King Fahd University of Petroleum & Minerals

Electrical Engineering Department

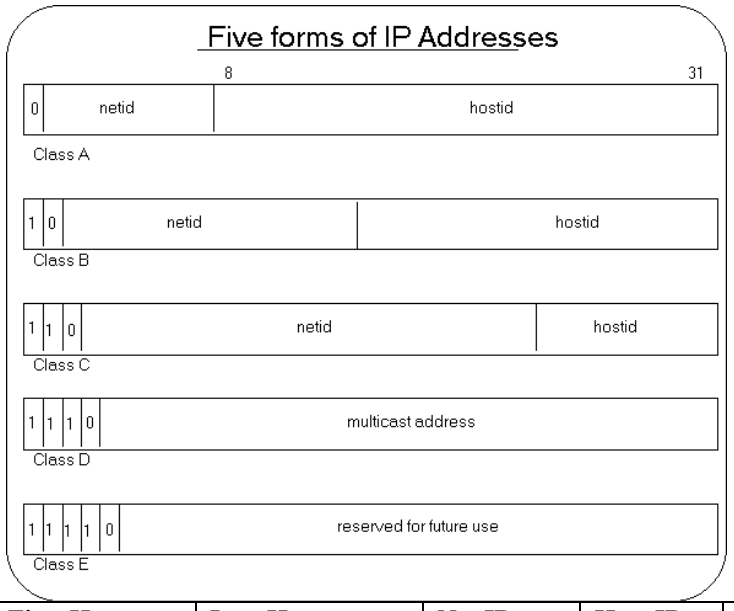
EE 400, Experiment # 2

IP Addressing and Subnetting: Establishing Elementary Networks using Hubs, Switches and Routers.

Objectives:

After this experiment, the students shall be able to explain the need and significance of assigning IP addresses statically or dynamically, its associated subnet mask, default gateway, and DNS servers. They shall be able to identify and use hubs, layer-2 switches, routers and layer-3 switches appropriately to establish an elementary network.

IP addressing:



	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

0.0.0.0 – Default route

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 196.15.32.0 network.)

127.anything - Loop back test

Given the above parameters, this system allows for the following combinations of valid Internet network and host addresses:
To determine the number of possible networks or hosts, use the formula $2^n - 2$, where n is the number of bits in the network or host space. The subtraction of 2 is for the actual network and broadcast address.

Class	Possible Networks	Possible Hosts
A	126	16,777,214
B	16,384	65,534
C	2,097,152	254

Several networks are reserved for private use and cannot be used on the Internet. They include:

Class	Address Range
A	10.x.x.x
B	172.16.x.x through 172.31.x.x
C	192.168.x.x

These addresses are commonly used for corporate intranets and for testing.

IP Subnetting *(Refer to Appendix C for more reading)*

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.X.1, 128.10.X.2, ..., 128.10.X.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 $2^3 – 2 = 8 – 2 = 6$ subnets are allowed because

- 0 is not allowed
- All 1's are used for broadcast.

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

Exercises

1. Students will distribute themselves in four groups A, B, C and D.
2. Connect computers in groups A and B to Hub 1 and Switch 1 respectively.
3. Connect computers in groups C and D to Switch 2 and Switch 3 respectively.

Phase 1

4. Assign IP addresses and subnet masks of the computers in each group as depicted in the figure 2.1. Groups A and B belong to the one subnet and Groups C and D belong to other subnet.
5. Interconnect group A and group B by connecting Hub 1 and Switch 1 with the help of Straight cable.
6. Verify the end-to-end link between computers of group A and B by pinging each other.
7. Repeat steps 4, 5 and 6 for group C and D with Switch 2 and Switch 3.

