King Fahd University of Petroleum and Minerals

Electrical Engineering Department
EE 400, Experiment # 4

IP Addressing and Subnetting

Objectives: After this experiment, the students should be able to configure for networking, assign IP address, and subnet mask to any of the host running on windows 98 OS. They should be able to test the connectivity of the host to the network and check the network status.

IP addressing:

Five forms of IP Addresses
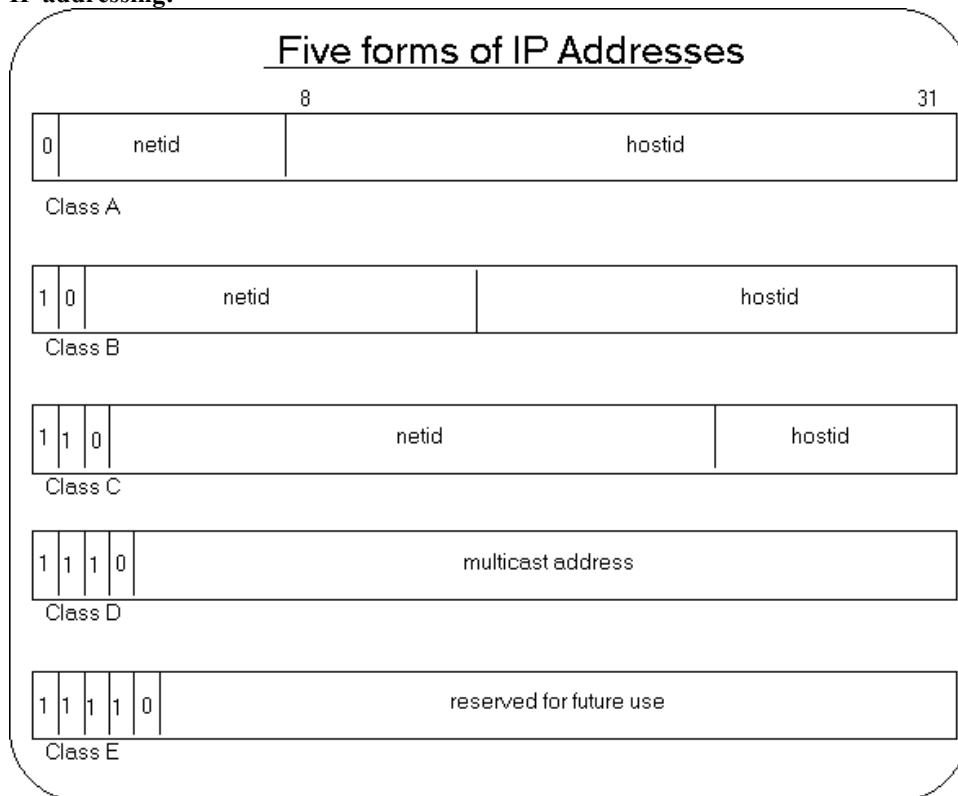
	Net ID	First Host	Last Host	Net ID (bytes)	Host ID (bytes)	Size of Net
Class A				1	3	Huge # of Host, Less # of NW
First Network	1.0.0.0	1.0.0.1	1.255.255.254			
Last Network	126.0.0.0	126.0.0.1	126.255.255.254			
Class B				2	2	# of Host = # of NW
First Network	128.1.0.0	128.1.0.1	128.1.255.254			
Last Network	191.254.0.0	191.254.0.1	191.254.255.254			
Class C				3	1	Huge # f NW, Less # of Hosts
First Network	192.0.1.0	192.0.1.1	192.0.1.254			
Last Network	223.255.254.0	223.255.254.1	223.255.254.254			

Class D: a multicast address.   (224.0.0.0 - 240.0.0.0)

Class E: reserved for future use.   (241.0.0.0 - 248.0.0.0)

Special forms of INTERNET Addresses

For class C address, only 254 hosts can be supported because
- 0 is reserved for boot process
- 255 reserved for broadcast e.g.

