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| **Course: CSE462 – Network Analysis & Design**  **Exercise 1st – IP Addressing** |

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| **Student ID** | *1931220012* |
| **Student Name** | *Hà Quang Minh* |
| **Final Score** |  |

**Exercise Submission**

Students are responsible for submitting the final report by the stated deadline for full marks. Late submissions will NOT be accepted. It is the students’ responsibility to submit the report on time.

**🙡 - Good luck - 🙣**

**Problem 1: Subnet mask presentation**

Complete the following table with the subnet mask value in different format

|  |  |  |  |
| --- | --- | --- | --- |
| Slash notation | Binary | Decimal | # of hosts |
| /8 | 11111111.00000000. 00000000.00000000 | 255.0.0.0 | 224 - 2 |
| /10 | 11111111.11000000. 00000000.00000000 | 255.192.0.0 | 2^22 – 2 |
| /12 | 11111111.11110000. 00000000.00000000 | 255.240.0.0 | 2^20 – 2 |
| /14 | 11111111.11111100.00000000.00000000 | 255.252.0.0 | 2^18−2 |
| /16 | 11111111. 11111111.00000000. 00000000 | 255.255.0.0 | 216 - 2 |
| /18 | 11111111.11111111.11000000.00000000 | 255.255.192.0 | 2^14 -2 |
| /22 | 11111111.11111111.11111100.00000000 | 255.255.252.0 | 2^10 – 2 |
| /24 | 11111111. 11111111. 11111111.00000000 | 255.255.255.0 | 28 - 2 |
| /26 | 11111111.11111111.11111111.11000000 | 255.255.255.192 | 2^6 – 2 |
| /28 | 11111111.11111111.11111111.11110000 | 255.255.255.240 | 2^4 – 2 |
| /30 | 11111111.11111111.11111111.11111100 | 255.255.255.252 | 2^2 – 2 |

**Problem 2. IP Address Information**

Suppose we have a network address: 192.168.1.0/22

We can have some information related to this network as shown in the following table:

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| Subnet address | 11000000.10101000.00000000.00000000 | 192.168.0.0/22 |
| Subnet Mask | 11111111.11111111.11111100. 00000000 | 255.255.255.0 |
| First IP address | 11000000.10101000.00000000.00000001 | 192.168.0.1/22 |
| Last IP address | 11000000.10101000.00000011.11111110 | 192.168.3.254/22 |
| Broadcast IP address | 11000000.10101000.00000011.11111111 | 192.168.3.255/22 |
| Number of valid IP address for host |  | 1022 |
| Total number of IP address in the subnet |  | 1024 |

Repeat the above task with the following network address:

1. 172.200.0.0/20

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| Subnet address | 11000000.10101000.00000000.00000000 | 172.200.0.0/20 |
| Subnet Mask | 11111111.11111111.11110000.00000000 | 255.255.240.0 |
| First IP address | 11000000.10101000.00000000.00000001 | 172.200.0.1 |
| Last IP address | 10101100.11001000.00001111.11111110 | 172.200.15.254 |
| Broadcast IP address | 10101100.11001000.00001111.11111111 | 172.200.15.255 |
| Number of valid IP address for host |  | 2^12 – 2 = 4096 – 2 = 4094 |
| Total number of IP address in the subnet |  | 2^12 = 4096 |

1. 196.210.64.208/28

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| Subnet address | 11000100.11010010.01000000.11010000 | 196.210.64.208 |
| Subnet Mask | 11111111.11111111.11111111.11110000 | 255.255.255.240 |
| First IP address | 11000100.11010010.01000000.11010001 | 196.210.64.209 |
| Last IP address | 11000100.11010010.01000000. 11011110 | 196.210.64.222 |
| Broadcast IP address | 11000100.11010010.01000000. 11011111 | 196.210.64.223 |
| Number of valid IP address for host |  | 2^4 – 2 = 14 |
| Total number of IP address in the subnet |  | 2^4 = 16 |

