UNIT-2

SUBNETTING NUMERICALS:

* FIXED LENGTH SUBNET MASK (FLSM - EQUAL SIZED SUBNETS)

CLASSLESS ADDRESSING:

Q 1) Using Class "C" Address:

An organization is granted with the IP address 192.16.2.0/24. The administrator wants to create 4 Subnets. Calculate the following.

1) Find the Subnet Mask
2) No. of hosts in each Subnet
3) First and Last host address of each Subnet.
4) Network and Broadcast address of each Subnet.

SOLUTION:

Given is class "c" address

192.16.2.0/24

Need to create 4 Subnets.

To find "n": $2^n \geq$ No. of Subnets

$2^n \geq 4$

No. of network bits: $n = 2$

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n ⇒ No. of host bits to be borrowed.

∴ '2' bits to be borrowed.

1) To find Subnet Mask:

192.16.2.00000000 /26

(2 bits borrowed)

Net id | Host id

∴ Subnet Mask is

11111111.11111111.11111111.11000000

(or) 255.255.255.192

2) To find no. of hosts in each Subnet(h):

No. of host bits (h) = 6

∴ Total No. of hosts = 2^6 = 64

No. of usable (or) Valid hosts = 64 − 2 (Excluding Network + Broadcast address)

= 62

3) To find the First host, Last host, Network and Broadcast Address:

192.16.2.[00]000000

Remains Unchanged

00
01
10
11

⇒ Four Subnets.

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* Subnet (1) : 00

Net id : 192.16.2.00000000

192.16.2.0/26

Broadcast : 192.16.2.00111111

192.16.2.63/26

∴ First Host : 192.16.2.1/26

Last Host : 192.16.2.62/26

* Subnet (2) : 01

Net id : 192.16.2.01|000000

192.16.2.64/26

Broadcast : 192.16.2.01/111111

192.16.2.127/26

First Host : 192.16.2.65/26

Last Host : 192.16.2.126/26

* Subnet (3) : 10

Net id : 192.16.2.10/000000

192.16.2.128/26

Broadcast : 192.16.2.01/111111

192.16.2.191/26

First Host : 192.16.2.129/26

Last Host : 192.16.2.190/26

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* Subnet (4) : 11

Net id : 192.16.2.11 /000000

192.16.2.192/26

Broadcast : 192.16.2.11/111111

192.16.2.255/26

First Host : 192.16.2.193/26

Last Host : 192.16.2.254/26

Q

2) Using class "B" address

IPaddress : 172.168.0.0/16

Create 32 Subnets.

To find n :

$2^n \geq 32$

$\boxed{n = 5}$

172.168.00000|000.000

1) To find Subnet Mask:

255.255.248.0

11111111.11111111.11111000.00000000

2) To find the number of hosts in each Subnet.

No. of host bits = 11 bits

∴ Total No. of hosts = 2^{11} = 2048

No. of usable hosts = 2048 − 2 = 2046

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3) To find the network, Broadcast, First Host and Last Host address of first and Last Subnet

a) Subnet 00000: [FIRST SUBNET]

Net id : 172.168. 00000/000.00000000

172.168.0.0

First Host id: 172.168.1.0

Last Host id: 172.168.6.254

Broadcast id: 172.168. 00000/111.11111111

172.168.7.255

b) Subnet 11111 : [LAST SUBNET]

Net id: 172.168. 11111/000.00000000

172.168.248.0

First Host id: 172.168.248.1

Last Host id: 172.168.255.254

Broadcast id: 172.168. 11111/111.11111111

172.168.255.255

Q3) Using class A Address:

An organization is granted with IP address 10.0.0.0/21. The administrator wants to create 200 fixed length subnets.

(i) First and Last Network's Address

(ii) Usable first and last host ID for the first and last network

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(iii) Broadcast id for the first & Last Network.

(iv) How many no. of hosts possible to connect in each network.

SOLUTION: N/w address

(i) Subnet 1: 10.0.0.0

Subnet 200 : 10.0.00000110.00111
199

(ie) 10.0.6.56

200 no. of subnet means from 0 to 199

(ii) First network

FH - First Host
LH - Last Host

FH : 10.0.0.1

LH : 10.0.0.6

No. of hosts in each Subnet $= 2^h = 2^3 = 8$

So 10.0.0.0 to 10.0.0.7

FH is => 10.0.0.1

LH is => 10.0.0.6

LAST SUBNET:

FH : 10.0.6.57

LH : 10.0.6.62

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(iii) Broadcast id:

for First Subnet : 10.0.0.7

for Last Subnet (200th) : 10.0.6.63

(iv) How many hosts?

