Private IP Addresses

★ Early network design, when global end-to-end connectivity was envisioned for communications with all Internet hosts, intended that IP addresses be globally unique. However, it was found that this was not always necessary as private networks developed and public address space needed to be conserved.

★ Computers not connected to the Internet, such as factory machines that communicate only with each other via TCP/IP, need not have globally unique IP addresses. Today, such private networks are widely used and typically connect to the Internet with network address translation (NAT), when needed.

Private IP Addresses

★ Hosts that do not require access to the Internet can use private addresses

- 10.0.0.0 to 10.255.255.255 (10.0.0.0/8)
- 172.16.0.0 to 172.31.255.255 (172.16.0.0/12)
- 192.168.0.0 to 192.168.255.255 (192.168.0.0/16)

Special use IPv4 Addresses

Network and Broadcast addresses – within each network the first and last addresses cannot be assigned to hosts

Loopback address – 127.0.0.1 a special address that hosts use to direct traffic to themselves (addresses 127.0.0.0 to 127.255.255.255 are reserved)

Link-Local address – 169.254.0.0 to 169.254.255.255 (169.254.0.0/16) addresses can be automatically assigned to the local host

TEST-NET addresses – 192.0.2.0 to 192.0.2.255 (192.0.2.0/24) set aside for teaching and learning purposes, used in documentation and network examples

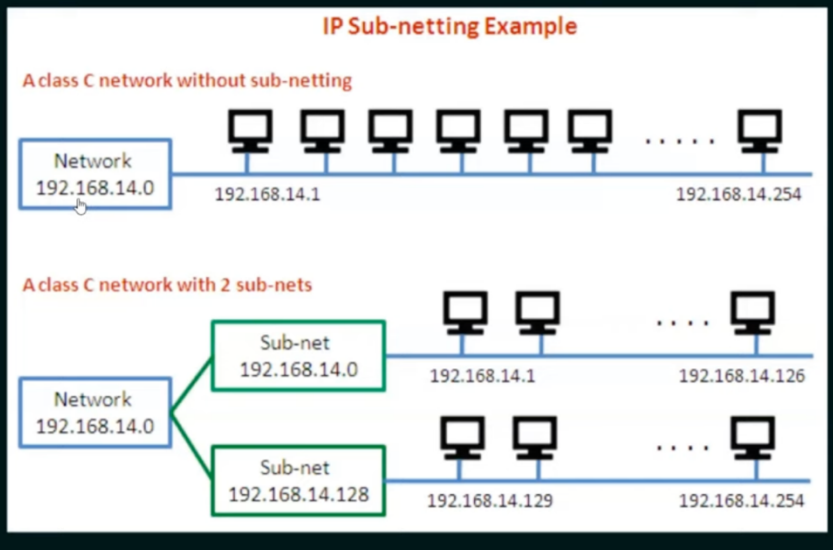
Classless Addressing

- ★ Formal name is Classless Inter-Domain Routing (CIDR).
- ★ Created a new set of standards that allowed service providers to allocate IPv4 addresses on any address bit boundary (prefix length) instead of only by a class A, B, or C address.
- ★ Classless addressing is possible with the help of subnetting.

Valid Subnet masks

/n	Mask	/n	Mask	/n	Mask	/n	Mask
/1	128.0.0.0	/9	255.128.0.0	/17	255.255.128.0	/25	255.255.255.128
/2	192.0.0.0	/10	255.192.0.0	/18	255.255.192.0	/26	255.255.255.192
/3	224.0.0.0	/11	255.224.0.0	/19	255.255.224.0	/27	255.255.255.224
/4	240.0.0.0	/12	255.240.0.0	/20	255.255.240.0	/28	255.255.255.240
/5	248.0.0.0	/13	255.248.0.0	/21	255.255.248.0	/29	255.255.255.248
/6	252.0.0.0	/14	255.252.0.0	/22	255.255.252.0	/30	255.255.255.252
/7	254.0.0.0	/15	255.254.0.0	/23	255.255.254.0	/31	255.255.255.254
/8	255.0.0.0	/16	255.255.0.0	/24	255.255.255.0	/32	255.255.255.255

