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|---|---|
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| Team Assignment | Networking Fundamentals Assignment |

## SOLUTION TO NETWORKING FUNDAMENTALS ASSIGNMENT

## Question One

### 1.0 Address Class Identification

| Address | Class |
|---|---|
| 10.250.1.1 | A |
| 150.10.15.0 | B |
| 192.14.2.0 | C |
| 148.17.9.1 | B |
| 193.42.1.1 | C |
| 126.8.156.0 | A |
| 220.200.23.1 | C |
| 230.230.45.58 | C |
| 177.100.18.4 | B |
| 119.18.45.0 _ | B |
| 249.240.80.78 | E |
| 199.155.77.56 | B |
| 117.89.56.45 | A |
| 215.45.45.0 | C |
| 199.200.15.0 | C |
| 95.0.21.90 | A |
| 33.0.0.0 | A |
| 158.98.80.0 | B |
| 219.21.56.0 | C |

## Question Two

2.0 Using the IP address and subnet mask shown write out the network address:

188.10.18.2 _____188.10.0.0
255.255.0.0

10.10.48.80 _____10.10.48.0
255.255.255.0

192.149.24.191 _____ 192.149.24.0
255.255.255.0

150.203.23.19 _____150.203.0.0
255.255.0.0

10.10.10.10 _____ 10.0.0.0
255.0.0.0

186.13.23.110 _____186.13.23.0
255.255.255.0

223.69.230.250 _____223.69.0.0
255.255.0.0

200.120.135.15 _____200.120.135.0
255.255.255.0

27.125.200.151 _____ 27.0.0.0
255.0.0.0

199.20.150.35 _____ 199.20.150.0
255.255.255.0

191.55.165.135 _____191.55.165.0
255.255.255.0

28.212.250.254 _____ 28.212.0.0

255.255.0.0

## Question Three

3.0 Subnetting

### i) Number of needed usable hosts 14 === Network Address 192.168.50.0

Solution:

*Comment: Since the question is in regards to usable host, we use the principle of power of two minus two.*

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = C
- Default Subnet Mask = 255.255.255.0
- n = 4 which will be 16 – 2 which will accommodate 14 usable hosts.
- Incremental Value = 16 which lowest bit after 4bit given to host on octet 4(32 bit block).
- Legend: Green color of usable host represents the answer.

| Subnets | Network Address | Subnet Mask | Usable host (14) | Broadcast Address |
|---|---|---|---|---|
| 1 | 192.168.50.0 | 255.255.255.240 | 192.168.50.1 – 192.168.50.14 | 192.168.50.15 |
| 2 | 192.168.50.16 | 255.255.255.240 | 192.168.50.17 – 192.168.50.30 | 192.168.50.31 |
| 3 | 192.168.50.32 | 255.255.255.240 | 192.168.50.33 – 192.168.50.46 | 192.168.50.47 |
| 4 | 192.168.50.48 | 255.255.255.240 | 192.168.50.49 – 192.168.50.62 | 192.168.50.63 |
| 5 | 192.168.50.64 | 255.255.255.240. | 192.168.50.65 – 192.168.50.78 | 192.168.50.79 |

### ii) Number of needed usable hosts 60 Network Address 165.100.0.0

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = B
- Default Subnet Mask = 255.255.0.0
- n = 6 which will be 64 – 2 which will accommodate 60 usable hosts.
- Incremental Value = 64 which lowest bit after 6bit given to host on octet 3(24 bit block).
- Legend: Green color of usable host represents the answer.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 165.100.0.0 | 255.255.0.192 | 165.100.0.1 – 165.100.0.62 | 165.100.0.63 |
| 2 | 165.100.0.64 | 255.255.0.192 | 165.100.0.65 – 165.100.0.126 | 165.100.0.127 |
| 3 | 165.100.0.128 | 255.255.0.192 | 165.100.0.129 – 165.100.0.190 | 165.100.0.191 |

