.

Multicast requires groups & group management. Some way is needed to create and destroy groups and allow process to join and leave groups. To do multicast Routing, each router computes a spanning tree covering all other routers. Here we have two groups 1 & 2. Some routers are attached to hosts that belong to one ~~or~~ or both of these groups.

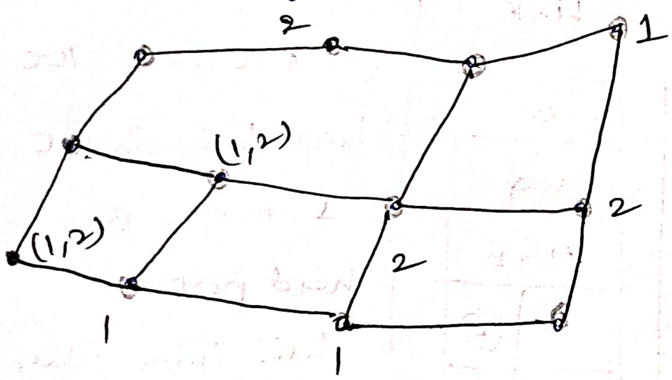


fig a, rep's a network
Spanning tree for left most

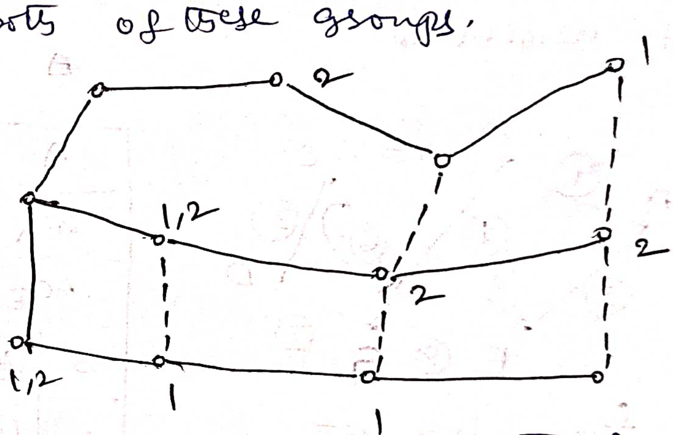
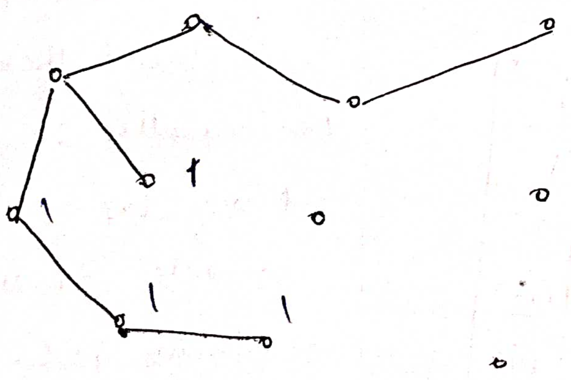


fig b, rep's a spanning tree for the left most router.



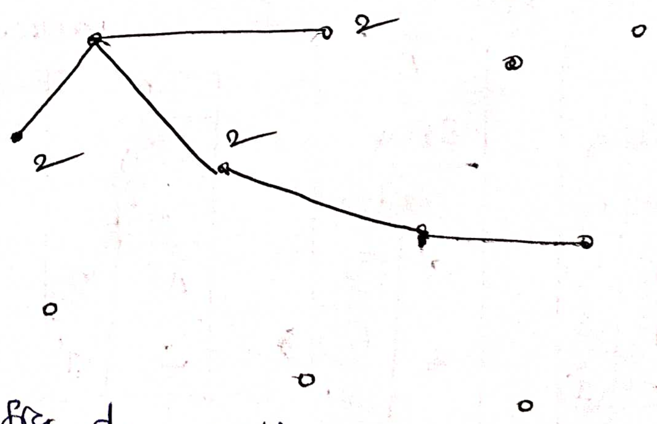


fig c, rep's a multicast of group 1

fig d, rep's a multicast of group 2

Miscellaneous Questions in Computer Networks (1)

Q. ① The following character encoding is used in a data link protocol:

A : 01000111 ; B : 11100011 ; FLAG : 01111110

ESC : 11100000 Show the bit sequence transmitted (in binary) for the four character frame : A, B, ESC, FLAG when each of the following framing methods are used.

i, Character Count ii, Flag bytes with byte stuffing

iii, starting and ending flag bytes with bit stuffing (6M)

Sol:- i, character count ie, four character frame.