Subnetting



Important Points for Supernetting

- All the Networks should be contiguous.
- The block size of every network should be equal and must be in form of 2^n.
- First Network id should be exactly divisible by whole size of supernet.

```
200.1.0.0,
200.1.1.0,
200.1.2.0,
200.1.3.0
```

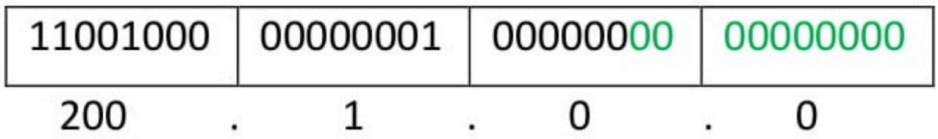
Build a bigger network that has a single Network Id.

Explanation: Before Supernetting routing table will look like as:

Network Id	Subnet Mask	Interface
200.1.0.0	255.255.255.0	A
200.1.1.0	255.255.255.0	B
200.1.2.0	255.255.255.0	C
200.1.3.0	255.255.255.0	D

- **Contiguous:** You can easily see that all networks are contiguous all having size 256 IP Addresses(or 254 Hosts)..
  Range of first Network from 200.1.0.0 to 200.1.0.255. If you add 1 in last IP address of first network that is 200.1.0.255 + 0.0.0.1, you will get the next network id which is 200.1.1.0. Similarly, check that all network are contiguous.
- **Equal size of all network:** As all networks are of class C, so all of them have a size of 256 which is in turn equal to 2^8.
- **First IP address exactly divisible by total size:** When a binary number is divided by 2^n then last n bits are the remainder. Hence in order to prove that first IP address is exactly divisible by while size of Supernet Network. You can check that if last n (n here refers to the number of bits required to represent the Total Size of the Supernet) bits are 0 or not.

In the given example first IP is 200.1.0.0 and whole size of supernet is $4*2^8 = 2^{10}$. If last 10 bits of first IP address are zero then IP will be divisible.



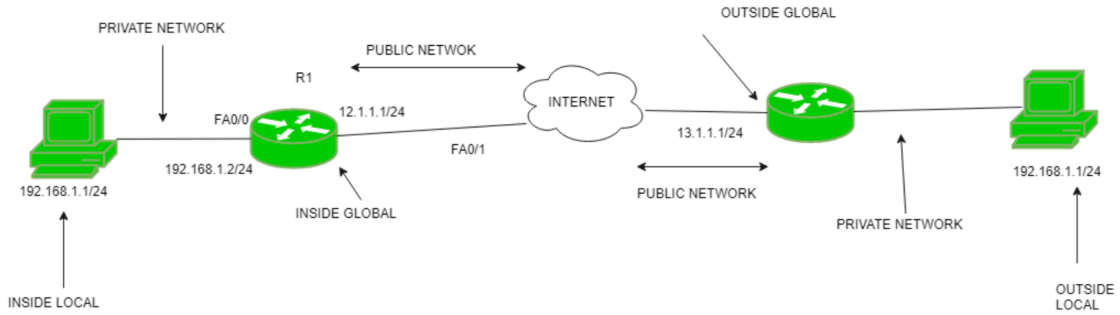
Last 10 bits of first IP address are zero (highlighted by green color). So 3rd condition is also satisfied.

Advantages of Supernetting

- Control and reduce network traffic
- Helpful to solve the problem of lacking IP addresses
- Minimizes the routing table i.e, it cannot cover a different area of the network when combined and all the networks should be in the same class and all IP should be contiguous

NAT inside and outside addresses –

Inside refers to the addresses which must be translated. Outside refers to the addresses which are not in control of an organization. These are the network Addresses in which the translation of the addresses will be done.



- **Inside local address** – An IP address that is assigned to a host on the Inside (local) network. The address is probably not an IP address assigned by the service provider i.e., these are private IP addresses. This is the inside host seen from the inside network.

- **Inside global address** – IP address that represents one or more inside local IP addresses to the outside world. This is the inside host as seen from the outside network.

- **Outside local address** – This is the actual IP address of the destination host in the local network after translation.

- **Outside global address** – This is the outside host as seen from the outside network. It is the IP address of the outside destination host before translation.