### iii) Number of needed subnets 6
### Network Address 210.100.56.0

**Solution:**

- $2^n$ , here n = number of ones since we are interested in subnets
- IP Class = C
- Default Subnet Mask = 255.255.255.0
- Subnet mask = 255.255.255.224
- n = 3 which will be 8 which will accommodate 6 subnets.
- Incremental Value = 32 which lowest bit after 3bit given to host on octet 4(32 bit block).
- Legend: Green color represents the subnets.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 210.100.56.0 | 255.255.255.224 | 210.100.56.1 – 210.100.56.30 | 210.100.56.31 |
| 2 | 210.100.56.32 | 255.255.255.224 | 210.100.56.33 – 210.100.56.62 | 210.100.56.63 |
| 3 | 210.100.56.64 | 255.255.255.224 | 210.100.56.65 – 210.100.56.94 | 210.100.56.95 |
| 4 | 210.100.56.96 | 255.255.255.224 | 210.100.56.97 – 210.100.56.126 | 210.100.56. 127 |
| 5 | 210.100.56.128 | 255.255.255.224 | 210.100.56.129 – 210.100.56.158 | 210.100.56. 157 |
| 6 | 210.100.56.160 | 255.255.255.224 | 210.100.56.161 – 210.100.56.190 | 210.100.56.191 |
| 7 | 210.100.56. 192 | | | |
| 8 | 210.100.56. 224 | | | |

### iv) Number of needed usable hosts 30
### Network Address 195.85.8.0

**Solution:**

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = C
- Default Subnet Mask = 255.255.255.0
- Subnet mask = 255.255.255.224
- n = 5 which will be 32 – 2 = 30, which will accommodate 30 usable hosts.
- Incremental Value = 32 which lowest bit after 5bit given to host on octet 4(32 bit block).
- Legend: Green color of usable host represents the answer.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 195.85.8.0 | 255.255.255.224 | 195.85.8.1 - 195.85.8.30 | 195.85.8.31 |
| 2 | 195.85.8.32 | 255.255.255.224 | 195.85.8.33 - 195.85.8.62 | 195.85.8.63 |
| 3 | 195.85.8.64 | 255.255.255.224 | 195.85.8.65 - 195.85.8.94 | 195.85.8.95 |
| 4 | 195.85.8.96 | 255.255.255.224 | 195.85.8.97 – 195.85.8.126 | 195.85.8.127 |

### v) Number of needed usable hosts 15
### Network Address 178.100.0.0

**Solution:**

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = B
- Default Subnet Mask = 255.255.0.0
- Subnet mask = 255.255.255.224
- n = 5 which will be 32 – 2 = 30, which will accommodate 15 usable hosts.
- Incremental Value = 32 which lowest bit after 5bit given to host on octet 4(32 bit block).
- Legend: Green color of usable host represents the answer.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 178.100.0.0 | 255.255.255.224 | 178.100.0.1 - 178.100.0.30 | 178.100.0.31 |
| 2 | 178.100.0.32 | 255.255.255.224 | 178.100.0.33 - 178.100.0.62 | 178.100.0.63 |
| 3 | 178.100.0.64 | 255.255.255.224 | 178.100.0.65 - 178.100.0.94 | 178.100.0.95 |
| 4 | 178.100.0.96 | 255.255.255.224 | 178.100.0.97 – 178.100.0.126 | 178.100.0.127 |

