Calculating the number of networks and the number of hosts per class

IP Address - Revisited

- IPv4 addresses are composed of two parts.

- The first numbers in the address specify the network, while the latter numbers specify the specific host.

- A packet with a destination address that is not on the same network as the source address will be forwarded, or routed, to the appropriate network.

- Once on the correct network, the host part of the address determines which interface the packet gets delivered to.

IP Address Classes

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network	Total addresses in class	Start address	End address
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})	2,147,483,648 (2^{31})	0.0.0.0	127.255.255.255
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})	1,073,741,824 (2^{30})	128.0.0.0	191.255.255.255
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)	536,870,912 (2^{29})	192.0.0.0	223.255.255.255
Class D (multicast)	1110	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	224.0.0.0	239.255.255.255
Class E (reserved)	1111	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	240.0.0.0	255.255.255.255

Subnet Mask

- A subnet mask specifies which part of an address is the network part, and which part addresses the specific host.

- A single IP address identifies both a network, and a unique interface on that network.

- A subnet mask can also be written in dotted decimal notation and determines where the network part of an IP address ends, and the host portion of the address begins.

Calculating the number of networks and the number of hosts per class

The number of networks and the number of hosts per class can be derived by this formula –

Number of networks $= 2\text{^network\_bits}$

Number of Hosts/Network $= 2\text{^host\_bits} - 2$

When calculating hosts' IP addresses, 2 IP addresses are decreased because they cannot be assigned to hosts, i.e. the first IP of a network is network number and the last IP is reserved for Broadcast IP.

Class A Addresses

Class A Address

The first bit of the first octet is always set to 0 (zero). Thus the first octet ranges from 1 – 127, i.e.

$$00000001 - 01111111$$
$$1 - 127$$

Class A addresses only include IP starting from 1.x.x.x to 126.x.x.x only. The IP range 127.x.x.x is reserved for loopback IP addresses.

The default subnet mask for Class A IP address is 255.0.0.0 which implies that Class A addressing can have 126 networks (2^7-2) and 16777214 hosts (2^{24}-2).

Class B Addresses

Class B Address

An IP address which belongs to class B has the first two bits in the first octet set to 10, i.e.

$$10000000 - 10111111$$
$$128 - 191$$

Class B IP Addresses range from 128.0.x.x to 191.255.x.x. The default subnet mask for Class B is 255.255.x.x.

Class B has 16384 (2^{14}) Network addresses and 65534 (2^{16}-2) Host addresses.

Class C Addresses

Class C Address

The first octet of Class C IP address has its first 3 bits set to 110, that is −

11000000 − **110**11111
192 − 223

Class C IP addresses range from 192.0.0.x to 223.255.255.x. The default subnet mask for Class C is 255.255.255.x.

Class C gives 2097152 (2^{21}) Network addresses and 254 (2^8-2) Host addresses.

Class D Addresses

Class D Address

Very first four bits of the first octet in Class D IP addresses are set to 1110, giving a range of –

11100000 – **1110**1111
224 – 239

Class D has IP address range from 224.0.0.0 to 239.255.255.255. Class D is reserved for Multicasting. In multicasting data is not destined for a particular host, that is why there is no need to extract host address from the IP address, and Class D does not have any subnet mask.

Class E Addresses

Class E Address

This IP Class is reserved for experimental purposes only for R&D or Study. IP addresses in this class ranges from 240.0.0.0 to 255.255.255.254. Like Class D, this class too is not equipped with any subnet mask.