**Classful Addressing**

Classful addressing was introduced in 1981, with classful routing, IPv4 addresses were divided into 5 classes (A through E).

* Classes A-C: unicast addresses
* Class D: multicast addresses
* Class E: reserved for future use

**Class A**

In a Class A address, the first bit of the first octet is always ‘0’. Thus, Class A addresses range from 0.0.0.0 to 127.255.255.255 (as 01111111 in binary converts to 127 in decimal). The first 8 bits or the first octet denote the network portion and the rest 24 bits or the 3 octets belong to the host portion. Its Subnet mask is 255.0.0.0.

Example: 10.1.1.1

Exception –

* 127.X.X.X is reserved for loopback
* 0.X.X.X is reserved for the default network

Therefore, the actual range of class A addresses is: 1.0.0.0 to 126.255.255.255

**Class B**

In a Class B address, the first octet would always start with ’10’. Thus, Class B addresses range from 128.0.0.0 to 191.255.255.255. The first 16 bits or the first two octets denote the network portion and the remaining 16 bits or two octets belong to the host portion. Its Subnet mask is 255.255.0.0.

Example: 172.16.1.1

**Class C**

In a Class C address, the first octet would always start with ‘110’. Thus, Class C addresses range from 192.0.0.0 to 223.255.255.255. The first 24 bits or the first three octets denote the network portion and the rest 8 bits or the remaining one octet belong to the host portion. Its Subnet mask is 255.255.255.0.

Example: 192.168.1.1

**Class D**

Class D is used for multicast addressing and in Class D addresses the first octet would always start with ‘1110’. Thus, Class D addresses range from 224.0.0.0 to 239.255.255.255. Its Subnet mask is not defined.

Example: 239.2.2.2

Class D addresses are used by routing protocols like OSPF, RIP, etc.

**Class E**

Class E addresses are reserved for research purposes and future use. The first octet in a Class E address starts with ‘1111’. Thus, Class E addresses range from 240.0.0.0 to 255.255.255.255. Its Subnet mask is not defined.

The disadvantage of classful addressing:

1. A Class A network with a netmask of 255.0.0.0 can support 27 (128) networks with a total of (224)-2 (16,777,214) hosts per network.
2. Class B network with a netmask mask of 255.255.0.0 can support 214 (16,384) networks with a total of (216)-2 (65,534) hosts per network.
3. Class C network with a netmask of 255.255.255.0 can support 221 networks with a total of (28)-2 (254) addresses per network.

**Classless Addressing**

Classless Inter-Domain Routing (CIDR)

CIDR or Class Inter-Domain Routing was introduced in 1993 to replace classful addressing. It allows the user to use Variable Length Subnet Masks (VLSM).

In CIDR subnet masks are denoted by /*x*, e.g. A subnet of 255.255.255.0 would be denoted by /24. To work a subnet mask in CIDR, we have to first convert each octet into its respective binary value.

The example subnet is 255.255.255.0:

**First Octet**

255 has 8 binary 1's when converted to binary, (11111111)

**Second Octet**

255 has 8 binary 1's when converted to binary, (11111111)

**Third Octet**

255 has 8 binary 1's when converted to binary, (11111111)

**Fourth Octet**

0 has 0 binary 1's when converted to binary, (00000000)

Therefore, in total there are 24 binary 1’s, so the subnet mask is /24.

Subnet masks in CIDR must be contiguous, e.g. A subnet mask like 10111111.X.X.X cannot exist.

With CIDR, we are able to VLSM which in turn leads to less waste of IP addresses. Unlike classful addressing, it is no longer necessary for the divider between the network and the host portions of an address to be an octet boundary, e.g. in CIDR a subnet mask like 255.224.0.0 or 11111111.11100000.00000000.00000000 can exist.