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Electrical Engineering Department

**EE 400, Experiment # 7**

## **Configuration of Routers and Establishing Routed Networks**

### **Objectives:**

The objective of this experiment is to introduce to the students different access levels and commands of routers for the purpose of monitoring and basic configuration of these devices. They will also be establishing different types of networks with basic backbone connectivity using back-to-back routers.

## **Accessing the Cisco Routers thru CLI**

### **Introduction**

Cisco IOS® Software runs on Cisco routers; this software manages all the processes that occur on the router while also allowing users to interact with and configure the router. Cisco IOS Software provides a relatively simple command-line interface (CLI) that is used both to accept user commands and to display router output.

### **Overview of User Levels and Modes**

As a security feature, Cisco IOS Software separates EXEC sessions into two different access levels: user EXEC level and privileged EXEC level.

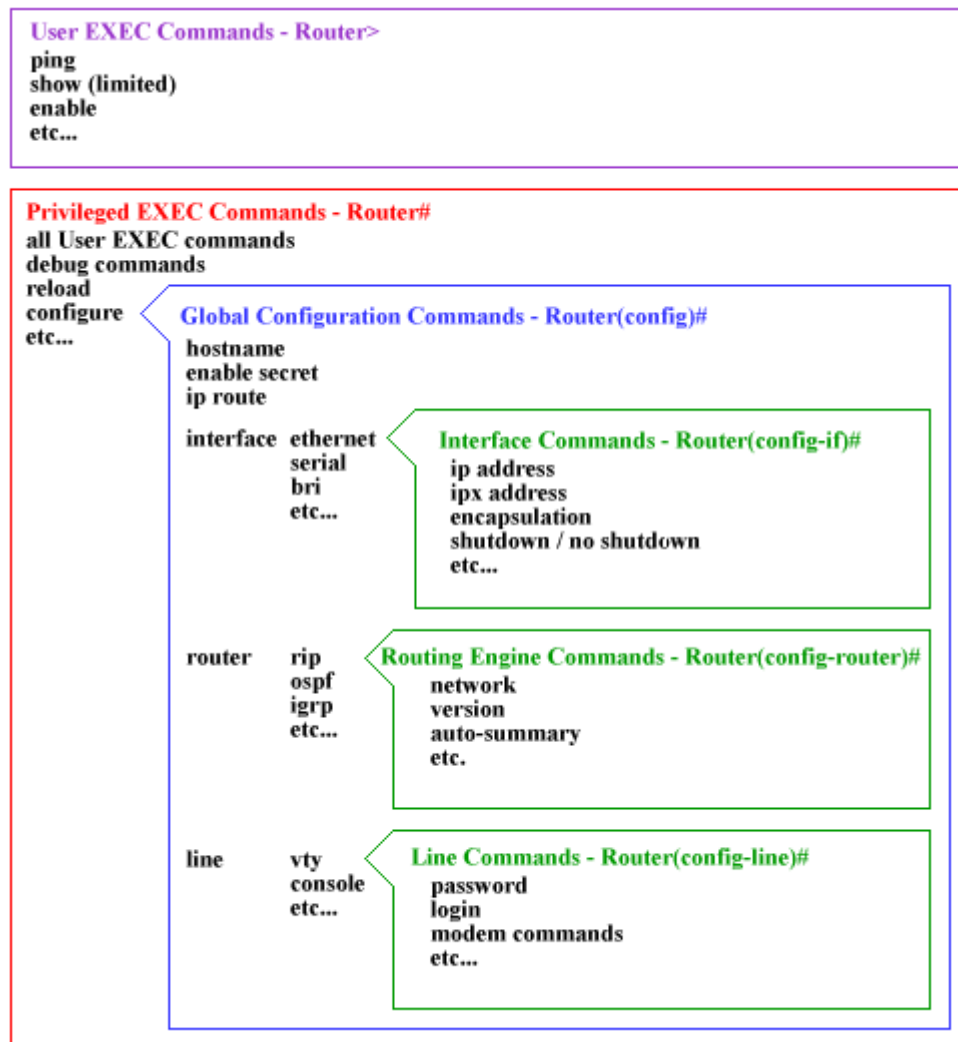
1. User EXEC level allows you to access only basic monitoring commands; privileged EXEC level allows you to access all router commands.
2. Privileged EXEC level can be password protected to allow only authorized users the ability to configure or manage the router. From privileged EXEC level, you can access all the command modes.

