# ASSIGNMENT-02

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# Answer to the Question No. 01

## (i)

No. of hosts the organization can support,

Subnet mask = 255.255.240.0

= 11111111.11111111.11110000.00000000.

This corresponds to /20 prefix.

∴ Hosts bits = 32 - 20 = 12 bits

∴ Usable hosts = $2^{12} - 2 = 4096 - 2 = 4094$ hosts

## (ii)

Given IP = 137.168.210.108/20

Third octet of IP = 210.

Now, $\frac{210}{256-240}$ = 13 remainder 2.

∴ Third octet network = 13 × (256 - 240) = 208

∴ Network Address = 137.168.208.0/20

iii)

LAN A = 2000 hosts

LAN B = 480 ..

LAN C = 350 ..

Two WAN links = 2 .. each.

Subnet masks :-

For LAN A -> 2000 hosts need $2^{11} = 2048$ -> ~~/21~~ 137.168.208.0/21

Range = 137.168.208.0 - 137.168.215.255

Network A = 137.168.208.0/21

next free

For LAN B -> 480 hosts need $2^9 = 512$ -> 137.168.216.0/23

Range = 137.168.216.0 - 137.168.217.255

Network B = 137.168.216.0/23

next free

For LAN C -> 350 hosts need $2^9 = 512$ -> 137.168.218.0/23

Range = 137.168.218.0 - 137.168.219.255

Network C = 137.168.218.0/23

For WAN 1 -> $2^2$ hosts -> 137.168.220.0/30

For WAN 2 -> 2 .. -> 137.168.220.4/30

The VLSM subnet network addresses are :

LAN A = 137.168.208.0/21
LAN B = 137.168.216.0/23
LAN C = 137.168.218.0/23
WAN 1 = 137.168.220.0/30
WAN 2 = 137.168.220.4/30

## Answer to the Question No. 02

### 11

The ISP router uses Port Address Translation (PAT). Although both devices send packets with the same internal source port 40540, the router changes the port numbers when it forwards them to the internet using the public IP 139.200.200.100.

The router keeps a translation table such as:

| Internet IP + Port | Translated Public Port |
|---|---|
| 192.168.20.10 : 40540 | 139.200.200.100 : 50001 |
| 192.168.20.11 : 40540 | 139.200.200.100.50002. |

The ISP router determines the correct device by examining the translated destination port number stored in its PAT table. If port is 50001 -> it will be sent to device A, if port is 50002, it will be sent to device B.

11

Device A and B use private IPv4 addresses that the router uses, The single address 139.200.200.100 is a public globally routable IPv4 address. The differences are as follows:-

- Private addresses are used only inside local networks and are not valid on the Internet.
- Public address is unique in the global internet and required for communication across ISP.

# Answer to the Question No. 03

Given data = 8240 bytes.

MTU per fragment = 830 bytes including 30 header.

∴ Payload per fragment = 830 - 30 = 800 bytes.

## (i)

No. of fragments = 8240 ÷ 800 = 10.3 ≈ 11 fragments

## (ii)

Data size of last fragment,

First 10 fragments carry = 10 × 800 = 8000 bytes.

∴ Last fragment data size = 8240 - 8000 = 240 bytes.

## (iii)

offset unit = 8 bytes, each full payload = 800 bytes.

∴ offset for n = (n-1) × 800} ÷ 8

∴ ∴ 7th fragment = (7-1) × 800 ÷ 8 = 600

## (iv)

If the Don't fragment (DF) bit is set, the router is not allowed to fragment. Since packet size is larger than the link MTU, the router will drop the packet and send "ICMP" "fragmentation Needed" message to the sender.

# Answer to the Question No. 04

## ii

Given, 2001 : db8 : : 0001 : 0 : 100 : 0

=> 2001 : 0db8 : 0000 : 0000 : 0000 : 0001 : 0000 : 0100 : 0000

## iii

Given, 0 : 1 : :

=> 0000 : 0001 : 0000 : 0000 : 0000 : 0000 : 0000 : 0000

## iii

Given, 2002 : C6 : : DB80 : 0 : 0.