4	A	B	ESC	FLAG
00000100	01000111	11100011	11100000	01111110

ii, FLAG Bytes with Byte stuffing

ie, FLAG A B ESC FLAG FLAG

Add FLAG for starting and Ending of stuffing then

FLAG	A	B	ESC	ESC	ESC	FLAG	FLAG
01111110	01000111	11100011	11100000	11100000	11100000	01111110	01111110

finally

01111110 01000111 11100011 11100000 11100000 11100000

01111110 01111110

iii, starting and ending FLAG Bytes with bit stuffing

FLAG	A	B	ESC	FLAG	FLAG
01111110	01000111	11100011	11100000	01111110	

finally FLAG Byte with Bit stuffing (2)

01111110 01000 11111 01000 11 111 00000

FLAG A B ESC

0 11111 010 01111110

FLAG FLAG.

Q(2) Imagine a sliding window protocol using so many bits for sequence numbers that wrap around never occurs. What relations must hold among the four window edges and window size, which is constant and the same for both the sender and the receiver.

Ans: In a sliding window protocol where sequence number wraparound never occurs, the relation between the window size (W) and the sequence numbers must ensure that the sender and receiver can uniquely identify each frame within the window.

Specifically, the relation would be : [2window > 1 + ext ie, either Two way or Three way handshaking methods and the {Range of sequence numbers ie, 2 bit | 3 bit | 4 bit sliding window Protocols}] Note;- Here bits range of Binary/octal/Decimal

This ensures that the sender can have (W) frames in transit, and the receiver can distinguish between different frames within the window without ambiguity. The range of sequence numbers should be large enough to cover all ~~Possible~~ Possible frame Positions with in the window size.

Ex, If the window size is 4 ie, W=4, then the sequence numbers should span a range greater than (2 times ie, 2x4 =8) to avoid ambiguity when identifying frames within the window

Q (3) A large number of consecutive IP Address are available starting 198.16.0.0. Suppose that four organizations A, B, C and D, request 4000, 2000, 4000, 8000 addresses, respectively and in that order. For each of these, give the First IP address assigned, the last IP address assigned and the mask in the w.x.y.z/s notation. (3)

Sol: Certainly! To determine the Subnet masks in the w.x.y.z/s notation for each organization, we need to allocate the required number of IP addresses to each organization in a way that satisfies their requests and optimizes address usage.

Let us start with organization A, which requests 4000 addresses. We can use a subnet with a subnet mask that provides at least 4000 addresses. The smallest subnet that accommodates 4000 addresses is a /21 subnet, so the mask would be 255.255.248.0 or in the w.x.y.z/s notation, it is 198.16.0.0/21.

For organization B, which requests 2000 Addresses, we need a subnet with at least 2000 addresses. The smallest subnet that fits is a /22 subnet, so the mask is 255.255.252.0 or 198.16.8.0/22

For organization C, which request 4000 Addresses, we need the requests similar to A ie, a /21 subnet is the smallest that accomodates 4000 addresses. So the mask is 255.255.248.0 or 198.16.16.0/21

Finally for D requests 8000 Addresses, for this we need a /20 subnet, making the mask 255.255.240.0 or 198.16.32.0/20

In summary, organization A: 198.16.0.0/21
organization B: 198.16.8.0/22
organization C: 198.16.16.0/21
organization D: 198.16.32.0/20

DISTANCE VECTOR ROUTING ALGORITHM

Q4 Apply the DVR Algorithm on for the graph below and Calculate distance vectors of every node during the iterations

