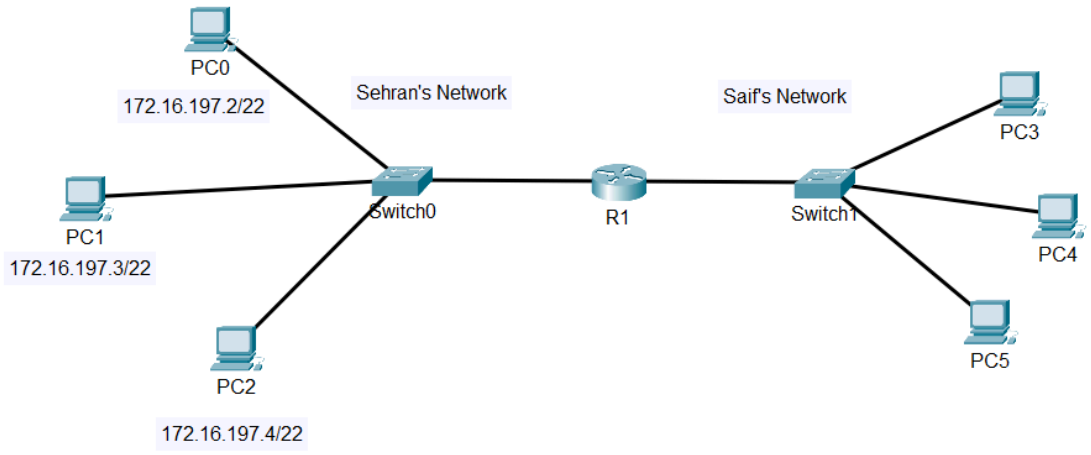
Practice Problem on IPv4 Address and Subnetting

Question 1 (15 Marks):

Both Sehran and Saif's LANs are separated by a router. See the picture below to answer the questions from a to e.



a) Can Saif set 172.17.210.0/23 as IP address in any of his PCs? Answer with proper reasoning. (2 Marks)

=> No, he can't. Values of the last two octets,

128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
1	1	0	1	0	0	1	0		0	0	0	0	0	0	0	0

In this address, the last 9 bits are host bits and from the binary representation it is clear that all of those host bits are 0s. So, it is a network address and a network address can't be set as an IP address for any device.

b) What are the subnet mask, network address and broadcast address of Sehran's network? (5 Marks)

=>IP address of a device from Sehran's network = 172.16.197.3/22

Values of the last 2 octets,

	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
Of IP address	1	1	0	0	0	1	0	1	0	0	0	0	0	0	1	1
For Subnet mask	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
For network address	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
For broadcast address	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1

Subnet mask = 255.255.252.0 (all network bits are 1s and all host bits are 0s)

network address = 172.16.196.0/22 (all host bits are 0s)

broadcast address = 172.16.199.255/22 (all host bits are 1s)

c) How many hosts including the default gateway can Sehran connect in his network? (2 Marks)

=> Number of host bits = 10

2 addresses will be used for network address and the broadcast address.

Tota IP addresses for hosts = 2^10 - 2 = 1022

d) If PC4 wants to send a packet to all of its neighbors in the local area network what will be the destination IP address? (1 Mark)

=>It will be a limited broadcast since it is going to send all the devices of its own network.

So, destination IP address = 255.255.255.255

e) If PC4 wants to send a packet to all the devices of Sehran's network what will be the destination IP address? Can the destination address of the previous question's answer be used in this case? Answer with proper reasoning. (3 Marks)

=>It will be a directed broadcast since Sehran's network and Saif's network are two different networks. So, the destination IP address will be the broadcast address of Sehran's network which is 172.16.199.255/22

255.255.255.255 can't be used as the destination IP address in this case because routers don't forward a packet if the destination IP address is 255.255.255.255

f) Can we have any other odd number excluding 255 in any of the octets of a subnet mask? State your answer with proper reasoning. (2 Marks)