=> 2002 : 00C6 : 0000 : 0000 : 0000 : DB80 : 0000 : 0000.

# Answer to the Question No. 05

## 11

The given command:

ip route 172.31.10.0 255.255.255.0 192.168.10.1

The problem is that 192.168.10.1 is not the connect next hop for reaching that network. The next hop should point toward the router directly connected to the ISP, not inside address.

To improve this, the router should use the connect next-hop address or exit interface. For example:

ip route 172.31.10.0 255.255.255.0 192.168.20.1

11

Default routes should be configured in edge routers R1 and R2, because only they can connect to external networks. Internal routers do not require default routes. Configure default static routes on routers that have connection toward the Internet to avoid unnecessary entries.

# Answer to the Question No. 06

(i)

Devices that will receive and forward :-

- Switch S1 will receive the ARP request from device D and forward it to all other ports because switches flood broadcast frames.
- Switch S2 and S3 will also receive and continue flooding within that broadcast domain.

Devices that will drop :

- Any router in the topology will drop the ARP request because ARP is a Layer-2 protocol valid only inside one network and routers separate broadcast domains.
- Switches outside the LAN of device D will not see the frame at all.

All switches in the same lane will receive and forward, while routers will drop the frames.

11

S1 Table:

| MAC | Port | TTL |
|---|---|---|
| D | f2 | 60 |
| A | f0 | 60 |

S3 Table:

| MAC | Port | TTL |
|---|---|---|
| D | f1 | 60 |
| A | f2 | 60 |

## Answer to the Question No. 07

Hop Limit in IPv6 header prevents packets from circulating forever in routing loops. Each router decreases this value by one; when it becomes zero the packet is discarded. The IPv4 field that performs the same function is called Time To Live (TTL).

## Answer to the Question No. 08

Link state routing protocols are called global because every router has knowledge of the entire network topology through LSAs and SPF algorithm.

Distance vector knows only neighbor distance, which causes slow convergence and count-to-infinity.

Therefore Link State converges faster and uses bandwidth efficiently. It is more efficient due to complete topology view and quick SPF computation.

# Answer to the Question No. 09

## (i)

The issue is that LAN 1 is in different broadcast domain from DHCP server. DHCP uses broadcast which routers do not forward by default.

The solution could be to configure DHCP Relay / IP Helper Address on the router connected to LAN 1. Enable DHCP relay so requests can reach server.

## (ii)

For Renewal of a leased IP address:

- DHCP Request (unicast to server)
- DHCP Ack with extended lease time.

Renewal uses Request and Ack messages.

# Answer to the Question No.10

## i)

Given MAC Address = 98:CC:12:23:40:BB.

In the first octet = 98 = 10011000.

Least Significant Bit of first octet = 0.

The given MAC Address is a unicast MAC address as LSB = 0.

## ii)

Why MAC changes every hop but IP does not is stated below:-

- MAC address is only used for local delivery inside one layer-2 segment.
- When a packet moves from one router to the next, it is encapsulated in a new Ethernet frame with new source and destination MAC addresses.
- IP address represents the original end-to-end logical identity of sender and receiver; routers only read IP header and forward without modifying it.
- Keeping IP unchanged ensures that higher layer protocols maintain session continuity.

MAC changes because each hop is a new layer-2 link, but IP remains the same to preserve end-to-end communication.

# Answer to the Question No. 11

If a device wants to send a packet to another device in a different network, it cannot reach that MAC directly. The initial ARP request will be sent for the Default Gateway Router, not the final destination.

After that, the device obtains the default gateway IP from its IP configuration or DHCP server. The operating system checks routing table and sees that remote destination is outside local subnet. Therefore it uses the stored field "Default Gateway" to generate ARP.