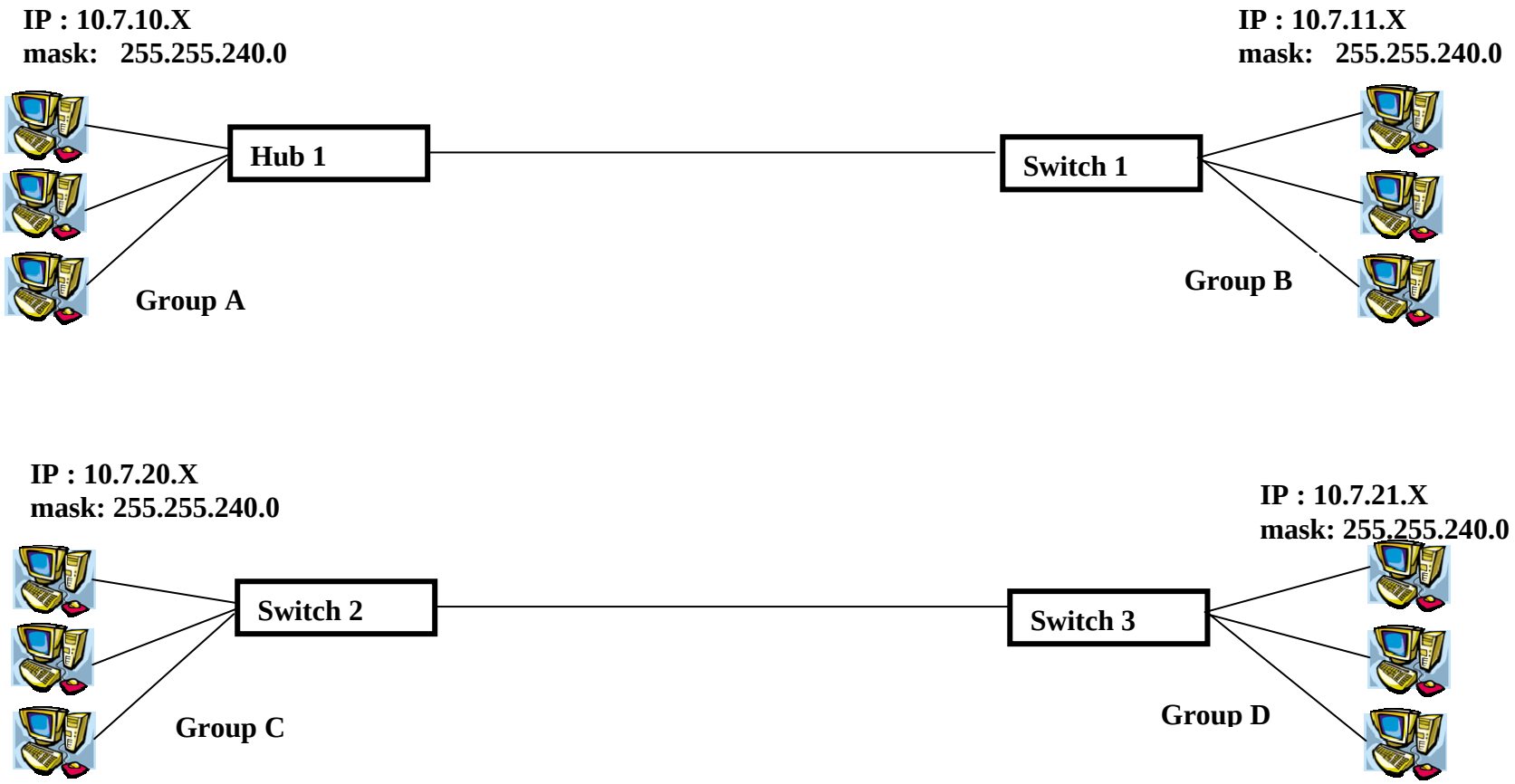
Phase 2

8. Assign IP addresses and subnet masks of the computers in each group as depicted in the figure 2.2.
9. Now interconnect group A and group C by connecting Hub1 and Switch 2 with the help of Straight cable.
10. Verify the inability of communication between computers of group A and C by pinging each other.
11. Repeat steps 8, 9 and 10 for group B and D.