$2^n = 2^3 =$ 8 hosts.

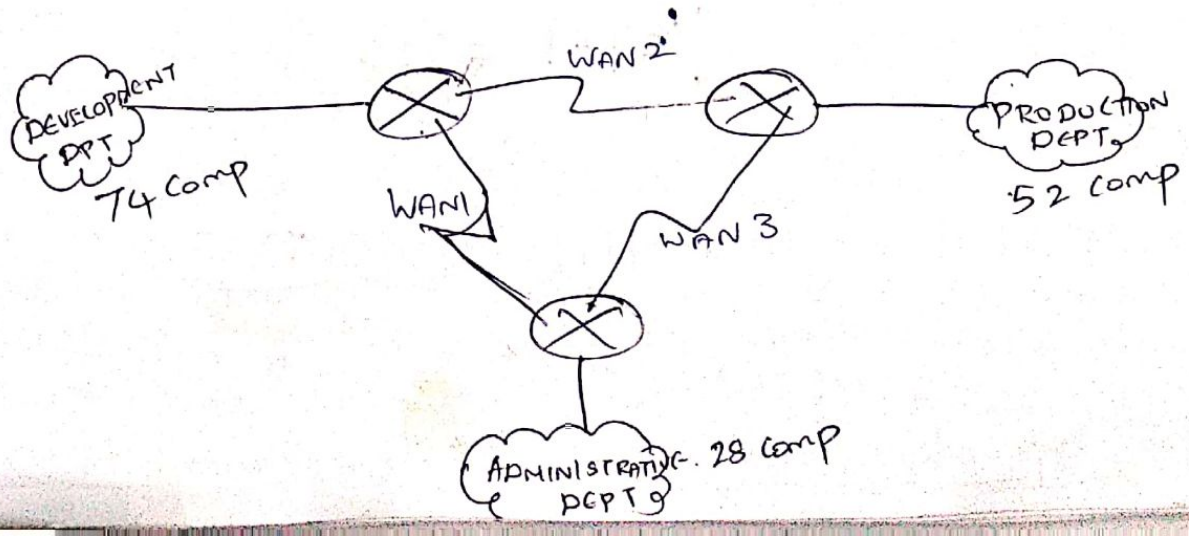
VLSM (VARIABLE LENGTH SUBNET MASK)

CLASS C

Q 1) Assume you are a network administrator at a Software Company, ~~for~~ which has three departments Connected via WAN Link & granted with 192.16.1.0.

* Development department has 74 Computers
* Production department has 52 computers
* Administrative department has 28 Computers.

All departments are Connected with each other via WAN Link. Each WAN Link requires two IP addresses.



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SOLUTION:

* Step 1:

First order all networks according to the host requirement (i.e) in Descending order (Largest to Smallest)

Subnet	Segment	Hosts
1	Development	74 + 2 (Net id + Broadcast id)
2	Production	52 + 2
3	Administrative	28 + 2
4	WAN Link 1	2
5	WAN Link 2	2
6	WAN Link 3	2

CLASS C ADDRESS: 192.16.1.00000000

(2)
74
52
28
2
2
2
160

Class "c" Address is enough

(i) Development: (76 hosts)

Formula: $2^h \geq 76$

$h = 7$ host bits

Hence CIDR is /24+1 = /25

∴ Customized subnet mask is

11111111.11111111.11111111.10000000

Network bits (25) | Host bits (7)

=> 255.255.255.128/25 New Subnet mask

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Range of Address

- Hence Netid : 192.16.1.0
  FH : 192.16.1.1
  LH : 192.16.1.126
  Broadcast : 192.16.1.127

*(ii) PRODUCTION DEPARTMENT : (54 Hosts)

$2^h \geq 54$

$\therefore \boxed{h = 6}$ [Host bits]

Hence CIDR is /24+2 = /26

Customized Subnet mask is

11111111.11111111.11111111.11000000

Network bits (26) | Host bits (6)

=> $\boxed{255.255.255.192/26}$ => New Subnet Mask.