### vi) Number of needed usable hosts 45
### Network Address 200.175.14.0

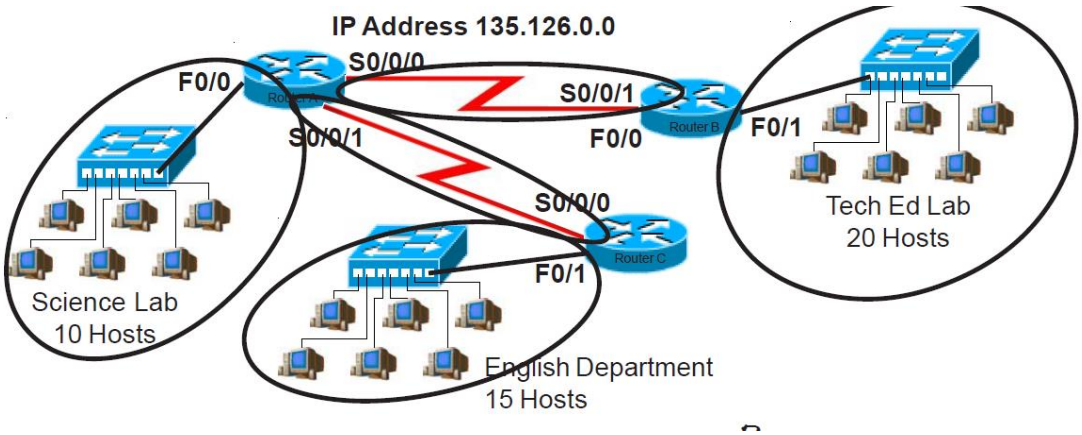
**Solution:**

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = C
- Default Subnet Mask = 255.255.255.0
- Subnet mask = 255.255.255.192
- n = 6 which will be 64 – 2 = 62, which will accommodate 45 usable hosts.
- Incremental Value = 64 which lowest bit after 6bit given to host on octet 4(32 bit block).
- Legend: Green color of usable host represents the answer.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 200.175.14.0 | 255.255.255.192 | 200.175.14.1 - 200.175.14.62 | 200.175.14.63 |
| 2 | 200.175.14.64 | 255.255.255.192 | 200.175.14.65 - 200.175.14.126 | 200.175.14.127 |
| 3 | 200.175.14.128 | 255.255.255.192 | 200.175.14.129 - 200.175.14.190 | 200.175.14.191 |

## 4.0 **Practical Subnetting**

i) Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 30% growth in all areas. Circle each subnet on the graphic and answer the questions below.




**Solution:**
The IP address: 135.126.0.0
Class = B
Subnet Mask: 255.255.0.0, have $2^{16}$ = 655,536 i.e. over 65,000 hosts.
To create extra subnet and that allow for at least 30% growth; this means that for any unit(lab or department) in the school, the subnet should be able to take minimum of 10 and 30% increase will be accommodated. This means:

- For Science Lab with 10 hosts, 1.3 * 10 = 13, 1.3*13 = 16.9 approx. 17
- For English Department with 15 hosts, 1.3 * 15 = 19.5, 1.3 * 19.5 = 25.35
- For Tech Ed Lab with 20 hosts, 1.3 * 20 = 26

From above, at 30% growth rate, the max host to achieve is 26. This implies $2^5 - 2 = 30$. So, n = 5 will give a host that will allow 30% which is octet 3 with 24 bits and above. 32 bit of whole octets – 5bit for 30% growth rate host = 27bits. Therefore, we would subnet the IP block to **/27** which is a block size of 32 bits.

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = B
- Default Subnet Mask = 255.255.0.0
- Subnet mask = 255.255.255.224
- n = 5 which will be 32 – 2 = 30, which will accommodate 45 max usable hosts.
- Incremental Value = 32 which lowest bit after 5bit given to host on octet 4(32 bit block).
- Legend: Green color of usable host represents the answer.

| Subnets | Network Address | Subnet Mask | Usable host (32) | Broadcast Address |
|---|---|---|---|---|
| 0 | 135.126.0.0 | 255.255.255.224 | **135.126.0.1 - 135.126.0.30** | 135.126.0.31 |
| 1 | 135.126.0.32 | 255.255.255.224 | **135.126.0.33 - 135.126.0.62** | 135.126.0.63 |
| 2 | 135.126.0.64 | 255.255.255.224 | **135.126.0.65 - 135.126.0.94** | 135.126.0.95 |
| 3 | 135.126.0.96 | 255.255.255.224 | **135.126.0.97 - 135.126.0.126** | 135.126.0.127 |