1. 180.220.6.8/30

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| Subnet address | 10110100.11011100.00000110.00001000 | 180.220.6.8 /30 |
| Subnet Mask | 11111111.11111111.11111111.11111100 | 255.255.255.252 |
| First IP address | 10110100.11011100.00000110.00001001 | 180.220.6.9 |
| Last IP address | 10110100.11011100.00000110.00001010 | 180.220.6.10 |
| Broadcast IP address | 10110100.11011100.00000110.00001011 | 180.220.6.11 |
| Number of valid IP address for host |  | 2^2 - 2 = 2 |
| Total number of IP address in the subnet |  | 2^2 = 4 |

1. 176.230.153.159/21 (host IP address)

21 bit mạng, 21 bit đầu tiên của địa chỉ IP và phần còn lại sẽ là 0 để tìm ra địa chỉ subnet

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| Subnet address | 10110000.11100110.10011000.00000000 | 176.230.152.0 |
| Subnet Mask | 11111111.11111111.11111000.00000000 | 255.255.248.0 |
| First IP address | 10110000.11100110.10011000.00000001 | 176.230.152.1 |
| Last IP address | 10110000.11100110.10011111.11111110 | 176.230.159.254 |
| Broadcast IP address | 10110000.11100110.10011111.11111111 | 176.230.159.255 |
| Number of valid IP address for host |  | 2^11 – 2 = 2046 |
| Total number of IP address in the subnet |  | 2^11 = 2048 |

**Problem 3. IP Subneting based on number of hosts**

A network has an address: 172.30.80.0/20.

Divide the above network into small subnets with considering of the following requirement:

1. At least 100 PCs each subnet

Cần cho 7 bit cho phần host ( 2^7 – 2 = 126 IP )

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| # of Subnet | 11111111.11111111.11111111.10000000 | 255.255.255.128 |
| New Subnet Mask | 11111111.11111111.11111111.10000000 | 255.255.255.128 |
| Number of valid IP address for host in each subnet | 2^7 – 2 = 128 – 2 = 126 | 126 |
| Total number of IP address in each subnet | 2^7 = 128 | 128 |
| Subnet address (1st subnet) | 10101100.00011110.01010000.00000000 | 172.30.80.0 |
| First IP (1st subnet) | 10101100.00011110.01010000.00000001 | 172.30.80.1 |
| Last IP (1st subnet) | 10101100.00011110.01010000.01111110 | 172.30.80.126 |
| Broadcast IP (1st subnet) | 10101100.00011110.01010000.01111111 | 172.30.80.127 |
| Subnet address (last subnet) | 10101100.00011110.01010000.11111111 | 172.30.95.128 |
| First IP (last subnet) | 10101100.00011110.01010000.11111110 | 172.30.95.129 |
| Last IP (last subnet) | 10101100.00011110.01010000.11111110 | 172.30.95.254 |
| Broadcast IP (last subnet) | 10101100.00011110.01010000.11111111 | 172.30.95.255 |

1. At least 500 PCs each subnet

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| # of Subnet | 11111111.11111111.11111110.00000000 | 255.255.254.0 |
| New Subnet Mask | 11111111.11111111.11111110.00000000 | 255.255.254.0 |
| Number of valid IP address for host in each subnet | 2^9 - 2 = 512 - 2 = 510 | 510 |
| Total number of IP address in each subnet | 2^9 = 512 | 512 |
| Subnet address (1st subnet) | 10101100.00011110.01010000.00000000 | 172.30.80.0 |
| First IP (1st subnet) | 10101100.00011110.01010000.00000001 | 172.30.80.1 |
| Last IP (1st subnet) | |  | | --- | | 10101100.00011110.01010000.11111110 |  |  | | --- | |  | | 172.30.81.254 |
| Broadcast IP (1st subnet) | 10101100.00011110.01010000.11111111 | 172.30.81.255 |
| Subnet address (last subnet) | 10101100.00011110.01010001.11111000 | 172.30.81.248 |
| First IP (last subnet) | 10101100.00011110.01010001.11111001 | 172.30.81.249 |
| Last IP (last subnet) | 10101100.00011110.01010001.11111110 | 172.30.82.254 |
| Broadcast IP (last subnet) | |  | | --- | | 10101100.00011110.01010001.11111111 |  |  | | --- | |  | | 172.30.82.255 |