Range of Address

Netid : 192.16.1.128
FH : 192.16.1.129
LH : 192.16.1.190
Broadcast id : 192.16.1.191

*(iii) ADMINISTRATIVE DEPARTMENT: (30 Hosts) (28+2)

$2^h \geq 30$

$\therefore \boxed{h = 5}$ [Host bits]

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Hence

CIDR is /24+3 = /27

Customized Subnet mask is

11111111.11111111.11111111.111,00000

Network bits (27) | Host bits (5)

New Subnet Mask will be } 255.255.255.224 /27

Range of Address

Net id : 192.16.1.192

First Host: 192.16.1.193

Last Host: 192.16.1.222

Broadcast id : 192.16.1.223

Q2) CLASS B.

Assume that you are a network administrator at Technosoft Solutions. The Company has 4 floors, which are Connected with each other via WAN links and it has been granted with an IP address 172.16.0.0. DO the Subnetting for given IP address satisfying all floor's requirements.

1. Call-centre floor needs 4000 hosts
2. Data-centre floor needs 2000 hosts
3. Operations floor needs 1000 hosts
4. Executive office floor needs only 100 hosts
5. Each WAN link requires two IP addresses.

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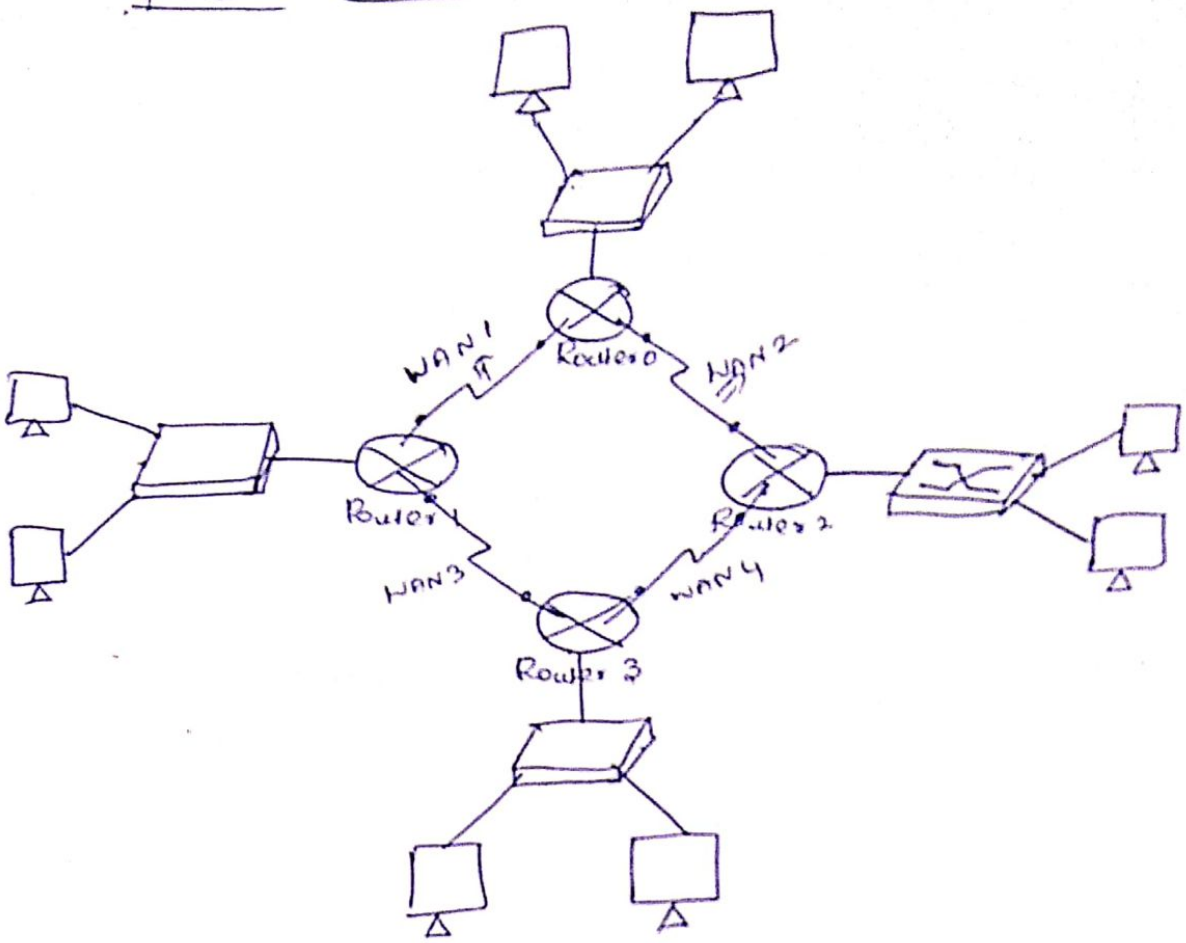
Network Scenario