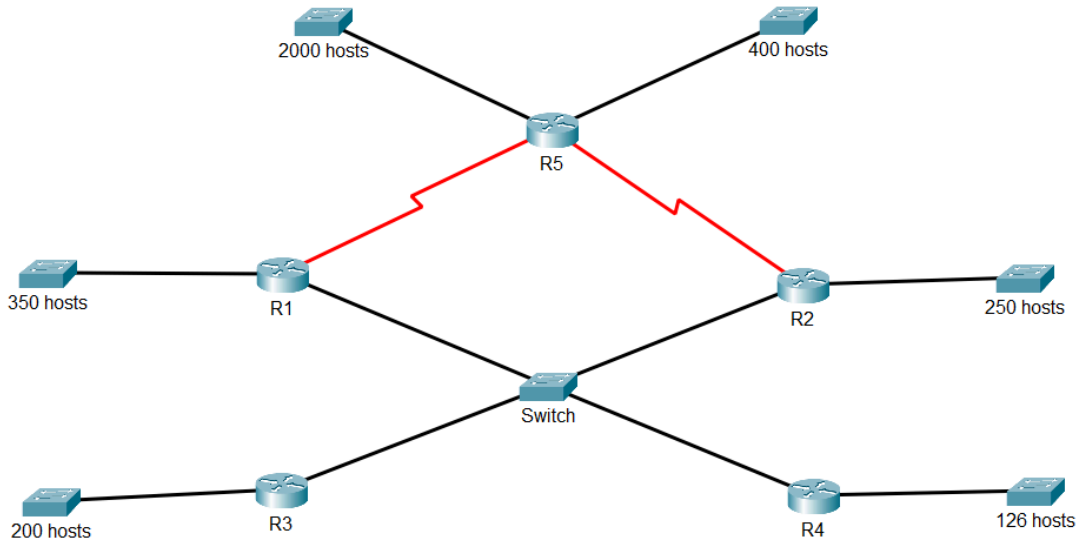
=> No, we can't. In the subnet mask, all the network bits are 1 and we know network bits are the most significant bits of an address.

Also, if we look at the decimal values of each position of an octet, all other positions represent even values (128, 64, 32, 16, 8, 4, 2) except the last one (1). So, a number will be odd if and only if the last positioned value of the octet is 1.

In a subnet mask, if the last value of the octet is 1, precedent values will also be 1 since all network bits are 1. If all other values are 1 too, we have only one odd number that is 255.

Question 2 (15 Marks):

See the topology below and answer the following questions.



a) How many networks are present in the above topology? (1 Mark)

=> 9

b) Using the network address of 192.168.172.209/20, efficiently calculate the required sub-network addresses of all the networks in the topology. Show necessary calculations and the hierarchical tree of network addresses. Hosts numbers given in the topology are including the default gateway. (14 Marks)