There are five command modes:

1. global configuration mode,
2. interface configuration mode,
3. subinterface configuration mode,
4. router configuration mode, and
5. line configuration mode.

## Cisco IOS Command Hierarchy

After an EXEC session is established, commands within Cisco IOS Software are hierarchically structured. Understanding this hierarchy is important for successfully configuring the router. The following figure illustrates a simple high-level schematic diagram of some Cisco IOS commands.



Command options and applications vary, depending on your position within this hierarchy. Configuration command options are not available until you have navigated to the configuration branch of the Cisco IOS CLI structure. When you are in the configuration branch, you may enter system-level configuration commands that apply to the entire router at the global configuration level. Interface-specific configuration commands are available when you switch to the interface configuration level.

To assist you in navigation through the Cisco IOS CLI, the command prompt changes to reflect your position within the command hierarchy. This setup allows you to easily identify where within the command structure you are at any given moment. The following table is a summary of command prompts and the corresponding location within the command structure.

<b>Router&gt;</b>	- User EXEC mode
<b>Router#</b>	- Privileged EXEC mode
<b>Router(config)#</b>	- Configuration mode (notice the # sign indicates this is accessible only at privileged EXEC mode)
<b>Router(config-if)#</b>	- Interface level within configuration mode
<b>Router(config-router)#</b>	- Routing engine level within configuration mode
<b>Router(config-line)#</b>	- Line level ( <u>vt</u> y, tty, async) within configuration mode

## Context-Sensitive Help

The Cisco IOS® command-line interface CLI offers context-sensitive help, a useful tool if you are a new user because at any time during an EXEC session, you can type a question mark (?) to get help. Two types of context-sensitive help are available: word help and command syntax help.

Word help can be used to obtain a list of available commands that begin with a character (or string of characters) that you have begun to type. To use word help, enter ? immediately after the character, or characters, in question, without a space.

Command syntax help can be used to obtain a list of command, keyword, or argument options that are available based on the syntax you have already entered. To use command syntax help, enter ? in the place of a keyword or argument.

### Logging on to the Router:

When you open a console session in a router, you are automatically in user EXEC command mode. Critical commands (for example, configuration and management) require that the user be logged into privileged EXEC level.

To change to the privileged EXEC level, type **enable** at the **Router>** prompt. The router prompt changes to **Router#**. The privileged EXEC mode prompt consists of the host name of the device followed by the pound sign (#). Then use the help system to display the commands available in privileged EXEC mode. Privileged EXEC level can be password protected to allow only authorized users the ability to configure or manage the router.

### Global Configuration Mode:

Global configuration commands apply to features that affect the system as a whole. Use the **configure** privileged EXEC command to enter global configuration mode. When you enter this command, the system EXEC prompts you for the source of the configuration commands:

Configuring from terminal, memory, or network [terminal]?

You can then specify either the terminal, nonvolatile random-access memory (NVRAM), or a file stored on a network server as the source of configuration commands. Configuring from the terminal is the system default. You can specify the source of the commands when first entering the command, by entering **configure terminal**, **configure memory**, or **configure network**. For now, press **Return** to select the default, terminal configuration.

The **configure memory** command loads the startup configuration from NVRAM as the running configuration.

The **configure network** command loads a configuration from a network source as the running configuration.

When the global configuration mode is entered, the router prompt changes to **Router(config)#**. Then use the help system to display the commands available in global configuration mode.

From global configuration mode, you can access many other command modes, the following being the most commonly accessed:

- Interface configuration mode
  - Subinterface configuration mode
- Router configuration mode
- Line configuration mode

## Interface Configuration Mode

Interface configuration commands modify the operation of an interface such as an Ethernet, Token Ring, or serial port. In order to configure a specific interface, you need to enter interface configuration mode, from global configuration mode, by entering the **interface <interface type port number>** command.

Enter interface configuration mode on the FastEthernet 0/0 interface by entering **interface FastEthernet 0/0**. The prompt **Router(config-if)#** indicates that you are in interface configuration mode. Then use the help system to display the commands available in interface configuration mode. To exit interface configuration mode and return to global configuration mode, enter the **exit** command.