Soln:

Given the no. of hosts as 4000, 2000, 1000 & 100. Given class B (172.16.0.0) network. So default Mask is 255.255.0.0.

(i) For 4000 hosts:

$2^h - 2 \geq 4000$,

$\therefore \boxed{h = 12}$

CIDR is /20

Customized subnet mask will be

11111111.11111111.1111 0000.00000000

(ii) 255.255.240.0

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Block Size is $2^{12} = 4096$

Formula ∴ No. of Blocks = $\frac{2^h}{256}$

$= \frac{4096}{256}$

$= 16$ blocks.

Hence the range is

172.16.0.0/20 to 172.16.15.255/20 for 4000 hosts

(ii) For 2000 hosts:

$2^h - 2 \geq 2000$

$h = 11$ (host bits)

CIDR is /21

Customized Subnet mask will be

11111111.11111111.11111000.00000000

(i.e) 255.255.248.0

Block Size is $2^{11} = 2048$

∴ No. of Blocks = $\frac{2^h}{256}$

$= \frac{2048}{256}$

$= 8$ blocks

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Hence the range is

172.16.16.0/21 to 172.16.23.255/21

for 2000 hosts.

(iii) For 1000 hosts:

$2^h - 2 \geq 1000$

$\therefore$ $h = 10$ (host bits)

$\therefore$ CIDR is /22

Customized Subnet mask is

11111111.11111111.11111100.00000000

(i.e) 255.255.252.0

Block size is $2^h = 2^{10} = 1024$

No. of Blocks $= \frac{2^h}{256}$

$= \frac{1024}{256}$

$= 4$ blocks

Hence the range is

172.16.24.0/22 to 172.16.27.255/22

for 1000 hosts

Hence the Complete range will be:

172.16.0.0/20 to 172.16.15.255/20 [4000 Hosts]

172.16.16.0/21 to 172.16.23.255/21 [2000 Hosts]

172.16.24.0/22 to 172.16.27.255/22 [1000 Hosts]

172.16.28.0/25 to 172.16.28.127/25 [100 hosts]

172.16.28.128/25 to 172.16.28.131/25 for WAN 1

172.16.28.132/25 to 172.16.28.135/25 for WAN 2

172.16.28.136/25 to 172.16.28.139/25 for WAN 3

172.16.28.140/25 to 172.16.28.143/25 for WAN 4

Q3) CLASS A Example

Requirements given as 5000, 2500, 3000, 100, 50, 10 hosts

Consider class A IP address. (for eg: 10. network)

Step 1:

First order the requirements in descending order.

5000 → Subnet (1)
3000 → Subnet (2)
2500 → Subnet (3)
100 → Subnet (4)
50 → Subnet (5)
10 → Subnet (6)
WAN1 → Subnet (7)
WAN 2 → Subnet (8)
WAN 3 → Subnet (9)

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* Subnet (1) : 5000 hosts.

$2^h - 2 \geq 5000$

$2^{13} = 8192$

Host bits, $\boxed{h = 13}$

CIDR : /19

Subnet Mask : 11111111.11111111.11100000.00000000

255.255.224.0

No. of blocks = $\frac{2^h}{256}$

$= \frac{8192}{256}$

$\boxed{\therefore \text{No. of blocks} = 32}$

Range of Address :

10.0.0.0 to 10.0.31.255

* Subnet (2) : 3000 hosts

$2^h - 2 \geq 3000$

$\boxed{h = 12}$

CIDR : /20

Subnet Mask : 255.255.240.0

No. of blocks = $\frac{2^h}{256} = \frac{2^{12}}{256} = \frac{4096}{256} = 16$ blocks