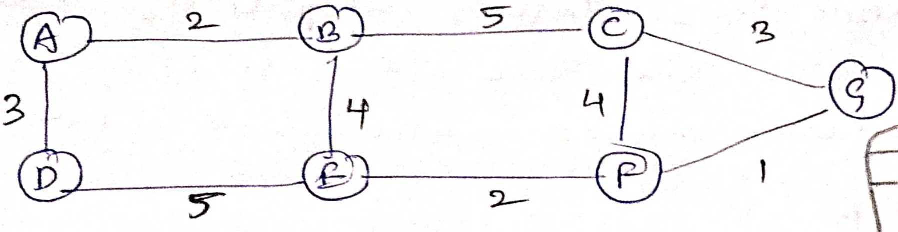


fig rep's weighted graph.

Information at Node / Distance to Nodes	A	B	C	D	E	F	G
A	0	2	∞	3	∞	∞	∞
B	2	0	5	∞	4	∞	∞
C	∞	5	0	∞	∞	4	3
D	3	∞	∞	0	5	∞	∞
E	∞	4	∞	5	0	2	∞
F	∞	∞	4	∞	2	0	1
G	∞	∞	3	∞	∞	1	0

'N' Nodes in the network

$N * (N-1)$ least - cost paths

A

A 0 ⇒ A ⇒ 0

B 2 ⇒ A+B ⇒ 0+2 ⇒ 2

C 7 ⇒ A+B+C ⇒ 0+2+5 ⇒ 7

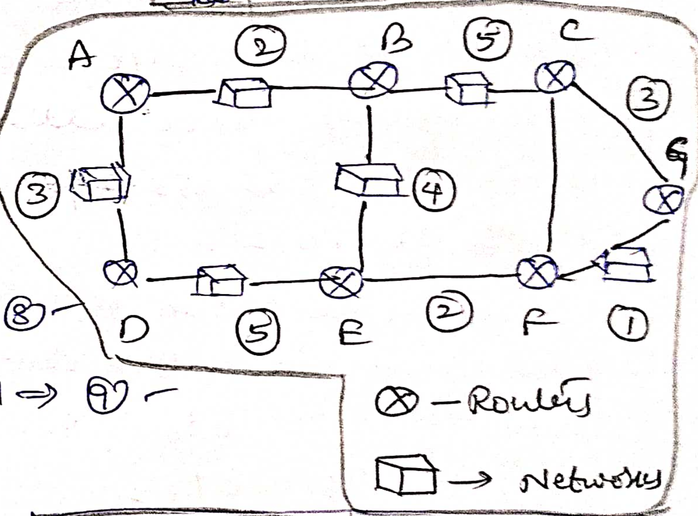
D 3 ⇒ A+D ⇒ 3

E 6 ⇒ A+B+E ⇒ 0+2+4 ⇒ 6

F 8 ⇒ A+B+E+F ⇒ 0+2+4+2 ⇒ 8

G 9 ⇒ A+B+E+F+G ⇒ 0+2+4+2+1 ⇒ 9

Calculation for Distance Vector for Node A.



