Course Packet 04

Introduction to TCP/IP Protocols

Activity Sheet 04a

IP Addressing Basics

Activity Sheet 04a

Objective

- Identify the class of an IP address based on the given network number

Background / Preparation

This lab activity helps to understand IP addresses and how TCP/IP networks operate. IP addresses are used to uniquely identify individual TCP/IP networks and hosts on networks in order to communicate. Workstations and servers on a network are called hosts and each has a unique IP address referred to as host address. TCP/IP is the most popular and widely used protocol in the world. The host must have an IP address in order to access the Internet. The IP address has two parts:

- A network address
- A host address

The network portion of the IP address is allotted to a company or organization. Routers use the IP address to transmit data packets between networks. As discussed in this course packet, IP addresses are 32-bits long and are divided into 4 octets of 8 bits each. They operate at the network layer of the OSI model, which correspond with the Internet layer of the TCP/IP model. IP addresses are assigned in the following ways:

- Statically – manually assigned by a network administrator
- Dynamically – automatically assigned by DHCP server

The IP address of a host can be changed because it is a logical address. The MAC address of the host is the physical address. This address is burned into the network interface card and cannot change unless the NIC is replaced. Combining the logical IP address and the physical MAC address helps route packets to their proper destination.

There are five classes of IP addresses, and depending on the class, the network and host part of the address can use a different number of bits. In this activity, different classes of IP addresses will be worked with and to help become familiar with the characteristics of each. Understanding IP addresses is key to the understanding TCP/IP and internetworks in general. The following resources are required:

- PC workstation with Windows OS installed
- Access to the Windows Calculator

Step 1: Review the five classes of IP address and their characteristics

There are five IP addresses classes: A, B, C, D and E. Only the first three classes are used commercially. The Class A address must start with a number between 1 and 126 or the first bit is always a zero, meaning the High Order Bit or the 128 bit cannot be used. 127 is reserved for loopback testing. The first octet defines the network ID for a Class A network address.

Default subnet mask

The default subnet mask uses all binary 1s or decimal 255, to mask the first 8 bits of the Class A address. The default subnet mask assists routers and hosts determine if the destination host is on this network or another one. Since there are only 126 Class A networks, the remaining 24

bits or 3 octets can be used for hosts. Every Class A network can have 224 or over 16 million hosts. It is common to subdivide the network, using a custom subnet mask, into smaller groupings called subnets.

Network and host address

The addresses' network or host portion cannot be all ones or all zeros. As an example, the Class A address of 118.1.1.10 is a valid IP address. The network portion, which are equal to 118, is not all zeros and the host portion is not all zeros or all ones. If the host portion are all zeros, it would be the network address itself, but if the host portion are all ones, it would be a broadcast address. The value of any octet can never be greater than binary 11111111 or decimal 255.

Class	1st Octet Decimal Range	1st Octet High Order Bits	Network/Host ID (N=Network, H=Host)	Default Subnet Mask	Number of Networks	Hosts per Network (Usable Addresses)
A	1 – 126 *	0	N.H.H.H	255.0.0.0	126 ($2^7 - 2$)	16,777,214 ($2^{24} - 2$)
B	128 – 191	10	N.N.H.H	255.255.0.0	16,382 ($2^{14} - 2$)	65,534 ($2^{16} - 2$)
C	192 – 223	110	N.N.N.H	255.255.255.0	2,097,150 ($2^{21} - 2$)	254 ($2^8 - 2$)
D	224 – 239	1110	Reserved for Multicasting			
E	240 – 254	11110	Experimental; used for research			

Note: Class A address 127 cannot be used since it is reserved for loopback and diagnostic functions.

Step 2: Determine basic IP addressing

Use the IP address chart above and your knowledge of IP address classes to answer the following questions:

1. What is the binary and decimal range of the first octet of all possible Class B IP addresses?
   Decimal: From: 128 to: 191
   Binary: From: 10000000 to: 10111111
2. Which octet(s) represent the network ID of a Class C IP address? The first 3 octets
3. Which octet(s) represent the host ID of a Class A IP address? The last 3 octets
4. What is the maximum number of usable hosts with an address in the Class C network? 224
5. How many networks are there in Class B? 16,384
6. How many hosts can Class B network have? 65,536
7. How many octets does an IP address have? 4 octets
8. How many bits per octet? 8 bits

Step 3: Given the IP address, determine the host and network addresses

With the following IP addresses, indicate the following:

- Class of each address
- Network address or ID
- Host portion
- Broadcast address for this network

