CSE421

COMPUTER NETWORKS

ASSIGNMENT 2

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<u>Answer to the question number 1</u>

(i)

Given IP configuration:

- IPv4 Address: 107.168.177.108
- Prefix: /17
- Default Gateway: 107.168.177.1

Prefix /17 means:

- First 17 bits = 1
- Remaining 15 bits = 0

Binary subnet mask: 11111111.11111111.10000000.00000000

Decimal subnet mask: 255.255.128.0

(ii)

Subnet mask: 255.255.128.0

- First 2 octets → fixed
- Third octet → block size = 128

Check third octet:

- IP = 107.168.177.108
- Subnet ranges:
    - 0–127
    - 128–255

Since 177 ∈ (128–255):

Network address: **107.168.128.0**

(iii)

Host Requirements

Network	Hosts Required
LAN A	2500
LAN B	1200
LAN C	1050
WAN Links	2 links

largest to smallest

Network	Hosts
LAN A	2500
LAN B	1200
LAN C	1050
WAN 1	2
WAN 2	2

LAN A – 2500 hosts

- Needs 2^{12} = 4096 addresses
- Prefix = /20
- Subnet mask = 255.255.240.0

LAN B – 1200 hosts

- Needs 2^{11} = 2048 addresses
- Prefix = /21
- Subnet mask = 255.255.248.0

LAN C – 1050 hosts

- Needs 2^{11} = 2048 addresses
- Prefix = /21
- Subnet mask = 255.255.248.0

WAN Links

- 2 usable hosts → /30
- Subnet mask = 255.255.255.252=

Allocate from 107.168.128.0

LAN A

- Network: 107.168.128.0/20
- Range: 107.168.128.0 – 107.168.143.255

LAN B

- Next block starts at 107.168.144.0
- Network: 107.168.144.0/21
- Range: 107.168.144.0 – 107.168.151.255

LAN C

- Next block starts at 107.168.152.0
- Network: 107.168.152.0/21
- Range: 107.168.152.0 – 107.168.159.255

WAN 1

- Network: 107.168.160.0/30
- Usable: .1 – .2

WAN 2

- Network: 107.168.160.4/30
- Usable: .5 – .6

Final VLSM Table

Network	Network Address	Prefix
LAN A	107.168.128.0	/20
LAN B	107.168.144.0	/21

LAN C	107.168.152.0	/21
WAN 1	107.168.160.0	/30
WAN 2	107.168.160.4	/30

Answer to the question number 2

(i)

Given

- Device A: 172.16.11.5/16
- Device B: 172.16.11.11/16
- Source Port (both): 42230
- ISP Public IP: 209.123.123.45

Even though both devices use the same source port, the ISP router:

- Changes the source port number for each outgoing connection
- Maintains a PAT table

Example PAT Table:

Inside IP	Inside Port	Public IP	Public Port
172.16.11.5	42230	209.123.123.45	50001
172.16.11.11	42230	209.123.123.45	50002

When reply arrives:

- Router checks destination port
- Matches it with PAT table
- Forwards packet to correct internal device

The ISP router uses the translated source port number stored in the PAT table to uniquely identify whether the reply belongs to device A or device B.

(ii)

Device A and B:

- Use Private IP addresses
- Range: 172.16.0.0 – 172.31.255.255
- Not routable on the Internet

ISP Router:

- Uses a Public IP address
- Globally unique
- Routable over the Internet

Device A and B use private IP addresses, while the ISP router uses a public IP address for PAT, allowing multiple private hosts to access the Internet using a single public address.

Answer to the question number 3

(i)

Given

- Total packet size = 7240 bytes
- Header = 40 bytes
- Data = 7200 bytes
- MTU = 800 bytes

Each fragment can carry: 800 – 40 = 760 bytes of data

Fragments needed: 7200 ÷ 760 ≈ 9.47 → 10 fragments

(ii)

Data sent by first 9 fragments: 9 × 760 = 6840 bytes

Remaining data: 7200 – 6840 = 360 bytes

Last fragment size: 360 + 40 = 400 bytes

(iii)

Fragment offset unit = 8 bytes

Data before 8th fragment: $7 \times 760 = 5320$ bytes

Offset: $5320 \div 8 = 665$

Fragment offset of 8th fragment = 665

(iv)

The MF bit is set to 0 for the last fragment to indicate that no more fragments remain, allowing the destination host to know reassembly is complete.

