# CS3611 Computer Networks (Spring 2023) Homework 4

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1. (1) The forwarding table is as follows.

Table 1: Forwarding table

| Destination Prefix | Link Interface |
|---|---|
| 11100000 00 | 0 |
| 11100000 01000000 | 1 |
| 1110000 | 2 |
| 11100001 1 | 3 |
| otherwise | 3 |

(2) The forwarding table is as follows.

Table 2: Forwarding table

| Destination Prefix | Link Interface |
|---|---|
| 224.0/10 | 0 |
| 224.64/16 | 1 |
| 224/7 | 2 |
| 225.128/9 | 3 |
| otherwise | 3 |

(3) The forwarding table is as follows.

Table 3: Forwarding table

| Destination Address | Link Interface |
|---|---|
| 11000000 00010001 01010001 01010101 | 0 |
| 11100000 01000000 11000011 00111100 | 1 |
| 11100001 10000000 00010001 01110111 | 3 |
| 11100000 01000000 00001000 00000001 | 1 |

2. (1) The assignment is as follows.

Table 4: Address Assignment

| **Subnet** | **Address** | **Interface** |
|---|---|---|
| A | 214.20.255/24 | 256 |
| B | 214.20.254.128/25 | 128 |
| C | 214.20.254.0/25 - 214.20.254.0/29 | 120 |
| D | 214.20.254.4/30 | 4 |
| E | 214.20.254.2/31 | 2 |
| F | 214.20.254.0/31 | 2 |

(2) The forwarding table is as follows.

Table 5: Forwarding table of R1

| **Destination Prefix** | **Link Interface** |
|---|---|
| 11010110 00010100 11111111 | Subnet A |
| 11010110 00010100 11111110 000001 | Subnet D |
| 11010110 00010100 11111110 0000000 | Subnet F |

Table 6: Forwarding table of R2

| **Destination Prefix** | **Link Interface** |
|---|---|
| 11010110 00010100 11111110 0 | Subnet C |
| 11010110 00010100 11111110 0000001 | Subnet E |
| 11010110 00010100 11111110 0000000 | Subnet F |

Table 7: Forwarding table of R3

| **Destination Prefix** | **Link Interface** |
|---|---|
| 11010110 00010100 11111110 1 | Subnet B |
| 11010110 00010100 11111110 000001 | Subnet D |
| 11010110 00010100 11111110 0000001 | Subnet E |

3. The distance table at node z is as follows.

Table 8: Distance table at z (Step 1)

| | u | v | x | y | z |
|---|---|---|---|---|---|
| v | $\infty$ | $\infty$ | $\infty$ | $\infty$ | $\infty$ |
| x | $\infty$ | $\infty$ | $\infty$ | $\infty$ | $\infty$ |
| z | $\infty$ | 4 | 2 | $\infty$ | 0 |

Table 9: Distance table at z (Step 2)

| | u | v | x | y | z |
|---|---|---|---|---|---|
| v | 1 | 0 | 3 | $\infty$ | 4 |
| x | $\infty$ | 3 | 0 | 3 | 2 |
| z | 5 | 4 | 2 | 5 | 0 |

Table 10: Distance table at z (Step 3)

| | u | v | x | y | z |
|---|---|---|---|---|---|
| v | 1 | 0 | 3 | 3 | 4 |
| x | 4 | 3 | 0 | 3 | 2 |
| z | 5 | 4 | 2 | 5 | 0 |

Table 11: Distance table at z (Step 4)

| | u | v | x | y | z |
|---|---|---|---|---|---|
| v | 1 | 0 | 3 | 3 | 4 |
| x | 4 | 3 | 0 | 3 | 2 |
| z | 5 | 4 | 2 | 5 | 0 |

4. LSR and DVR differ in the following aspects.

   - Message complexity: LSR sends $O(nm)$ messages in total. DVR sends $O(n)$ messages each round, but the number of rounds is not determined.
   - Convergence speed: The time complexity of LSR is $O(n^2)$. LSR converges after 1 iteration but oscillations may occur. The time complexity of DVR is not determined. DVR converges within $n$ iterations, but there may be routing loops and count-to-infinity problems.
   - Algorithm Robustness: For LSR, the routing of each node is computed independently. For DVR, the routing of each node is used by its neighbors. Hence, errors can propagate through the network.

   Therefore, LSR is suitable for small networks or networks requiring strong robustness. DVR is suitable for large or complex networks. Both of them are widely used in practice.

   Poisoned reverse can be used to solve the count-to-infinity problem. In RIP, the number of hops is limited to 15. In DGP, AS path is specified. Both of these methods can deal with the count-to-infinity problem.

5. Intra-AS routing and Inter-AS routing differ in the following aspects.

   - Policy: For Inter-AS routing, the administrator requires control over how its traffic routed and who routes through its network. For Intra-AS routing, no policy decisions are needed.

- Scale: Intra-AS routing and Inter-AS routing works for different hierarchical levels.
- Performance: Intra-AS routing can focus on performance. Inter-AS routing must consider policy before performance.

6. Here are some methods to reduce the size of routing tables.

   - Use CIDR to summarize multiple entries into a single entry.
   - Use longest prefix matching rule instead of exact match.
   - Use hierarchical routing to simplify routing tables.

7. Here are some reasons for replacing IPv4 with IPv6..

   - The address space of IPv4 is severely limited. IPv6 has a much larger address space.
   - The header of IPv4 is more complex. IPv6 has a simplified header and a higher efficiency.
   - IPv6 supports more features such as QoS, which is not supported by IPv4.

8. The assignment with CIDR is as follows.

Table 12: Address Assignment

| **Network Identity** | **Network Prefix** | **Network Mask** |
|---|---|---|
| LAN0 | 206.0.64.0 | 255.255.255.255 |
| LAN1 | 206.0.64.0 | 255.255.255.128 |
| LAN2 | 206.0.64.128 | 255.255.255.128 |
| LAN3 | 206.0.65.0 | 255.255.255.128 |
| LAN4 | 206.0.65.128 | 255.255.255.128 |
| LAN5 | 206.0.66.0 | 255.255.255.192 |
| LAN6 | 206.0.66.64 | 255.255.255.192 |
| LAN7 | 206.0.66.128 | 255.255.255.192 |
| LAN8 | 206.0.66.192 | 255.255.255.192 |
| LAN9 | 206.0.67.0 | 255.255.255.192 |
| LAN10 | 206.0.67.64 | 255.255.255.192 |
| LAN11 | 206.0.67.128 | 255.255.255.192 |
| LAN12 | 206.0.67.192 | 255.255.255.192 |