Part A – IP Addressing Basics

1. What is an IP address and why is it important in a network?

Answer: An IP (Internet Protocol) address is an identification or label given to devices connected to a given network. It is important because devices can’t know who they’re sending data to or who is sending the data they are receiving. It will be chaotic and it will be like a letter in the post office whose receiver and sender addresses don’t exist.

2. Differentiate between IPv4 and IPv6 in terms of:

- Address length

- Notation format

- Number of available addresses

Answer: They are both Internet Protocol versions but IPv6 is an improvement on the IPv4 because IPv4 was running out of addresses to assign to devices.

With regards to Address length IPv4 uses a 32 bit addressing length while IPv6 uses a 128 bit address length.

They are different in their notation formatting because IPv4 uses decimal numbers from 0 – 255 (both inclusive) in the spaces before, between and after 3 decimal points. (e.g. 192.168.1.1). On the other hand IPv6 uses hexadecimal numbers ranging from 0000 to ffff (both inclusive) in the spaces before, between and after the 7 semi colons. Also leading zeros can be omitted meaning …4:0000:0000:4… can be written as …4::4… (e.g. 2001:0db8:85a3::8a2e:0370:7334)

With IPv4 you can have around 232 which is 4.3 billion addresses, which is not enough for 8 billion people who could also contain multiple devices like phones, PCs, refrigerators etc. But with IPv6 you can have around 2128 which is 340 undecillion that can run multiple devices.

3. Write the binary equivalent of the IPv4 address 192.168.10.1.

Answer: we convert each decimal number until the dots to their own binaries

192 = 11000000

168 = 10101000

10 = 00001010

1 = 00000001

Therefore the address 192.168.10.1 is **11000000.10101000.00001010.00000001** in binary.

4. Convert the following binary IP address to decimal:

11000000.10101000.00000001.00000010

Answer: we convert each binary number until the dots to their own decimals

11000000 = 192

10101000 = 168

00000001 = 1

00000010 = 2

Therefore the binary address 11000000.10101000.00000001.00000010 becomes **192.168.1.2** in decimal.

5. What are the ranges of Class A, B, and C IPv4 addresses?

Answer: **Class A** has a range between 1.0.0.0 to 126.255.255.255. This is because the first bit of Class A (**1**.0.0.0) is always 0. Even though the range 0.0.0.0 to 0.255.255.255 and 127.0.0.0 to 127.255.255.255 may fall under this category, they are reserved for default/unknown network and localhost respectively.

**Class B** has a range that begins with 128.0.0.0 and spans up to 191.255.255.255 because of the start of the bit for Class B is 10(**128**.0.0.0).

**Class C** always begins with the bits 110(**192**.0.0.0) which gives it the range 192.0.0.0 to 223.255.255.255.

6. Which IP class does the address 172.16.5.4 belong to?

Answer: It belongs to **Class B**.

7. What is the difference between public IP and private IP? List private IP ranges.

Answer: **Public IP** addresses are those given by the ISP and are visible for everyone. They are usually given to websites, servers and other entities that desire a public presence.

**Private IP** addresses are those given in a specific local network and aren’t accessible from the internet or across any network other than the one it is given in. I usually ranges from **192.168.0.0 – 192.168.255.255**, **10.0.0.0 – 10.255.255.255**, and **172.16.0.0 – 172.31.255.255**.

8. What is the role of loopback address in IP networking?

Answer: It helps in testing before deployment. This means developers can see their work and progress, errors and results using loopback/localhost to fine tune their product.

9. Explain the use of static IP vs dynamic IP with examples.

Answer: In the basic terms Static IP’s address doesn’t change while Dynamic IP’s address does. This means that a Static IP address is given to devices that are servers and other highly coveted resource or service providers. And Dynamic addresses are given as a temporary address usually for home networks or to be used on browsing the internet which don’t require a “set in stone” IP address.

Examples can be a server hosting a website, a DNS provider server etc… for Static while for dynamic we can mention a computer that receives a new IP whenever it connects to a router, or a cellphone with the same situation.

10. What is the default subnet mask for:

- Class A → 255.0.0.0

- Class B →255.255.0.0

- Class C →255.255.255.0

11. What is subnetting and why is it used?

Answer: Subnetting is the process of dividing a large network into smaller and more manageable networks which are called subnets. It is used to improve the network organization, enhance security etc.

12. Given the IP address 192.168.1.0/24, how many total IP addresses are available?

Answer:

Network bits –> **24**

Host bits –> 32 – 24 = **8**

Total IP addresses are: 28 = **256**

13. From question 12, how many usable host IPs are there?

Answer: We find that by subtracting 2 from the total IP addresses available.

Usable host IPs: 256 – 2 = **254**

14. How many subnets can be created from a /24 network if you borrow 2 bits?

Answer: It technically becomes a /26 network, so:

Network bits –> 26

Host bits –> 32 – 26 = 6

Number of subnets: 22 = **4**

15. What will be the new subnet mask if you borrow 3 bits from a /24 network?

Answer: No need to explain since explained above.

Number of subnets: 23 = **8**

16. Given IP: 192.168.10.0/26

- How many hosts per subnet?

- How many subnets can be created?

Answer: borrowed 2

Network bits –> 26

Host bits –> 32 – 26 = 6

- Hosts per subnet: 26 – 2 = 64 -2 = **62**

- Subnets: 22 = **4**

17. Calculate the first and last usable IP address in the subnet 192.168.10.64/26.

Answer: Since the range is from 01000000 to 01111111 for the bits that aren’t borrowed:

The first usable is **192.168.10.65**

And last usable is **192.168.10.126**

18. Identify the network address and broadcast address of 10.0.0.0/22.

Answer: The network address is **10.0.0.0**

The Broadcast address is **10.0.3.255** this is found by all 10 of the host’s bits to 1.

19. Fill in the blanks:

- CIDR /30 gives **2** usable IP addresses.

- CIDR /28 supports **14** hosts per subnet.

20. You are given the address block 172.16.0.0/20.

- How many subnets can be created if you want each subnet to support at most 510 hosts?

- What will be the subnet mask?

Answer:

- To support 510 we need 2n – 2 = 510

2n = 512

n = **9**

Using this we change the CIDR from /20 to 32 – 9 = **/23**

The difference between the previous CIDR subnet mask and the new one will give the number needed to calculate the subnets.

23 – 20 = **3**

23 = 8

Therefore **8** subnets can be created to support at most 510 hosts.

- The subnet mask will be from the /23 CIDR

The number **255.255.254.0** will be the subnet mask.