



RACKSPACE
OPEN CLOUD
ACADEMY

RACKSPACE
OPEN CLOUD
ACADEMY

(sub)netmask

Subnetting saved the internet and other tales.

IPv4

- The IP address is 32 binary bits. For example 192.168.0.100 is:
11000000.10101000.00000000.01100100
- Every IP address gives us 2 pieces of information:
 - The Network Address (net addr)
 - The unique host address on that network.
- However, it is only by ANDing the (sub)netmask to the IP can you learn the net addr.
 - Without a (sub)netmask, it is impossible to tell what network an IP addr is on.

What is a (sub)netmask?

A Subnet mask is a 32-bit number that masks an IP address, and divides the IP address into network address and host address.

A Subnet Mask is made by setting network bits to all "1"s and setting host bits to all "0"s.

Within a given network, two host addresses are reserved for special purpose, and cannot be assigned to hosts. The "0" address is assigned a network address and "255" is assigned to a broadcast address, and they cannot be assigned to hosts.*

*This varies as we will see later.

Format of a (sub)netmask

IP addr 192.168.32.176

(sub)netmask 255.255.255.0

IP 11000000.10101000.00100000.10110000

SM 11111111.11111111.11111111.00000000



Network bits

Host bits

ANDing

ANDing requires you to first convert the IP addr and the (sub)netmask into binary. You AND as follows:

1 and 1 = 1

1 and 0 = 0

0 and 1 = 0

0 and 0 = 0

IP addr 192.168.32.176

(sub)netmask 255.255.255.0

IP 11000000.10101000.00100000.10110000

SM 11111111.11111111.11111111.00000000

net addr 11000000.10101000.00100000.00000000

net addr 192 . 168 . 32 . 0

ANDing

Example #2

IP addr 172.21.103.191

(sub)netmask 255.255.255.0

IP 10101100.00010101.01100111.10111111

SM 11111111.11111111.11111111.00000000

net addr 10101100. 00010101.01100111.00000000

net addr 172 . 21 . 103 . 0

ANDing

Example #3

```
IP addr      172.21.103.191
(sub)netmask 255.255.0.0
```

```
IP          10101100.00010101.01100111.10111111
SM          11111111.11111111.00000000.00000000
net addr   11000000.10101000.00000000.00000000
net addr   172 . 21 . 0 . 0
```

ANDing

Example #4

IP addr 172.21.103.191
 (sub)netmask 255.255.224.0

IP 10101100.00010101.01100111.10111111
 SM 11111111.11111111.11100000.00000000
 net addr 11000000.10101000.01100000.00000000
 net addr 172 . 21 . 96 . 0

What is CIDR?

- The acronym stands for: **C**lassless **I**nter**D**omain **R**outing
- It is a shorter but clearer way of expressing a (sub)netmask
- CIDR notation is expressed as /XX
- The CIDR notation indicates how many bits in the (sub)netmask are network bits

CIDR	Binary	Dotted Decimal
/0	00000000.00000000.00000000.00000000	0.0.0.0
/1	10000000.00000000.00000000.00000000	128.0.0.0
/2	11000000.00000000.00000000.00000000	192.0.0.0
/3	11100000.00000000.00000000.00000000	224.0.0.0
/4	11110000.00000000.00000000.00000000	240.0.0.0
/5	11111000.00000000.00000000.00000000	248.0.0.0
/6	11111100.00000000.00000000.00000000	252.0.0.0
/7	11111110.00000000.00000000.00000000	254.0.0.0
/8	11111111.00000000.00000000.00000000	255.0.0.0

CIDR	Binary	Dotted Decimal
/9	11111111.10000000.00000000.00000000	255.128.0.0
/10	11111111.11000000.00000000.00000000	255.192.0.0
/11	11111111.11100000.00000000.00000000	255.224.0.0
/12	11111111.11110000.00000000.00000000	255.240.0.0
/13	11111111.11111000.00000000.00000000	255.248.0.0
/14	11111111.11111100.00000000.00000000	255.252.0.0
/15	11111111.11111110.00000000.00000000	255.254.0.0
/16	11111111.11111111.00000000.00000000	255.255.0.0

CIDR	Binary	Dotted Decimal
/17	11111111.11111111.10000000.00000000	255.255.128.0
/18	11111111.11111111. 11000000.00000000	255.255.192.0
/19	11111111.11111111. 11100000.00000000	255.255.224.0
/20	11111111.11111111. 11110000.00000000	255.255.240.0
/21	11111111.11111111. 11111000.00000000	255.255.248.0
/22	11111111.11111111. 11111100.00000000	255.255.252.0
/23	11111111.11111111. 11111110.00000000	255.255.254.0
/24	11111111.11111111. 11111111.00000000	255.255.255.0