# Networking

 Consider this device in a network

host id has one octet i.e. 8 bits i.e 2^8

ip: 192.168.0.11

sm: 255.255.255.0

nid: 192.168.0

hid: 11

This network size = 2^n - 2 => 2^8 -2 = 256 - 2 = 254 n is number of host id bits

2 ip addresses cannot be used

 one ip is left for network id all zeros => 00000000 => 0 => 192.168.0.0

 one ip is left for broadcast ip all ones => 11111111 => 255 => 192.168.0.255

Consider the following network

Size of network => hid octets => 2 => 2 \* 8 => 2^16-2 => 65536-2 => 65534 Lets say i want to design a network for 200 devices

ip: 172.16.0.11

sm: 255.255.0.0

nid: 172.16

hid: 0.11

Lets say i want to design a network for 400 devices

2^n - 2 ~= 200

2^n ~= 200

n has only 3 possibilities => 8, 16,24 n = 8 (hosd id = 8 bits)

N = 32 - 8 (Network id = 24 bits)

For designing networks we have two approaches  classful networks

2^n - 2 ~ = 400

2^n ~= 400

n = 8 or 16 or 24

n = 16

N = 16

 CIDR (Classless inter domain routing)

# CIDR

 This is expressed as x.x.x.x/N

 N = number of bits for network id

 Look at subnet mask as binary not decimal number  Example

Expand

192.168.0.0/16

10.0.0.0/8

172.16.0.0/12

192.168.0.0/16

N (network id bits) = 16

n (host id bits ) = 32 - 16 = 16

size of network => 2^n - 2 => 2^16 -2 = 65534

Example:

|  |  |
| --- | --- |
| ip: | 192.168.0.0 |
| sm: | 255.255.0.0 |
| sm: | 11111111.11111111.00000000.00000000 |

Valid sm in decimal

Valid sms in binary

255.255.255.0

255.255.0.0

255.0.0.0

11111111.11111111.11111111.11111100

11111111.11111111.11111111.11111000

11111111.11111111.11111111.11110000

11111111.11111111.11111111.11100000

11111111.11111111.11111111.11000000

11111111.11111111.11111111.10000000

11111111.11111111.11111111.00000000

11111111.11111111.11111110.00000000

11111111.11111111.11111100.00000000

number of sequence of ones => Network id number of sequence of zeros => host id Lets try creating a network of 50 devices

11111111.11111111.11111000.00000000

...

Lets try creating a network of size 500 devices

2^n - 2 ~= 50

n = 6

N = 32 - 6 = 26

ip range: 192.168.0.0/26

SM: 11111111.11111111.11111111.11000000

Lets try creating a network of 66000 devices

2^n - 2 ~= 500

n = 9

N = 32 -9 = 23

SM: 11111111.11111111.11111110.00000000

Lets try creating a network of 1000 devices

2^n -2 ~= 66000

n = 17

N = 32 -17 = 15

SM: 11111111.11111110.00000000.00000000

Lets try creating a network of 10000 devices

2^n - 2 ~= 1000

n = 10

N = 32 - 10 = 22

SM = 11111111.11111111.11111100.00000000

2^n -2 ~= 10000

n = 14

N = 32 - 14 = 18

SM: 11111111.11111111.11000000.00000000

private network cidr ranges

192.168.0.0/16

172.16.0.0/12

10.0.0.0/8

Expand CIDR 192.168.0.0/16

192.168.0.0/16

N (1) = 16

n (0) = 16

ip: 192.168.xxxxxxxx.xxxxxxxx SM: 11111111.11111111.00000000.00000000

start: 192.168.00000000.00000000 = 192.168.0.0

end: 192.168.11111111.11111111 = 192.168.255.255

range: 192.168.0.0 to 192.168.255.255

Expand CIDR 10.0.0.0/8

10.0.0.0/8

N = 8

n = 32 - 8 = 24

ip:

10.xxxxxxxx.xxxxxxxx.xxxxxxxx

SM: 11111111.00000000.00000000.00000000

start: 10.00000000.00000000.00000000 = 10.0.0.0

end: 10.11111111.11111111.11111111 = 10.255.255.255

range: 10.0.0.0 to 10.255.255.255

Expand CIDR 172.16.0.0/12

172.16.0.0/12

N = 12

n = 32 -12 = 20

ip:

172.0001xxxx.xxxxxxxx.xxxxxxxx

SM: 11111111.11110000.00000000.00000000

start: 172.00010000.00000000.00000000 = 172.16.0.0

end: 172.00011111.11111111.11111111 = 172.31.255.255

range: 172.16.0.0 to 172.31.255.255

Expand a CIDR: 192.168.128.0/19

192.168.128.0/19

N = 19

Expand a CIDR : 10.160.0.0/13

n = 32 -19 = 13

ip:

192.168.100xxxxx.xxxxxxx

SM: 11111111.11111111.11100000.0000000

start: 192.168.10000000.0000000 => 192.168.128.0

end: 192.168.10011111.1111111 => 192.168.159.255

range: 192.168.128.0 to 192.168.159.255

Expand the following cidr 192.168.192.0/27

10.160.0.0/13

N = 13

n = 32 -13 = 19

ip:

10.10100xxx.xxxxxxx.xxxxxxx

SM: 11111111.11111000.0000000.0000000

start: 10.10100000.0000000.0000000 = 10.160.0.0

end: 10.10100111.1111111.1111111 => 10.167.255.255

range: 10.160.0.0 to 10.167.255.255

192.168.192.0/27

N = 27

n = 32 - 27 = 5

ip: 192.168.192.000xxxxx SM: 11111111.11111111.11111111.11100000

start: 192.168.192.00000000 = 192.168.192.0

end: 192.168.192.00011111 = 192.168.192.31

range: 192.168.192.0 to 192.168.192.31

Expand the following cidr 192.168.192.0/19

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N = | 19 | | | |
| n = | 32 -19 = 13 | | | |
| ip: | 192.168.110xxxxx.xxxxxxxx | | | |
| SM: | 11111111.11111111.11100000.00000000 | | | |
| start: | | 192.168.11000000.00000000 | = | 192.168.192.0 |
| end: | | 192.168.11011111.11111111 | = | 192.168.223.255 |

Expand the following 10.100.101.0/24

192.168.192.0/19

10.100.101.0/24

N = 24

n = 8

ip =

10.100.101.xxxxxxxx

SM = 11111111.11111111.11111111.00000000

range: 10.100.101.0 to 10.100.101.255