Answer to the question number 4

(i)

2001:0db8:0000:0000:0001:0000:0000:0100

→ Remove leading zeros: 2001:db8:0:0:1:0:0:100

→ Longest zero sequence = 0:0 (two places)

Shortened form: 2001:db8::1:0:0:100 (Answer)

(ii)

ff02:0000:0000:0000:0000:0000:0000:0001

→ Remove leading zeros: ff02:0:0:0:0:0:0:1

→ Longest zero sequence = 6 hextets

Shortened form: ff02::1 (Answer)

(iii)

2001:0000:0000:3C10:0000:0000:0000:0000

→ Remove leading zeros and longest zero sequence

Shortened form: 2001:0:0:3c10:: (Answer)

Answer to the question number 5

(i)

Given static route on R1:

ip route 172.31.10.0 255.255.255.0 10.10.10.2

- R1 has two equal paths to R2:
    - 10.10.10.0/30
    - 10.10.20.0/30
- Using next-hop IP only can cause:
    - Recursive lookup
    - Wrong interface selection
    - Delay in packet forwarding

Improvement: Using exit interface or fully specified static route.
Better command: ip route 172.31.10.0 255.255.255.0 s1/0 or
ip route 172.31.10.0 255.255.255.0 10.10.10.2 s1/0

(ii)

Default routes should be configured on: R1 & R2

Justification:

- This is a **stub network**
- All unknown destinations go toward the ISP
- Default route reduces routing table size

On R1 (towards ISP): ip route 0.0.0.0 0.0.0.0 192.168.10.2

On R2 (towards R1): ip route 0.0.0.0 0.0.0.0 10.10.10.1

Answer to the question number 6

(i)

ARP is:

- Broadcast
- Layer-2 frame
- Destination MAC = FF:FF:FF:FF:FF:FF

Devices that receive and forward:

- S2 → floods
- S1 → floods
- S3 → floods

Devices that drop the frame:

- R1
- R2

Reason: Routers do not forward broadcasts

(ii)

ARP reply is **unicast from A → E**

S3 MAC Table

MAC	Port
A	f2

S2 MAC Table

MAC	Port
A	f2
E	f1

Answer to the question number 7

Field added in IPv6: Flow Label

Purpose:

- Identifies packets belonging to the same flow
- Used for:
  - QoS
  - Real-time traffic (voice, video)
  - Load balancing

Why needed: IPv6 routers can process flows faster and no need to inspect transport-layer headers

<u>Answer to the question number 8</u>

Distance vector is decentralized because:

- Routers only know:
  - Their neighbors
  - Distance to destinations
- No global topology knowledge
- Decisions are made independently

Differences (Any Two)

Distance Vector	**Link State**
Periodic updates	Event-driven updates
High convergence time	Fast convergence
Routing loops possible	Loop-free
Low CPU & memory	High CPU & memory

Answer to the question number 9

(i)

Issue:

- DHCP requests are **broadcast**
- Routers **do not forward broadcasts**
- LAN2 requests never reach R1

Solution:

Configure **DHCP Relay (ip helper-address)** on R2: interface f1/0 or LAN2
ip helper-address <R1-IP>

(ii)

Renewal uses **2 messages**:

1. **DHCPREQUEST**
2. **DHCPACK**

(No DISCOVER/OFFER)

Answer to the question number 10

(i)

MAC: AF:CC:FE:12:23:40

- First **3 bytes**

OUI = AF:CC:FE

(ii)

The MAC is a Flat Address because

- No hierarchy
- Not location-based
- Cannot be summarized
- Assigned by manufacturer

<u>Answer to the question number 11</u>

Destination MAC in received ARP request: FF:FF:FF:FF:FF:FF

Router Actions (All Scenarios)

1. Router checks target IP
2. If IP matches its interface:
    - Sends ARP reply (unicast)
3. If IP does not match:
    - Drops the packet
4. Router does not forward ARP broadcasts
5. Updates ARP cache if needed