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| **Practicum Case** |  |
| CPEN6220  Computer Networks & Information Security |
| **Computer Engineering** | **O221-CPEN6098-PH01-02** |
| ***Valid on*** *Odd Semester Year 2021/2022* | **Revision 00** |

## Learning Outcomes

* Basic concepts of network
* Concepts of create network environment
* Basic structures of network

## Topic

* Basic Subnetting

## Subtopics

* IP Addressing
* Classful Subnetting (FLSM)
* Creating LAN
* Exercises

## Soal

*Case*

1. IP Addressing

An IP address is a unique number that is representing a device on the internet or a local network. An IP address consists of a 32-bit binary number or a string of numbers that are separated by periods For example, an IP address can be a form of binary number which is 11000000.10101000.00010000.00111100, or can also be in a form of a four-string of number which is 192.168.16.60. Normally, the four-string of number is often more used because of readability issues. The previous IP address is an IPv4 address. IPv4 address has a maximum value of 232 which is roughly 4.3 billion. Therefore, the IPv6 address was found due to the fear of running out of space. The difference is that IPv6 uses a 128-bit binary number to store the address meaning there is a total of 2128 unique addresses or roughly 340 duo decillion.

In IPv4 address, there are five classes available, class A, class B, class C, class D, and class E. But, mostly only class A, class B, and class C are being used. Below is the IP range for each class

|  |  |  |
| --- | --- | --- |
| Class | Range | Default Subnet Mask |
| Class A | 1.0.0.0 – 126.255.255.255 | 255.0.0.0 |
| Class B | 128.0.0.0 – 191.255.255.255 | 255.255.0.0 |
| Class C | 192.0.0.0 – 223.255.255.255 | 255.255.255.0 |
| Class D | 224.0.0.0 – 239.255.255.255 | - |
| Class E | 240.0.0.0 – 255.255.255.255 | - |

* Class A

Class A is used when there are a large number of a host in the network. The first octet (8 bit) is used to identify the number, meanwhile, the remaining 24 bits are used for the host in that network. Therefore, a class A network can have a total of 126 networks and a total of 224 – 2 (16777214) hosts for each network. For example, there is a class A IP address which is 100.168.100.25. The first number which is 100 identify the network meanwhile the remaining number which is 168.100.25 identify the host.

* Class B

Class B will be used for a medium-sized network. In the class B address, the first two octets will be used to identify the network and the remaining two-octet will be used to identify the host. The first octet from class B will always be assigned to a value of 128 to 191. Therefore, there can be a total of 16384 networks and a total of 216 – 2 (65534) hosts for each network. An example of a class B address is 150.100.12.25. The first two number which is 150.100 will identify the network and the remaining two number which is 12.25 will identity the host.

* Class C

Class C will be used for a small local area network. A class C network will be using the first three octets to identity the network and the remaining one octet to identify the host. Therefore, there can be a total of 2097152 networks and 28 – 2 (254) hosts for each network. An example of this class is 192.168.100.12. The first three number which is 192.168.100 will identity the network and the last number which is 12 will identify the host.

* Class D

Class D is not allocated to the host but is used for multicasting and never for regular networking. Multicast is sending a packet to a group of devices that is in the same multicast group. Therefore, because there is no requirement to extract host address, so the class D does not have any default subnet mask

* Class E

Class E is reserved and not available for general uses. They are only reserved for research purposes. This class also does not have any default subnet mask.

1. Subnetting

Subnetting is dividing a network into a smaller network. This helps with the routing efficiency and also helps to enhance the security of the network. One of the methods of subnetting is FLSM (Fixed Length Subnet Mask). Below are the steps to perform FLSM,

To give an example of FLSM, we will be using the following case,

Network Address = 192.168.100.0

Subnet Mask = /24

= 255.255.255.0

Requirements:

* Staffroom needs 32 host
* The front office needs 10 host
* Admin room needs 5 host

1. Determine the highest host

For this case, the highest needed host is for the staff room which is 32 hosts.

1. Determine the new subnet mask

To determine the new subnet mask, we will be using the following formula

For this case, because we need a total of 32 hosts, then the formula will be as the following,

h is 6 because 6 is the smallest power of two that is larger than the needed number of the host. After that, we will find the new subnet mask for our network. The formula to find a new subnet mask is shown below,

Where h is the smallest power of 2 that is larger than the needed host that we have calculated earlier.

n will be the number of 1 in our total bit number, so the final subnet mask will be

11111111.11111111.11111111. 11000000

Or

255.255.255.192

1. Determine each network IP host

After the new subnet mask has been found, then we can proceed to the next step which is determining the network IP for each host.

|  |  |  |  |
| --- | --- | --- | --- |
| Host | Network Address | Broadcast Address | Usable IP |
| Staff Room | 192.168.100.0 | 192.168.100.63 | 192.168.100.1 – 192.168.100.62 |
| Front Office | 192.168.100.64 | 192.168.100.127 | 192.168.100.65 – 192.168.100.126 |
| Admin Room | 192.168.100.128 | 192.168.100.191 | 192.168.100.129 – 192.168.100.190 |

* The first usable IP will be used as the network address
* The last usable IP will be used as the broadcast address
* The usable IP will be the remaining IP address

1. Variable Length Subnet Mask (VLSM)

VLSM or Variable Length Subnet Mask is a subnetting technique similar to FLSM (Fixed Length Subnet Mask). The difference between VLSM and FLSM is, in VLSM we can have different sizes of a subnet. Therefore, we can have a subnet for the needed amount of hosts.

For example we have the following case,

Network Address = 199.10.15.0

Subnet Mask = /24

Requirements:

* Staffroom needs 47 hosts
* Admin room needs 12 hosts
* The front office needs 27 hosts

1. Sort the host in a descending order

Staffroom: 47 hosts

Front office: 27 hosts

Admin room: 12 hosts

1. Find the new subnet for each network

For finding a new subnet, we will be using the following formula,

* Staffroom

New subnet mask:

11111111.11111111.11111111. 11000000

Or

255.255.255.192

* Admin room

New subnet mask:

11111111.11111111.11111111. 11100000

Or

255.255.255.224

* Front office

New subnet mask:

11111111.11111111.11111111. 11110000

Or

255.255.255.240

1. Determine each network IP host

After the new subnet mask has been found, then we can proceed to the next step which is determining the network IP for each host.

|  |  |  |  |
| --- | --- | --- | --- |
| Host | Network Address | Broadcast Address | Usable IP |
| Staff Room | 199.10.15.0 | 199.10.15.63 | 199.10.15.1 - 199.10.15.62 |
| Front Office | 199.10.15.64 | 199.10.15.95 | 199.10.15.65 – 199.10.15.94 |
| Admin Room | 199.10.15.96 | 199.10.15.111 | 199.10.15.97 – 199.10.15.110 |

1. Case

Quantum & Clock is a new startup company that recently moved to a new building. Therefore, they will need a new computer network in the new building. There will be 4 rooms in the building each with its network. Those networks will be under the main network which network address is 192.168.36.0/24. The details of each room will be written below,

* Staffroom – 68 computers
* IT room – 27 computers
* Designer room – 33 computers
* Operational room – 12 computers

With the room details already explained above, the CEO of Quantum & Clock wanted you to do the following task,

1. Create a new subnet mask for every network above using FLSM and VLSM.
2. Open the .pka file and follow the instruction written inside the file to create a LAN connection. Make sure that each device can connect.