## Interface Description

An interface can be given a description to document specific information about that interface. The configured description appears in the output when you display the configuration information that exists in router memory. Use the **description** interface configuration command to assign the description **FirstEthernet1** to interface fastethernet 0/0, making sure that there are no spaces between the words in the description.

## Router Name

The default router name is "Router." Giving each router a unique name aids in network management by allowing you to uniquely identify each router within the network. The name of the router is considered to be the host name and is displayed in the system prompt. Let's change the host name from "Router" to "lab400-router1" Notice that the name in the system prompt changes immediately after the **hostname** command is entered.

Task	Command
1 From user EXEC mode, enter privileged EXEC mode of router1	<b>enable</b>
2 From privileged EXEC mode, enter global configuration mode.	<b>configure terminal</b>
3 From global configuration mode, configure a new host name.	<b>hostname lab400-router1</b>

## IP Addresses

Use the **ip address** command to assign an IP address and subnet mask to the FastEthernet 0/0 and FastEthernet 0/1 interfaces. Use the IP address 10.7.1.25 and 10.7.20.25 for the two interfaces respectively and the subnet mask 255.255.240.0. An interface must be assigned a unique logical network address before it can establish connectivity to a network.

Task	Command
1 From global configuration mode, enter interface configuration mode of <b>Fastethernet 0/0</b>	<b>interface Fastethernet 0/0</b>
2 From interface configuration mode, assign an IP address to the interface.	<b>ip address 10.7.1.25 255.255.240.0</b>
1 From global configuration mode, enter interface configuration mode <b>Fastethernet 0/1</b>	<b>interface Fastethernet 0/1</b>
2 From interface configuration mode, assign an IP address to the interface.	<b>ip address 10.7.20.25 255.255.240.0</b>

## Adding Static Routes and Default Gateway

Use the **ip route <subnet-IP-address> <subnet-mask> <default-gateway>** command to add a static route in the routing table.

To add the **Gateway of Last Resort** use the following command.

**ip route 0.0.0.0 0.0.0.0 <gateway-ip-address>**

## Removing/Undoing commands

The Cisco IOS Software provides an easy way to remove commands from a configuration: simply navigate to the proper mode and type **no** followed by the command to be removed.

## Viewing Running Configuration

To display the running configuration, use the **show running-config** command in privileged EXEC mode. Once again, display the running configuration to see the changes you have made. To display the running configuration, use the **show running-config** command in privileged EXEC mode.

If an interface is in a shutdown state, "shutdown" appears indented under that particular interface. Also, commands that are enabled by default are not displayed in output of **show running-config**.

## View Interface Details

To view information about a particular interface, you can use the **show interfaces** command, which provides the important information about interface. From privileged EXEC mode, display interface information for the interface by **show interfaces Fastethernet 0/0** command

## Viewing Protocols

Use the **show protocols** or **show running-config** command to view the active protocols on the router.

- **show protocols**: Notice that under the *Global values* section you do not see *Internet Protocol routing is enabled*, indicating that IP routing has been turned off in this router.
- **show running-config**: You can tell if IP routing is disabled by looking at the configuration file for an entry stating "no ip routing."

*Remember:* IP routing is supported by default in Cisco routers. To enable IP routing on Router\_A, enter the global configuration command **ip routing**.

Use the **show protocols** command to view the active protocols on the router. Notice that under the *Global values* section you now see *Internet Protocol routing is enabled*, indicating that IP routing is enabled on this router.

## Viewing Static Routes

Use the **show ip route** command to see the details of routes in the routing table.