Distance Vector Corresponding to a tree

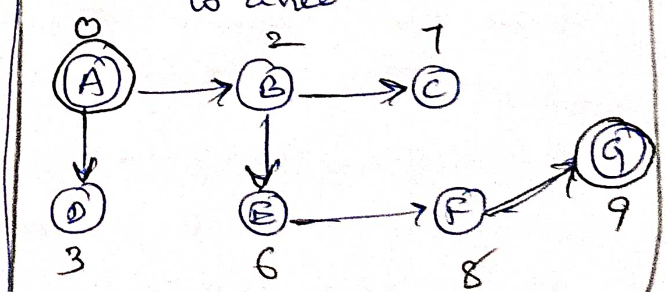


fig rep's Tree for node A

Updating distance vectors

	New B		Old B		A
A	2	A	2	A	0
B	0	B	0	B	2
C	5	C	5	C	∞
D	5	D	∞	D	3
E	4	E	4	E	∞
F	∞	F	∞	F	∞
G	∞	G	∞	G	∞

$B[\,] = \min(B[\,], 2 + A[\,])$

Here 'B' receives a copy of A's vector

Updating Distance Vectors ⑤

	New B		Old B		E
A	2	A	2	A	∞
B	0	B	0	B	4
C	5	C	5	C	∞
D	5	D	5	D	5
E	4	E	4	E	0
F	6 *	F	∞	F	2
G	∞	G	∞	G	∞

$B[\,] = \min([B], 4 + E[\,])$

b. Second event, B receives a copy of E's vector

① Finding shortest path i.e, minimum distance between source node to destination node

② Exchanging vectors eventually stabilizes the system and allows all nodes to find the ultimate least cost

③ Remember that after updating a node, it immediately sends its ~~uptodate~~ updated vector to all neighbours.

(Q5) The CIDR Notation of an IP Address is as follows:
167.199.170.82/27

i, what type of address is the above (Host | network | broadcast)?

ii, what is the Network Address?

iii, what are the total numbers of hosts that can be connected in that network?

iv, what is the subnet mask?

v, what is the broadcast address of that network?

Sol:- Given address : 167.199.170.82/27 ; Prefix length, CIDR, n=27

Total Number of Address $2^{(32-n)} = 2^{(32-27)} = 2^{(5)}$
= 32 Address.

i, First Address ie,

$\;\;2^6\;2^4\;2^3$
10100111 = 167
$2^7\;\;2^5\;\;2^2\,2^1\,2^0$

(Similarly)

128+0+32+0+0+4+2+1 ⇒ 167

for $\;2^5\;2^3$
11000111 ⇒ 128+64+0+0+0+4+2+1 = 199
$2^7\,2^6\;2^4\;\;2^2\,2^1\,2^0$

$2^7\;\;2^5$
10101010 ⇒ 128+0+32+0+8+0+2+0 = 170
$2^6\;2^4\,2^3\,2^2\,2^1\,2^0$

$2^7\,2^6\,2^5$
01010010 ⇒ 0+64+0+16+0+0+2+0 ⇒ 82
$2^4\,2^3\,2^2\,2^1\,2^0$

ie, the given address, its binary form

10100111.11000111.10101010.01010010

As $(32-n) = 32-27 = 5$, so the last octet right last 5 bits will let '0' ie, $2^5 = 32$

ie, now the binary form

10100111.11000111.10101010.01000000 which is in the decimal form 167.199.170.64 so, the first address is 167.199.170.64/27

(OR)

Address 167.199.170.82 = 10100111.11000111.10101010.01000000

(as range 128 – 191 so class B)

iv, SUB Net mask : 255.255.255.224 = 27

11111111.11111111.11111111.11100000 (as default mask class B)

Network Address : 167.199.170.64/27 (class B 'AND' operation on given address and mask)

iii, Last Address :- Given IP binary form

10100111.11000111.10101010.01010010 [Add 16 bits]

As $(32-n) = 32-27 = 5$, so the last octet right last 5 bits 1

ie, the the binary form

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

10100111.11000111.10101010.01011111 ⇒ 0+64+0+16+8+4+2+1 ⇒ 95

167.199.170.95 ie, 'OR' operation of the Mask

v, Broadcast Address; the last Address is 167.199.170.95/27.

iii, Total Number of hosts to be Connected ?

Sol:- the formula for calculating the Total number of hosts in a subnet is (2^{(32 – subnet – mask – length)} – 2), where the subtraction of 2 accounts for the network and broadcast addresses. for "/27", It would be (2^{(32–27)} – 2 = 2^5 – 2 = 32–2 = 30)

So, there are a total of 30 hosts that can be connected in the Network.

Q4) The following is part of TCP header dump (contents) in Hexa decimal format, (7)

E293 0017 00000001 00000000 5002 07FF...