Phase 3

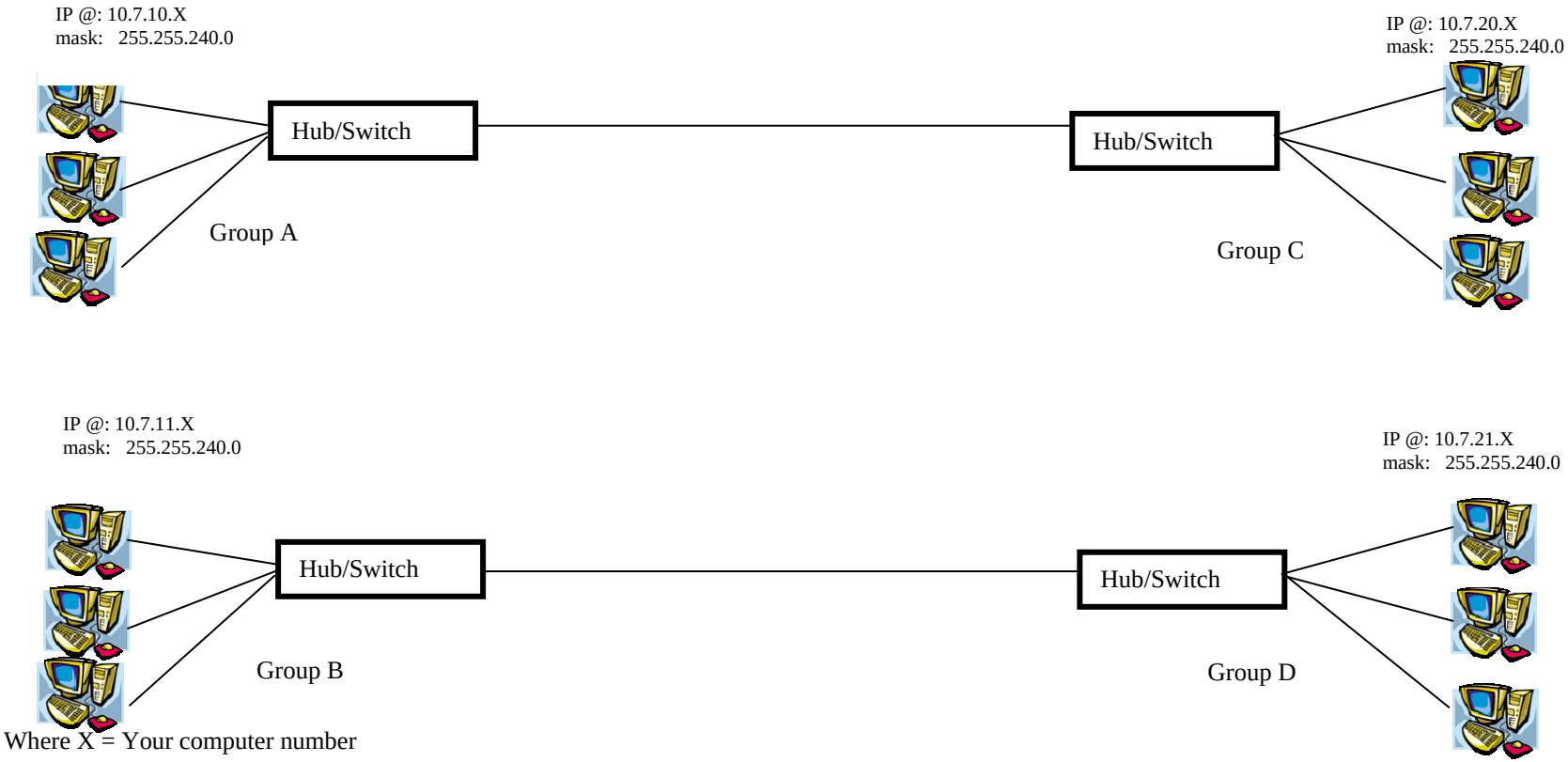
12. Assign IP addresses and subnet masks of the computers in each group as depicted in the figure 2.3.
13. Interconnect group A and group C by connecting Hub 1 and Switch2 through Router1 interfaces FastEthernet0/0 and FastEthernet0/1 respectively.
14. Verify the end-to-end link between computers of group A and C by pinging each other.
15. Repeat steps 12, 13 and 14 for group B and D using Router2.