=>**Values of the last 2 octets,**

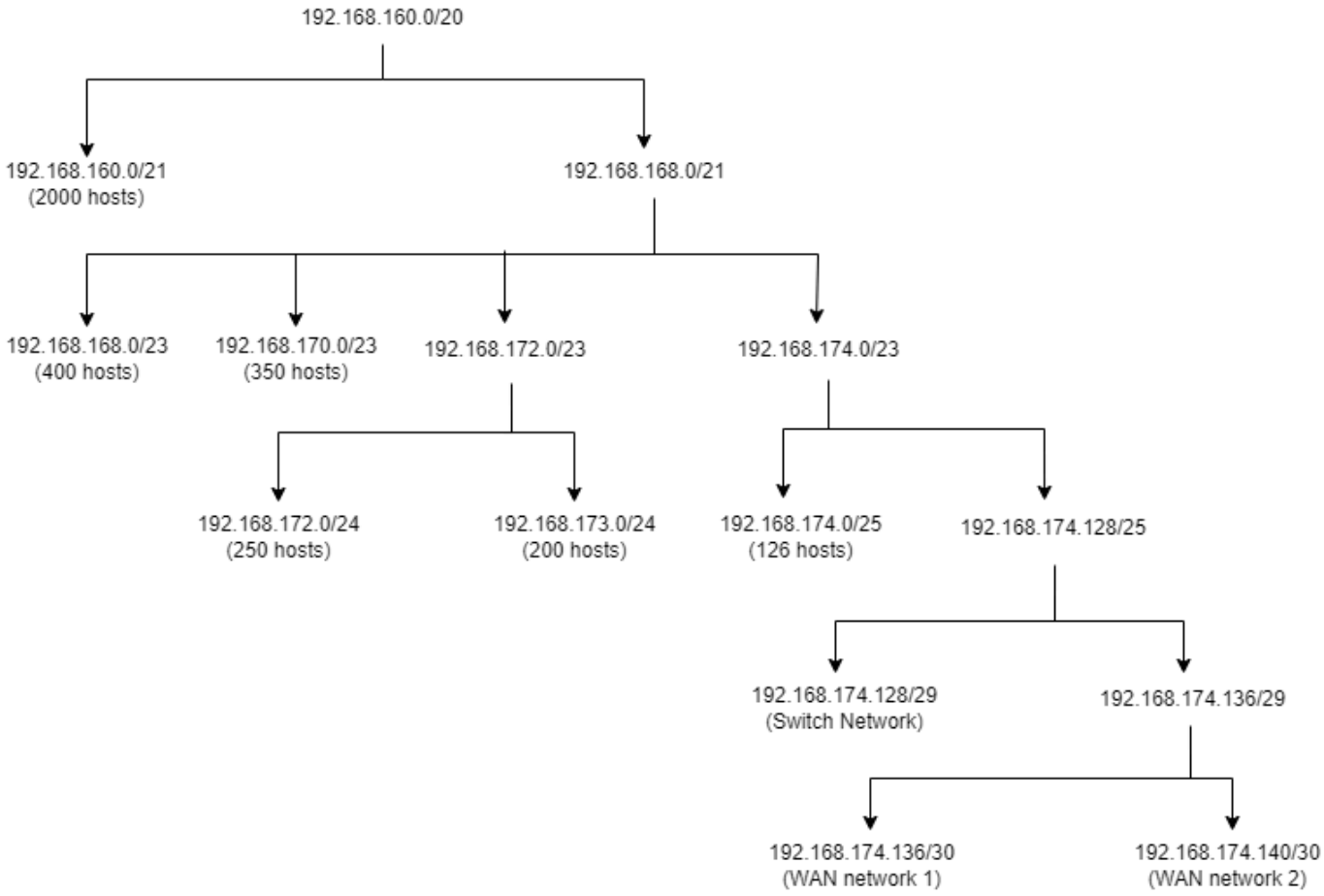
	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
Of IP address	1	0	1	0	1	1	0	0		1	1	0	1	0	0	0	1
For network address	1	0	1	0	0	0	0	0		0	0	0	0	0	0	0	0

So, the network address is 192.168.160.0/20

Values of the last 2 octets for subnetting,

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	
1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**2000 hosts**
1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	**400 hosts**
1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	**350 hosts**
1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	
1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	**250 hosts**
1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	**200 hosts**
1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	
1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	**126 hosts**
1	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	
1	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	**Switch network**
1	0	1	0	1	1	1	0	1	0	0	0	1	0	0	0	
1	0	1	0	1	1	1	0	1	0	0	0	1	0	0	0	**WAN network 1**
1	0	1	0	1	1	1	0	1	0	0	0	1	1	0	0	**WAN network 2**

Hierarchical Tree,


192.168.160.0/20
192.168.160.0/21
(2000 hosts)
192.168.168.0/21
192.168.168.0/23
(400 hosts)
192.168.170.0/23
(350 hosts)
192.168.172.0/23
192.168.174.0/23
192.168.172.0/24
(250 hosts)
192.168.173.0/24
(200 hosts)
192.168.174.0/25
(126 hosts)
192.168.174.128/25
192.168.174.128/29
(Switch Network)
192.168.174.136/29
192.168.174.136/30
(WAN network 1)
192.168.174.140/30
(WAN network 2)