Computer Networking HWK4

Junesh Gautam

March 2025

1 Main Functions of the Network Layer

The Network layer (Layer 3) in the OSI model is responsible for the following main functions:

- **Routing**: Determining the optimal path for data packets using algorithms like distance vector or link-state.
- **Forwarding**: Directing packets to the correct outgoing interface based on routing tables.
- **Logical Addressing**: Assigning IP addresses for unique device identification.
- **Fragmentation and Reassembly**: Breaking down and reassembling packets for transmission.
- **Congestion Control**: Managing network traffic to prevent overload.
- **Inter-networking**: Connecting different networks via routers.

2 Distance Vector Routing Table for Router C

Given Data:

- Vectors received by C:
  - From B: [A=5, B=0, C=8, D=12, E=6, F=2]
  - From D: [A=16, B=12, C=6, D=0, E=9, F=10]
  - From E: [A=7, B=6, C=3, D=9, E=0, F=4]
- Link costs from C: C→B=6, C→D=3, C→E=5

Calculations:

Destination	Via B	Via D	Via E
A	$5+6=11$	$16+3=19$	$7+5=12$
B	$0+6=6$	$12+3=15$	$6+5=11$
D	$12+6=18$	$0+3=3$	$9+5=14$
E	$6+6=12$	$9+3=12$	$0+5=5$
F	$2+6=8$	$10+3=13$	$4+5=9$

Resulting Routing Table:

Destination	**Outgoing Line**	**Cost**
A	B	11
B	B	6
D	D	3
E	E	5
F	B	8

3 Number of Class B Networks with 20-bit Network Part

Given:

- Original Class B uses 16 bits for the network part (14 variable bits after fixed `10`).
- Modified scenario: 20 bits for the network part.

Steps:

1. Class B addresses start with the fixed binary prefix `10` (2 bits).
2. Original variable network bits: $16 - 2 = 14 \rightarrow 2^{14} = 16,384$ networks.
3. With 20-bit network part:
   - Total network bits: 20.
   - Fixed bits: 2 (`10`).
   - Variable bits: $20 - 2 = 18$.
   - Number of networks: $2^{18} = 262,144$.

Answer:

$$\boxed{262144}$$

4 Maximum Number of Hosts with Subnet Mask 255.255.240.0

Given:

- Subnet mask: 255.255.240.0

Analysis:

1. Binary representation of subnet mask:

$$255.255.240.0 \rightarrow 11111111.11111111.1111\mathbf{0000}.00000000$$

2. Host bits are the trailing zeros in the subnet mask:
   - 3rd octet: 4 host bits (from 1111**0000**).
   - 4th octet: 8 host bits (from 00000000).
   - Total host bits: $4 + 8 = 12$.
3. Maximum hosts = $2^{12} - 2 = 4094$.

Answer:

$$\boxed{4094}$$

5 Routing Table Entries with CIDR

Given Routing Table:

Address/Mask	Next Hop
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
192.53.40.0/23	Router 1
default	Router 2

Analysis for Each IP Address:

a. 135.46.63.10

- Convert IP and networks to binary:
  - IP: `135.46.63.10` → `10000111.00101110.00111111.00001010`
  - Network `135.46.56.0/22`: `10000111.00101110.00111000.00000000` (first 22 bits: `10000111.00101110.001110`)
  - Network `135.46.60.0/22`: `10000111.00101110.00111100.00000000` (first 22 bits: `10000111.00101110.001111`)
- Match: IP's first 22 bits (`10000111.00101110.001111`) match `135.46.60.0/22`.

Action: Forward to `Interface 1`.

b. 135.46.57.14

- Convert IP and network to binary:
  - IP: `135.46.57.14` → `10000111.00101110.00111001.00001110`
  - Network `135.46.56.0/22`: First 22 bits (`10000111.00101110.001110`) match IP's first 22 bits.

Action: Forward to `Interface 0`.

c. 135.46.52.2

- Convert IP to binary:
  - IP: `135.46.52.2` → `10000111.00101110.00110100.00000010`
  - No match for `135.46.56.0/22` or `135.46.60.0/22`.

Action: Use `default` route → Forward to `Router 2`.

d. 192.53.40.7

- Convert IP and network to binary:
  - IP: `192.53.40.7` → `11000000.00110101.00101000.00000111`
  - Network `192.53.40.0/23`: First 23 bits (`11000000.00110101.0010100`) match IP's first 23 bits.

Action: Forward to `Router 1`.

e. 192.53.56.7

- Convert IP to binary:
  - IP: `192.53.56.7` → `11000000.00110101.00111000.00000111`
  - Network `192.53.40.0/23` covers `192.53.40.0{192.53.41.255`. IP is outside this range.

Action: Use `default` route → Forward to `Router 2`.