1. At least 1000 PCs each subnet

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| # of Subnet | 11111111.11111111.11111100.00000000 | 255.255.252.0 |
| New Subnet Mask | 11111111.11111111.11111100.00000000 | 255.255.252.0 |
| Number of valid IP address for host in each subnet | 2^10 - 2 = 1024 - 2 = 1022 | 1022 |
| Total number of IP address in each subnet | 2^10 = 1024 | 1024 |
| Subnet address (1st subnet) | 10101100.00011110.01010000.00000000 | 172.30.80.0 |
| First IP (1st subnet) | 10101100.00011110.01010000.00000001 | 172.30.80.1 |
| Last IP (1st subnet) | 10101100.00011110.01010000.11111110 | 172.30.83.254 |
| Broadcast IP (1st subnet) | 10101100.00011110.01010000.11111111 | 172.30.83.255 |
| Subnet address (last subnet) | 10101100.00011110.01010111.11111000 | 172.30.83.248 |
| First IP (last subnet) | 10101100.00011110.01010111.11111001 | 172.30.83.249 |
| Last IP (last subnet) | 10101100.00011110.01010111.11111110 | 172.30.84.254 |
| Broadcast IP (last subnet) | 10101100.00011110.01010111.11111111 | 172.30.84.255 |

Fill the following table for each case:

|  |  |  |
| --- | --- | --- |
| Content | Binary | Decimal |
| # of Subnet |  |  |
| New Subnet Mask |  |  |
| Number of valid IP address for host in each subnet |  |  |
| Total number of IP address in each subnet |  |  |
| Subnet address (1st subnet) |  |  |
| First IP (1st subnet) |  |  |
| Last IP (1st subnet) |  |  |
| Broadcast IP (1st subnet) |  |  |
| Subnet address (last subnet) |  |  |
| First IP (last subnet) |  |  |
| Last IP (last subnet) |  |  |
| Broadcast IP (last subnet) |  |  |

**Problem 4. IP Subneting for LAN requirement**

A company has a network of **10.114.20.0/22** that needs to provide IP addressing for 3 LAN as follows:

* LAN1 has 120 PCs

|  |  |
| --- | --- |
| Content | Result |
| Subnet address | 10.114.21.0/25 |
| Subnet Mask | 255.255.255.128 |
| First IP address | 10.114.21.1 |
| Last IP address | 10.114.21.126 |
| Broadcast IP address | 10.114.21.127 |
| Number of valid IP address for host | 126 |
| Total number of IP address in the subnet | 128 |

* LAN2 has 150 PCs

|  |  |
| --- | --- |
| Content | Result |
| Subnet address | 10.114.20.0/24 |
| Subnet Mask | 255.255.255.0 |
| First IP address | 10.114.20.1 |
| Last IP address | 10.114.20.254 |
| Broadcast IP address | 10.114.20.255 |
| Number of valid IP address for host | 254 |
| Total number of IP address in the subnet | 256 |

* LAN3 has 30 PCs

|  |  |
| --- | --- |
| Content | Result |
| Subnet address | 10.114.21.128/27 |
| Subnet Mask | 255.255.255.224 |
| First IP address | 10.114.21.129 |
| Last IP address | 10.114.21.158 |
| Broadcast IP address | 10.114.21.159 |
| Number of valid IP address for host | 30 |
| Total number of IP address in the subnet | 32 |

Use VLSM technique to provide subnet that satisfies the company requirement.

Fill the following table with the result for each LAN:

|  |  |
| --- | --- |
| Content | Result |
| Subnet address |  |
| Subnet Mask |  |
| First IP address |  |
| Last IP address |  |
| Broadcast IP address |  |
| Number of valid IP address for host |  |
| Total number of IP address in the subnet |  |