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- Default subnet mask

IP Address	Class Address	Network Address or ID	Host Address	Broadcast Address	Default Subnet Mask
215.14.55.136	Class C	215.14.55.0	136	215.14.55.255	255.255.255.0
122.1.1.15	Class A	122.0.0.0	1.1.15	122.255.255.255	255.0.0.0
150.127.220.222	Class B	150.127.0.0	220.222	150.127.255.255	255.255.0.0
192.125.35.199	Class C	192.125.35.0	199	192.125.35.255	255.255.255.0
175.10.239.145	Class B	175.10.0.0	239.145	175.10.255.255	255.255.0.0

Step 4: Given an IP address of 192.20.0.25 and a subnet mask of 255.255.255.0, answer the following questions:

What is the class of the address? Class A

What is the network address of the IP address? 192.0.0.0

Is this a valid IP host address (Y/N)? Yes

Why or why not?

Because it still follows the structure and range rules of IPv4 addresses.

Step 5: Determine which of the given IP host addresses are valid for commercial networks

Determine which are valid for commercial networks for the following IP host addresses, and why or why not. Valid means it can be assigned to any of the following:

- Workstation
- Server
- Printer
- Router interface
- Any other compatible device

Fill in the following table:

IP Host Address	Valid Address? (Yes/No)	Why or Why Not
160.100.255.254	Yes	all octets are within 0-255 range and the first octet is within Class B
178.100.10.1	Yes	all octets are within 0-255 range and the first octet is within Class B
256.125.150.1	No	first octet is not within the 0-255 range
100.100.10.1	Yes	all octets are within 0-255 range and the first octet is within Class A
180.258.221.176	Yes	all octets are within 0-255 range and the first octet is within Class B
127.0.0.1	Yes	all octets are within 0-255 range and the first octet is within Class A
224.156.271.39	No	3rd octet is not within the 0-255 range

Activity Sheet 04b

Activity Sheet 04b

Subnetting

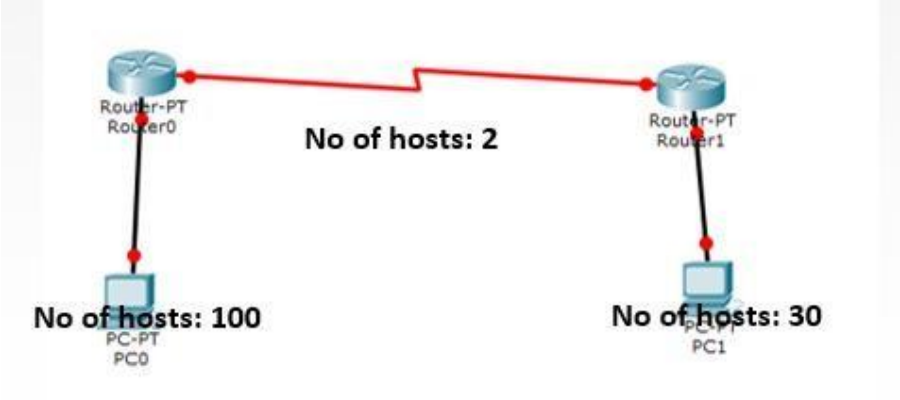
Objective

- Identify the network, hosts and broadcast address

Background / Preparation

This is a written exercise and is to be performed without the aid of an electronic calculator.

1. Divide the network: 10.0.0.0/8 into 10 equal subnets.
2. What subnet mask must be used to support 10 hosts if you are using a network address of 100.0.0.0/8?
3. What subnet mask should be used to support 6 hosts if you are using a network address of 190.18.1.0/16?
4. Use VLSM in subnetting the network: 172.16.0.1/16



ANSWER:

1.

2. 2^H - 2 >= 10 or 2^4 = 16 - 2 >= 10. Therefore, we need 4 bits for host, we can use the remaining 20 bits for network portion, 8 + 20 = /28 and so the subnet mask would be /28.

3. 2^H - 2 >= 6 or 2^3 = 8 - 2 >= 6. Therefore, we need 3 bits for hosts, 16-3 = 13 and so, 16 + 13 = /29. The subnet mask would be /29.

4. Subnet 1: 100
   Subnet 2: 30

   Subnet 1:
   2^H - 2 >= 100 or 2^7 = 128 - 2 is greater than 100 and so, /16 would be /25.
   Subnet 2:
   2^H - 2 >= 30 or 2^5 = 32 - 2 is greater than 30 and so, /16 would be /27.

   Subnet 1: (100 hosts, /25)
   Network: 172.16.0.0/25
   Range: 172.16.0.1 - 172.16.0.126
   Broadcast: 172.16.0.127

   Subnet 2: (30 hosts, /27)
   Network: 172.16.0.128/27
   Range: 172.16.0.129 - 172.16.0.158
   Broadcast: 172.16.0.159