

IPv4 Subnet Calculations

Assume that you are working for a corporation that is using the private IP address range 192.168.0.0/16 for its internal network. The company management wants to be able to accommodate 16 departments where each department has its own routed subnet with at least 4000 hosts per department subnet. You are requested to design the network layout. Answer the following questions and fully explain the logic behind each answer:

/16 means a bit mask with 16 ones followed by 16 zeros (slash notation)
11111111.11111111.00000000.00000000 (binary bitmask)
255.255.0.0 (dotted decimal notation)

/12 is the same as 255.240.0.0 (google IPv4 netmasks)

The one bits in a netmask give you the netid part of the IP address
The zero bits then give you the hosted part of the IP address

E.g. an IP address 192.168.1.45/24 or 192.168.1.45 netmask 255.255.255.0

Each LAN needs its own subnet within a larger network and traffic between LANs is routed using a layer 3 (network layer) protocol usually IPv4 and/or IPv6

- What subnet mask (the network mask that will be used within each subnet) will need to be used and what are the valid host addresses on the first, second and last subnets?

We want to have 16 Departments each with its own subnet. So, we are going to split one big network into 16 smaller LANs each with its own routed subnet. We need 4 bits for our subnet id, as 2^4 is 16. So, our subnet mask then becomes 11111111.11111111.11110000.00000000 or /20 or 255.255.240.0

The first subnet would be written as 192.168.0.0/20 the valid host range on the first subnet is from 192.168.0.1 up to 192.168.15.254. The broadcast address in the first subnet is then 192.168.15.255. We now have 12 bits in the hosted part of the ip address and 2^{12} is 4096

The second subnet then is 192.168.16.0/20. Host range is 192.168.16.1 up to 192.168.31.254.

The last subnet then is 192.168.240.0/20. Host range is 192.168.240.1 up to 192.168.255.254

- What network mask would be required if one of the Departments decided to further subnet the network range that was allocated to that Department, such that each of its internal subnets could accommodate up to 500 hosts? How many subnets in total would then be available within that Department and what IP range would be allocated on the first internal subnet? Why might the Department decide to do this further subnetting?

We would therefore need to split the subnet into 8 further subnets. For example if this was the Department that was allocated 192.168.16.0/20 it would then use instead a /23 subnet mask (255.255.254.0) within that Department, this would three additional bit to identify the internal Department subnet. In this case then the first internal Department subnet would be

192.168.16.0/23 and the host range would be from 192.168.16.1 up to 192.168.17.254 and the broadcast address would be 192.168.17.255. The second internal Department subnet would then start at 192.168.18.0/23 and so on...

- What other private IP ranges could the company use if needed? When is it appropriate to use IP private addressing versus public addressing?

Based on RFC1918 the private IP ranges used for internal networks that then use a NAT router to share a public IP address are:

192.168.0.0/16

172.16.0.0/12

10.0.0.0/8

Use private addressing on your internal LAN when you have to share a public IP on your WAN interface or Internet connection using a NAT router like on your home internet connection. Public IP addresses are also used to reach servers like web servers etc.