0.0.0.0 - This host.

0.host_number - host on this net.

255.255.255.255 - Limited broadcast (local net).

net_number.255 - Directed broadcast for the specified net. (e.g 196.15.32.255 broadcast to all hosts of the local network.)

127.anything - Loop back (should never appear on the net).

IP Subnetting

Subnetting is a Technique used to allow a single IP network address to span multiple physical networks. IP hosts should support subnetting. Subnetting is done by using some of the bits of the host-id part of the IP address as a physical network identifier. The subnet mask is used to determine the bits of the network identifier. All hosts on the same network should have the same subnet mask.
An example of Subnetting:
The Class B network 128.10.0.0 can be subnetted using the first 8 bits of the host-id, to span 254 different physical networks. The subnet mask for this case is 255.255.255.0 The subnetworks are: 128.10.1.0, 128.10.2.0, ..., 128.10.254.0 . Each of the subnetworks can have up to 254 different hosts:
128.10.XXX.1, 128.10.XXX.2, ..., 128.10.XXX.254 .
If there is a need for less physical nets and more hosts in each one, less host-id bits can be used for subnetting. For example: With the subnet mask 255.255.254.0, 126 different subnets are available with up to 510 hosts in each one.

Many Class A and B networks do not contain as many hosts as they could. This situation causes a lot of address space waste. Subnetting better utilizes the address space by dividing these big networks to smaller ones.

IP Subnetting examples

Class C subnetting example.

In Host ID, 3 bits are used for subnet, 5 are used for Hosts
Only ($2^5 = 32$) – 2 = 30 Host are allowed for each subnet because
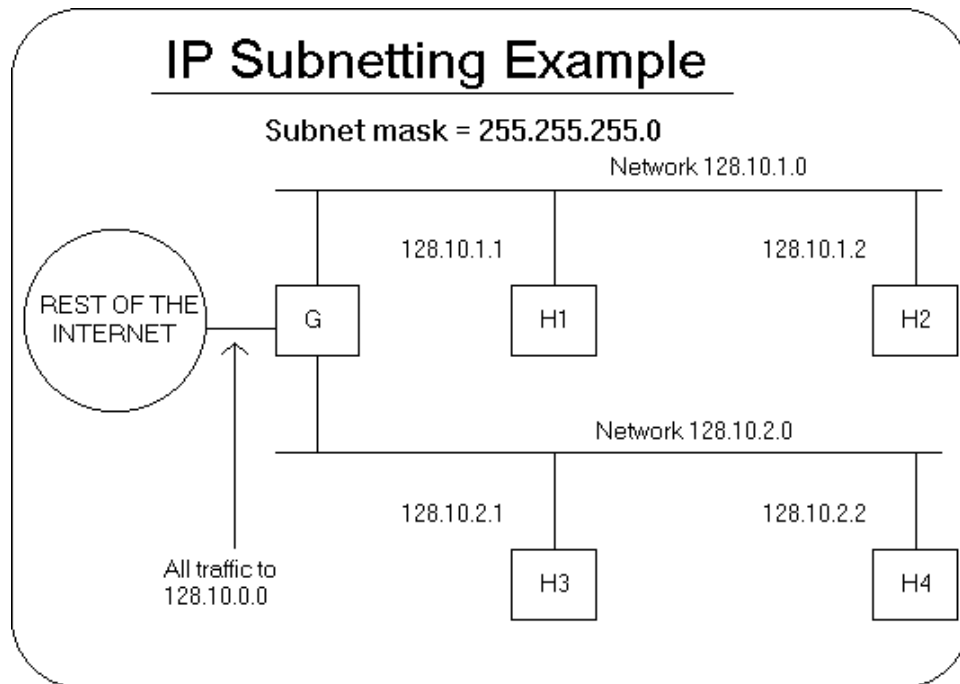- 31 used for broadcast
- 0 used for bootup
Only ($2^3 = 8$) –1 = 7 subnets are allowed because

25

- 0 is not allowed

Subnet mask for Host ID field will be $(1110\ 0000)_b = (224)_d$
Thus full Subnet mask will be 255.255.255.224

Class B subnetting example.