Based on the above table, we choose to do the following assignment,

- **Tech Ed Lab** = subnet 1 === 30 hosts. (Allows for about 30% growth from 20 hosts)

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 135.126.0.32 | 255.255.255.224 | **135.126.0.1 - 135.126.0.30** | 135.126.0.63 |

- **English Department:** = subnet 2 == 30 hosts (which allows for 30% growth from 15 hosts)

| Subnets | Network Address | Subnet Mask | Usable host (14) | Broadcast Address |
|---|---|---|---|---|
| 2 | 135.126.0.64 | 255.255.255.224 | **135.126.0.65 - 135.126.0.94** | 135.126.0.95 |

If we take the subnet of 135.126.0.96 255.255.255.224. and break it down further to get a block of 16 hosts for **science lab**. We use 16bit increment which is lowest bit after taking n = 4 to get 30% growth rate from 15 host.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 0 | 135.126.0.96 | 255.255.255.240 | **135.126.0.97 - 135.126.0.110** | 135.126.0.111 |
| 1 | 135.126.0.112 | 255.255.255.240 | **135.126.0.113 - 135.126.0.126** | 135.126.0.127 |

- **Science Lab** = 135.126.0.96 255.255.255.224 (/28) at 4bits increment since we gave 6 zeros to get 10 hosts with 30% growth rate.

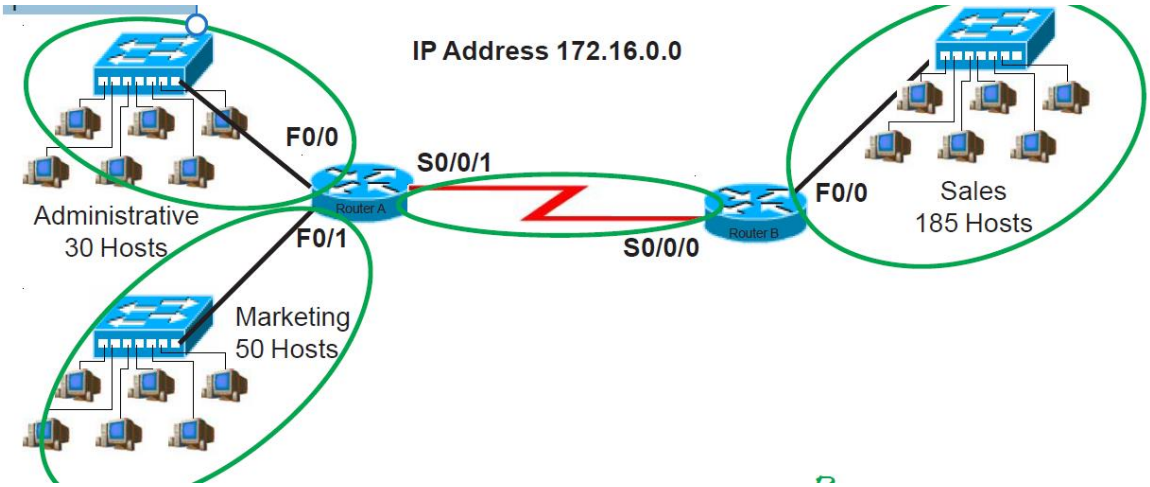
Finally, subnet; 135.126.0.112 255.255.255.240 and break it down further to get a block size of 4bit (2 usable hosts).

**255.255.255.252** which is **135.126.0.252** is the last subnet we can get from 135.126.0.0 that will give 30% growth across various school units.