Figure 2.1: Phase 1



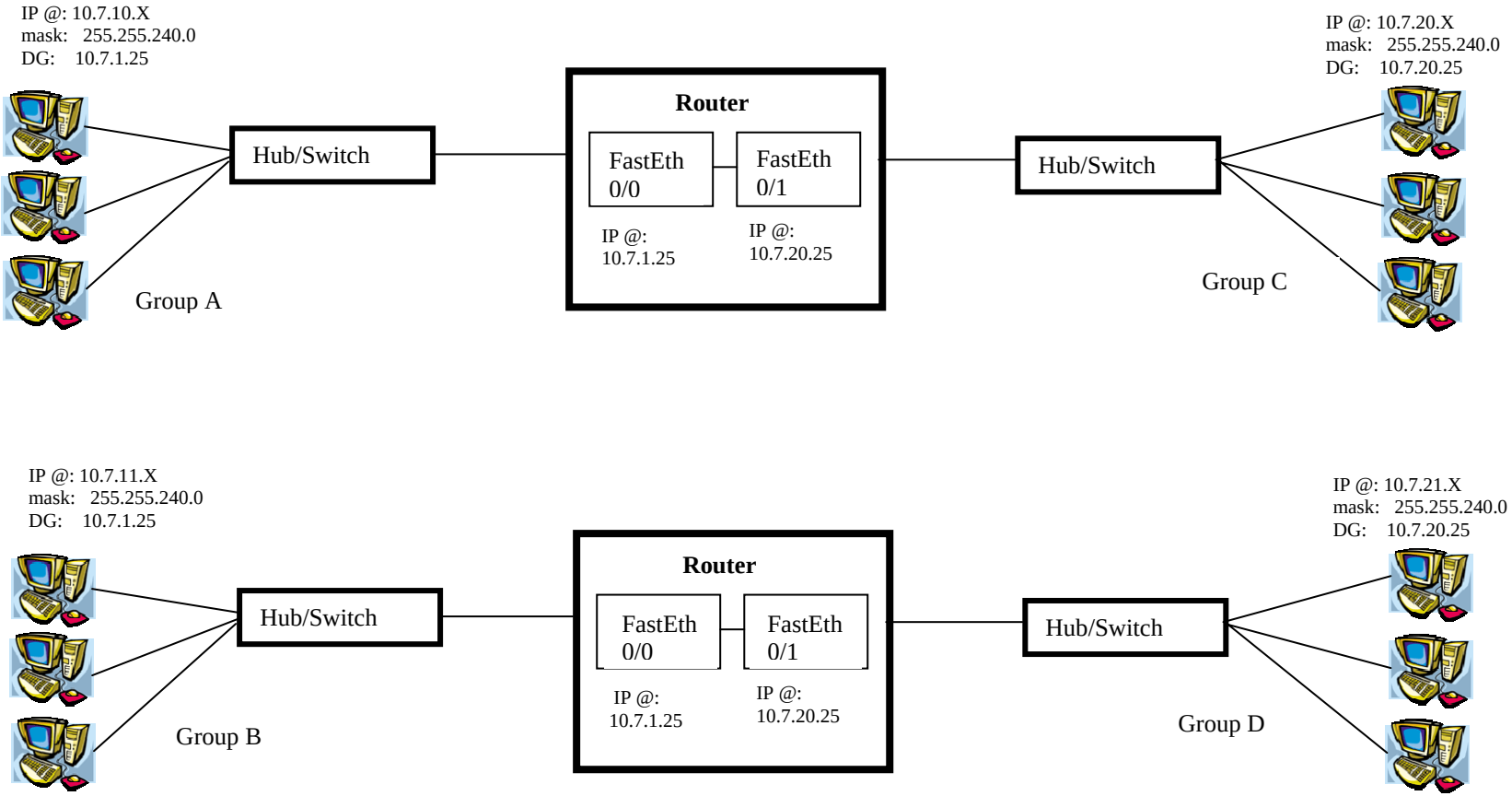
Where X = your computer number

Figure 2.2: Phase 2



Where X = Your computer number

Figure 2.3: Phase 3



Where X = Your computer number