Sol:- a) what is the source & destination port numbers

Source port number is → E293

Destination port number is → 0017

b) what is the sequence number & Acknowledge number

Sequence number is → 00000001 ie, '1'.

Acknowledge Number is → 00000000 ie, '0'

c) what is the length of the Header (4 Bits) → 4

d) Type of segment → 0X02 or 5002

e) Window size → 07FF

f) TCP Header format [Note:- If possible draw TCP header dump]

← 16 Bits → ← 16 Bits →

Source Port (16 Bits)								Destination Port (16 Bits)
Sequence Number								
Acknowledge Number								
Header length (4 Bits)	Reserved Bits (6 Bits)	URG	ACK	PSH	RST	SYN	FIN	Window size
Check sum								Urgent Pointer (UP)
Options (0-40 Bytes)								
Data (optional)								

fig rep's TCP Header format

(Q7) In a TCP Connection, the initial sequence number at the client side is 2171. The client opens the connection, sends three segments, the second of which carries 1000 bytes of data, and closes the connection. What is the value of the sequence number in each of the following segments sent by the client ? (8)

i, The SYN segment ii, The data segment iii, The FIN Segment

Sol:- i, The SYN segment:- In a TCP Connection, the initial sequence number (ISN) is chosen by the client and sent in the SYN (Synchronize) segment. Given that the initial sequence number at the client side is 2171, this is the value for the SYN segment

∴ for SYN segment = 2171

ii, The data segment :- The sequence number for the data segment would be the initial sequence number (ISN) plus the length of the data in the previous segments. In this case, it would be 2171 + 1000 (Bytes) for the second segment

or, the data segment is determined by the following formula

i.e, sequence number in the client side + 1 ⇒ 2171 + 1
⇒ 2172

∴ for the data segment it will be

either 3171 or 2172

iii, The FIN Segment:- The sequence number for the FIN segment (ie, finish) segment is the sequence number of the last byte of data sent, plus 1. So, for the FIN segment, it would be the sequence number of the data segment (3171 + 1000) plus 1 ie, 4172

or,

2171 + 1000 + 1 ⇒ 3172

Broadcast Routing :- Transmission of message to all nodes in a network
Broadcast Address :- An Address that allows transmission of a message to all nodes of network. Sending a packet to all destinations simultaneously is called "Broad casting". It consists of 5 methods of Broadcast Routing. (9)

① One broadcasting method that requires no special features from the subnet is for the source to simply send a distinct packet to each destination. It also requires the source to have a complete list of all destinations.

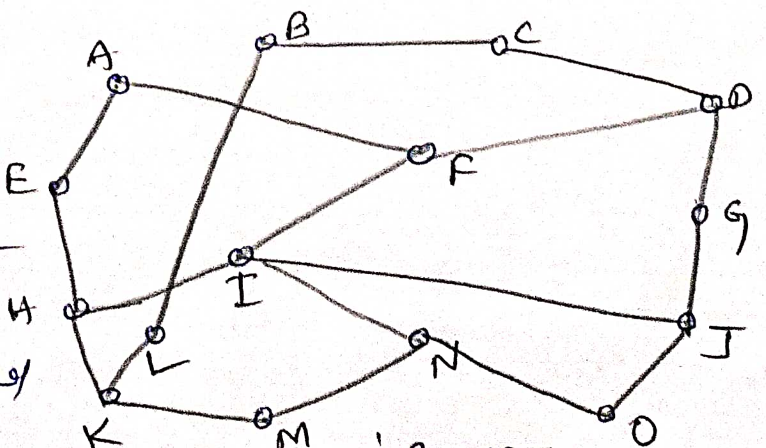
② Flooding is the another method which is ill-suited for ordinary point-to-point communication for broadcasting it might rate serious consideration, it generates too many packets and consumes too much Bandwidth.

③ Multidestination Routing method contains each packet towards a list of destinations. or bit map indicating the desired destinations. when a packet arrives at a router, the router checks all the destinations to determine the set of output lines that will be needed.