Range of Address :

10.0.32.0 to 10.0.47.255

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* Subnet ③ : 2500 hosts

$$2^{h-2} \geq 2500$$

$h = 12$

CIDR : /20

MASK : 255.255.240.0

Range of Address :

10.0.48.0 to 10.0.63.255

* Subnet ④ : 100 hosts

$h = 7$

CIDR : /25

MASK : 255.255.255.128

Range of Address : 10.0.64.0 to 10.0.64.127

* Subnet ⑤ : 50 hosts

$h = 6$

CIDR : /26

MASK : 255.255.255.192

Range : 10.0.64.128 to 10.0.64.191

* Subnet ⑥ : 10 hosts

$h = 4$

CIDR : /28

MASK : 255.255.255.240

Range : 10.0.64.192 to 10.0.64.207

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* Subnet (7): WAN 1

Range: 10.0.64.208 to 10.0.64.211

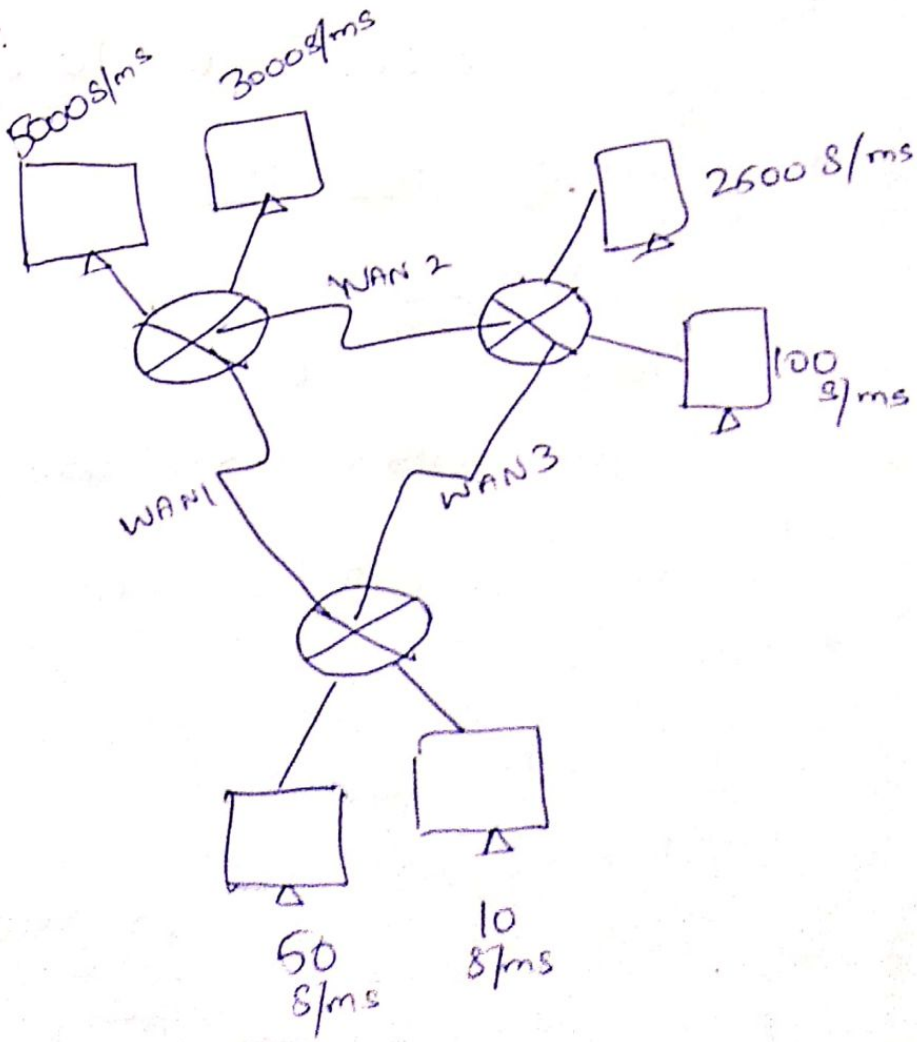
* Subnet (8): WAN 2

Range: 10.0.64.212 to 10.0.64.215

* Subnet (9): WAN 3

Range: 10.0.64.216 to 10.0.64.219

SCENARIO:



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