Dividing a single Class B network into two subnetworks:

Configuring the HOSTS File:

You will add host name/IP address mappings to your HOSTS file, and then use the file to resolve host names.

Pinging local hostname:

You will ping the name of local host to verify that Microsoft TCP.IP can resolve local host names without entries in the HOSTS file.

1. Type **ping** *hostname* (where hostname is the name of your computer) and then press Enter. See what was the response?
2. Type **ping** *hostname* (where hostname is the name of another computer) and then press Enter. See what was the response?

Pinging Remote hostname:

1. Type **ping** *vlsi* and then press Enter. (vlsi is the remote computer name). See what was the reponse?

Editing HOSTS File:

1. Start command prompt, and then change the directory to
   cd d:\winnt\system32\drivers\etc
2. You will now use a text editor to modify a file called **HOSTS**. Type **edit hosts** and then press Enter.
3. Add the following entry to the HOSTS file:
   196.1.64.70   vlsi
4. Press **Alt** key, then **Save** the file, and then **Exit**.

Using HOSTS file for name resolution:

1. Type **ping vlsi** and then press Enter. See what was the response.

Domain Name System (DNS)

The Domain Name System protocol provides a mapping between cryptic IP address and, easier to remember, host names. Host names are used because they are easier for humans to remember. For example, telnet itc.itc.kfupm.edu.sa is easy to remember than telnet 196.15.32.8

The Internet Domain Name System (DNS) is an attempt to decentralize administration of the mapping of host names to host addresses by the use of name-servers, each of which controls part of name space. This becomes necessary partly because the static host table formerly used for that purpose most of the hosts in the Internet are on networks local to particular organizations. It is desirable to allow the local administration to control that mapping. The DNS also implements a hierarchical naming scheme and provides protocols for communication with the name-servers. A set of top-level domains is administered by the Internet and is defined in the basic DNS specifications.

Top Level Domains:

The top level domains can be categorized as Organizational and Geographic:

com	Commercial
edu	Educational
gov	Governmental
mil	Military
net	Administrative organizations for network such as CSNET, BITNET etc.
org	Other Organizations
XX	two letter country code, e.g., sa for Saudi Arabia.

DNS Naming Convention:

- Besides the root, each node in DNS database has a name of up to 63 characters.
- Each sub domain must have a unique name within its parent domain.

Domains-Subtrees of the Entire Database:

Root-Level Domain: Top of the hierarchy is called the root domain.

Top-Level Domain: First level domain contains second level domains and hosts. Top Level domains include .com and .net. This is a child of the root.

Second-Level Domain: It contains hosts and other domains called "subdomains". Microsoft.com and Compaq.com are second level domains. Second level domains are children of First-Level Domains.

Third-Level Domain: It contains hosts and other domains called "subdomains". mspress.microsoft.com is a subdomain and a third-level domain. A third-level domain is a child of a second-level domain.

DNS Operation:

DNS uses a client/server model, in which DNS servers (name servers) contain information about the DNS database and make this information available to clients (resolvers).

DNS name servers perform name resolution by interpreting network information to find a specific IP address. Let see how DNS operates using the example of widget.universal.com

1. A resolver (or client) passes a query to its local name server.
2. The local name server sends an iterative request to one of the DNS root servers, requesting resolution of the domain name. The DNS root server returns a referral to the name servers that are authoritative for the com DNS domain.
3. The local name server sends an iterative request to one of the com name servers, which responds with a referral to the "universal" name servers.
4. The local name server sends an iterative request to one of the "universal" name servers.
5. When the universal name server receives the request from the local name server, it passes the widget piece of the DNS name to its local WINS server for resolution, WINS returns the IP address for widget to the universal name servers, which returns the IP address of the domain name to the local DNS server, which then send it back to the client resolver.