SUBNETTING

The interest and steady growth of the internet as an information sharing resource and a communication tool brought forth the need for the IP address to be further subdivided into small units that could easily communicate, share data and be manageable. This need facilitated the creation of the subnet masks in 1985 to subdivide the classes A, B and C into smaller units. This subdivision enabled the creation of one level in the IP address scheme hierarchy.

Two-Level Hierarchy

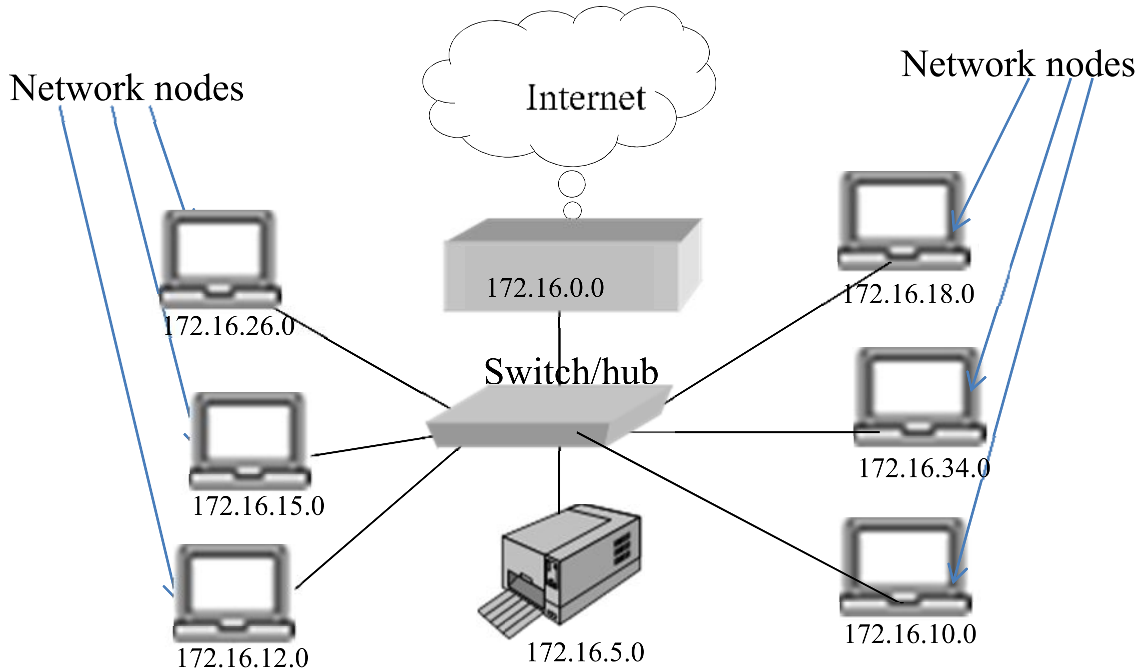
Network Prefix	Host Number

Three-Level Hierarchy

Network Prefix	Subnet Number	Host Number

The introduction of the third level number in the IP address hierarchy enabled the expansion of the routing tables by encapsulating and abstracting the structure of the subnet from external exposure. That is, ensuring that the subnet structure of the organizations private network is never seen outside the organizations private network. This is done by ensuring that the IP Address network route from outside the organizations private network such as from the internet is the same as the IP address network prefix of the organizations private network no matter the subnet mask of the organizations private network. The reason is that all subnets of a given network number use the same network prefix but different subnet numbers, hence internet routers simply collects all the subnets into a single routing table entry, enabling subdivision of the organizations private network without necessarily giving attention to the size of the internet routing tables.

Subnetting additionally addressed the registered number issue from private organizational network administrators by assigning each organization a few network numbers from the IPV4 address space then let the organizations freely assign distinct subnet mask numbers for each of their internal networks. This helped the organizational private network administrators deploy additional subnets without necessarily needing to obtain new network numbers from internet service providers.



A sample network site

In the sample network above, the site utilizes several subnet mask addresses to converge their traffic to a single class B network address. The router intercepts all traffic from the internet and only sips traffic addressed to the seven (7) hosts within its network. Therefore all the network modules including the printer are connected to the internet media through single communication media router 172.16.0.0 because of their ability to share network address 172.16 of the router 172.16.0.0., though belonging to divergent host configurations. This mode of subnetting is beneficial in various ways:-

i) The capacity of the global internet routing table is rarely disturbed because of the needs of the organizational private network operator but because of the global growth in the requirement of the internet as a resource in general.

ii) The organizational network administrator has the liberty of deploying additional subnets without requiring new network numbers from the Internet.

iii) Rapid route changing within the organizational private network does not affect the internet routing tables because Internet routers do not care much about the individual subnets but the reachability of the parent network number.

The Third-Level Hierarchy (The Subnet Masks)

External or internet routers always utilizes network numbers or prefixes of the destination address to route to organizational private network which is always subnetted. The subnetted internal or organizational private networks usually utilize the subnets to route the traffic between individual subnets. The subnets are composed of classful network prefixes and the subnet number.

In simple terms, the subnet mask is the part of an IP address that identifies the network unto which a node belongs. The other part of the address identifies the host. Consider the following address:

178.60.124.5 255.255.0.0

The address shown has a subnet mask of 255.255.0.0. The subnet mask follows two basic rules:

- If a binary bit is set to a 1 (or on) in a subnet mask, the corresponding bit in the address identifies the network.
- If a binary bit is set to a 0 (or off) in a subnet mask, the corresponding bit in the address identifies the host.

Looking at the above address and subnet mask in binary:

IP Address: 10110010.00111100.01111100.00000111

Subnet Mask: 11111111.11111111.00000000.00000000

The first 16 bits of the subnet mask are set to 1 and therefore, the first 16 bits of the address (178.60) identify the network. The last 16 bits of the subnet mask are set to 0 and therefore, the last 16 bits of the address (124.5) identify the unique host on the network. Note that the network portion of the subnet mask must be **contiguous** and therefore, a subnet mask of 255.0.0.255 is invalid.

Hosts on the same logical network must have identical network addresses to communicate. For example, the following two hosts are on the same network and communicate:

Host A: 178.60.124.100 255.255.0.0

Host B: 178.60.124.101 255.255.0.0

This two host nodes share the same network address (178.60), which is determined by the 255.255.0.0 subnet mask and therefore are in communication. Hosts that are on different networks cannot communicate without an intermediating device. For example:

Host A: 178.60.164.100 255.255.0.0

Host B: 178.45.164.101 255.255.0.0

In the two hosts, the subnet masks remains the same, but the network addresses are now different (178.60 and 178.45 respectively) and therefore, the two hosts are not on the same network, and therefore, they cannot communicate without a router between them. Routing is the process of forwarding packets from one network to another.

Consider the following example:

Host A: 178.60.1.1 255.248.0.0

Host B: 178.69.1.1 255.248.0.0

The specified subnet mask is now 255.248.0.0, which doesn't fall cleanly on the octet boundary. To determine if these hosts are on separate networks, first convert everything to binary:

Host A Address: 10110010.00111100.00000001.00000001

Host B Address: 10110010.01001111.00000001.00000001

Subnet Mask: 11111111.11111000.00000000.00000000

As noted earlier, remember that the 1 (or on) bits in the subnet mask identify the network portion of the address. In this example, the first 13 bits (the 8 bits of the first octet, and the first 5 bits of the second octet) identify the network. Looking at only the first 13 bits of each address:

Host A Address: 10110010. 00111

Host B Address: 10110010.01001

It is clear that the network addresses are not identical and therefore the two hosts are on separate networks hence cannot communicate unless through a router.