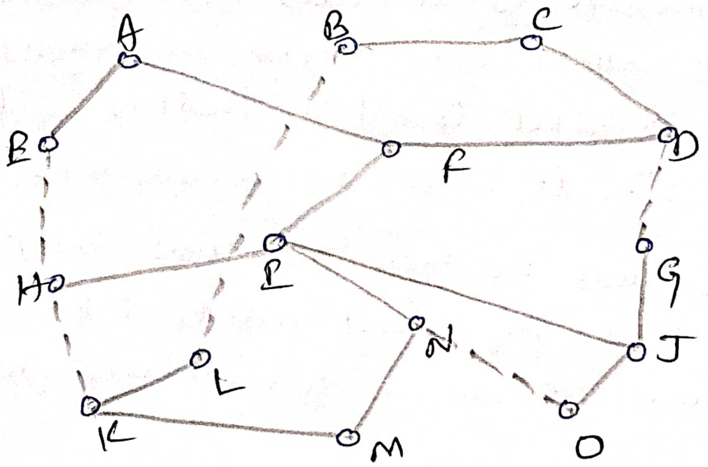
The router generates a new copy of the packet of each output lines to be used and includes in each packet only those destinations that are to use the line. In effect, the destination set is partitioned among the output lines. After sufficient hops, each packet will carry only one destination and can be treated as a normal packet

④ The Broad cast algorithm makes explicit use of the sink tree for the router initiating the broadcast or any other spanning tree for that matter, the spanning tree can copies an incomming broadcast packets onto all spanning tree lines. This method will use the excellent use of bandwidth, generating the obsolute minimum number of packets necessary to do the job.

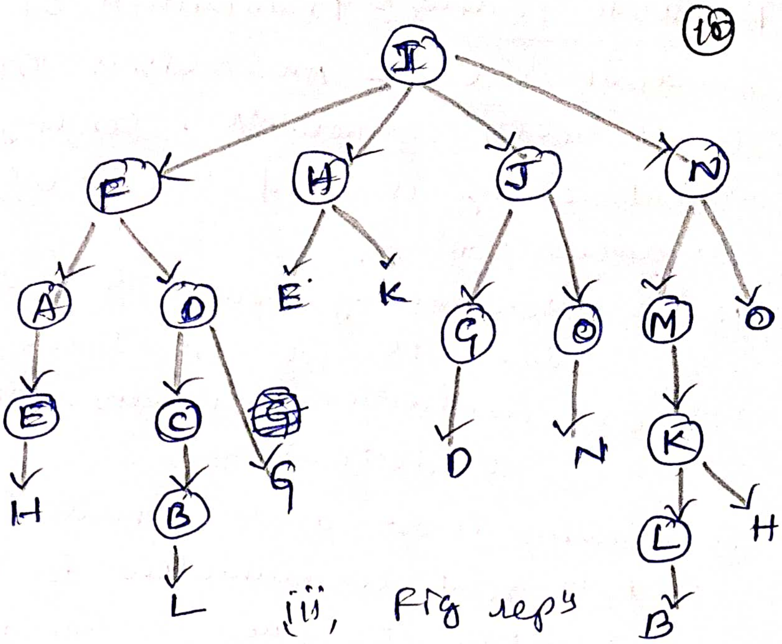
⑤ Broadcast Algorithm is an attempt to approximate the behaviour of previous one, even when the routers donot know any thing at all about spanning trees, the idea is called "Reverse Path forwarding".



i, SUBNET



(i) Fig rep's SINK TREE



(ii) Fig rep's the tree built by Reverse forwarding.

Q. Describe a way to reassemble IP fragments at the destination

Sol:- At the destination, the IP fragments can be reassembled using the identification, fragment offset and more fragments fields in the IP header. The destination collects fragments with matching identification values and arranges them in order based on the fragment offset. It then combines the payload data from each fragment to reconstruct the original IP packet. If all fragments are received successfully, the destination can perform a checksum verification to ensure data integrity.

Note:- For further reference go through IP fragmentation concept in FRAGMENTATION.