(/30) networks

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 0 | 135.126.0.112 | 255.255.255.252 | **135.126.0.113 - 135.126.0.114** | 135.126.0.115 |
| 1 | 135.126.0.116 | 255.255.255.252 | **135.126.0.113 - 135.126.0.114** | 135.126.0.119 |
| 2 | 135.126.0.120 | 255.255.255.252 | **135.126.0.113 - 135.126.0.114** | 135.126.0.123 |
| 3 | 135.126.0.124 | 255.255.255.252 | **135.126.0.113 - 135.126.0.114** | 135.126.0.127 |

ii) Based on the information in the graphic shown, design a classfull network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 25% growth in all areas. Circle each subnet on the graphic and answer the
Questions below:




**Solution:**

The IP address: 172.16.0.0
Class = B
Subnet Mask: 255.255.0.0, have $2^{16}$ = 655,536 i.e. over 65,000 hosts.
To create extra subnet and that allow for at least 30% growth; this means that for any unit (administrative, Sales or marketing), the subnet should be able to take minimum of 30 and 30% increase will be accommodated. This means:

- For Administrative with 30 hosts, 1.3 * 30 = 39, 1.3*39 = 50.7 approx. 51
- For Marketing with 50 hosts, 1.3 * 15 = 65, 1.3 * 65 = 84.5
- For Sales with 185 hosts, 1.3 * 185 = 240.5

From above, at 30% growth rate, the max host to achieve is 240. This implies $2^8 - 2 = 254$. So, n = 8 will give a host that will allow 30% which is octet 3 with 24 bits and above. 32 bit of whole octets – 8bit for 30% growth rate host = 24bits. Therefore, we would subnet the IP block to **/24** which is a block size of 24bits.

- $2^n - 2$, here n = number of zeros since we are interested in usable host
- IP Class = B

- Default Subnet Mask = 255.255.0.0
- Subnet mask = 255.255.255.0
- n = 8 which will be 256 – 2 = 254, which will accommodate 254 max usable hosts.
- Legend: Green color of usable host represents the answer.

Available IP Block = 172.16 .0.0, with default subnet = 255.255.0.0

Sales department will require a minimum block size of 256($2^8$)

New subnets ➔ 255.255.254.0 (/23)

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 172.16 .0.0 | 255.255.254.0 | **172.16 .0.1 - 172.16 .0.254** | 172.16 .1.255 |

- For, **Sales =172.16 .0.0 255.255.254.0 (/23)**

Provides 254 usable host addresses. Gives room for about for over 30% growths.

- Subnet 1: **172.16 .0.0, 255.255.254.0** broken down further to smaller subnet to provide block size of 64 which serves for Administrative and Marketing department

New Subnets, 255.255.255.192 (/26) will serve **Administrative** of 30 hosts and allowing 30% growth rate.

| Subnets | Network Address | Subnet Mask | Usable host | Broadcast Address |
|---|---|---|---|---|
| 1 | 172.16 .255.0 | 255.255.255.192 | **172.16 .255.1 - 172.16 .255.62** | 172.16 .255.63 |
| 2 | 172.16 .255.64 | 255.255.255.192 | **172.16 .255.65 - 172.16 .255.126** | 172.16 .255.127 |
| 3 | 172.16 .255.128 | 255.255.255.192 | **172.16 .255.129 - 172.16 .255.190** | 172.16 .255.191 |

- For **Administrative Dept. = 172.16 .255.0 255.255.255.192** (/26) = 62 usable host addresses which will allow 30% growth rate.
- For **Marketing = 172.16** .255.0 **255.255.255.192** (/25) = 128 usable host addresses which will accommodate 30% growth rate
- Finally, the subnet 172.16.255.128 255.255.255.128; will be given to Marketing department and it will allow 30% growth of usable host

| Subnets | Network Address | Subnet Mask | Usable host (2) | Broadcast Address |
|---|---|---|---|---|
| 1 | 172.16 .255.128 | 255.255.255.128 | **172.16.255.129 - 172.16 .255.254** | 172.16 .2.131 |

**The end**

**Solution presented by Team-K8S.**