## Lab Exercise

### Phase 1

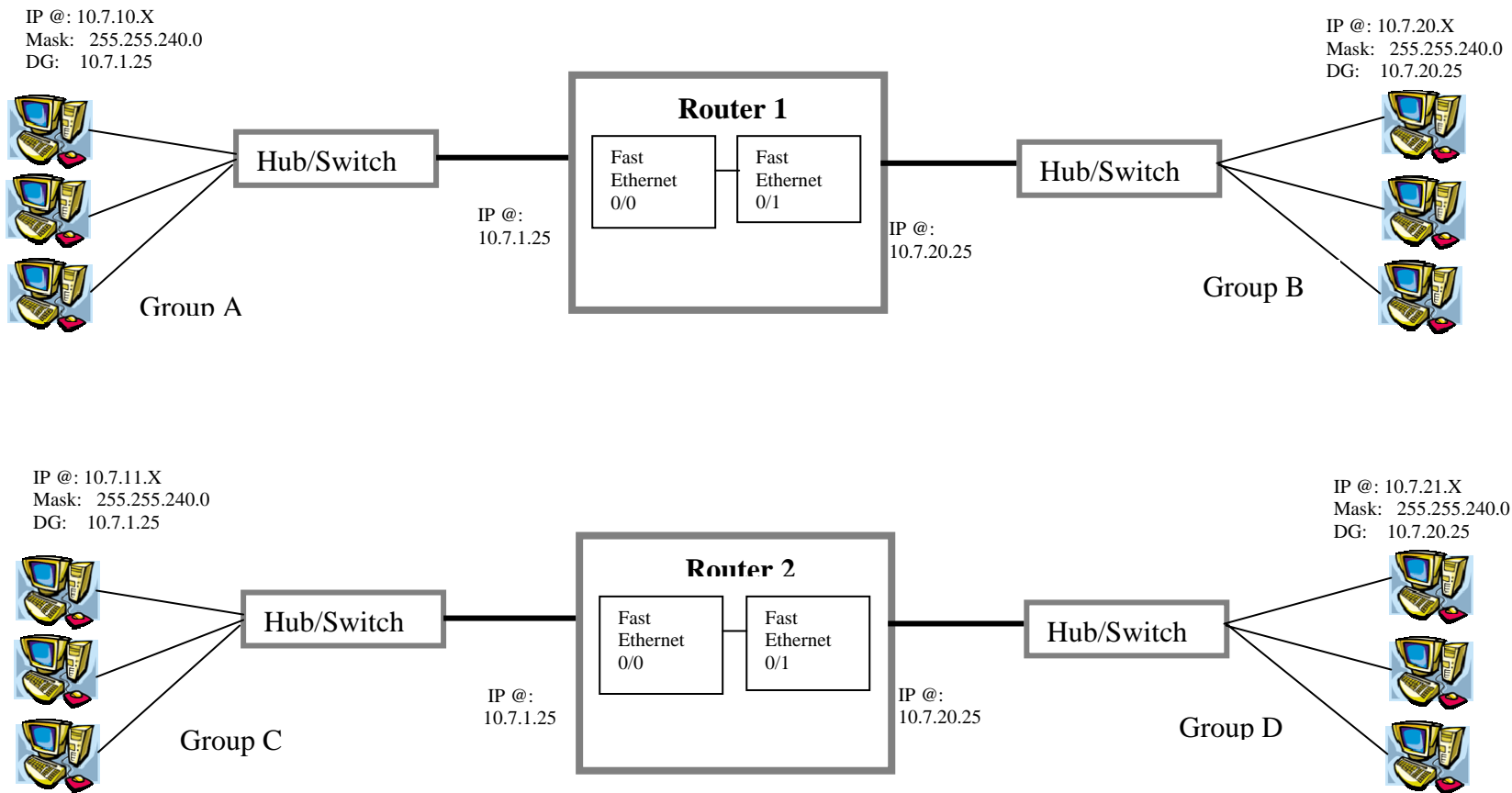
1. Login to the router-1 in Privilege EXEC mode.
2. Assign name to the router.
3. Assign IP addresses to both interfaces of the router as shown in the figure1
4. Connect group A to switch-1 and group B to switch-2.
5. Connect switch –1 to FastEthernet 0/0 and switch –2 to FastEthernet 0/1.
6. Check the connectivity of group A and B.
7. Enable IP routing on the router and check the connectivity of group A and B.
8. Repeat the above steps for Group C and D.

### Phase 2

1. Login to the routers in Privilege EXEC mode.
2. Assign IP addresses to both interfaces of the routers as shown in figure2
3. Assign Default Gateways (gateway of last resort) to the routers as shown in figure2
4. Connect Network-1 to switch-1 and Network-2 to switch-2.
5. Connect switch –1 to FastEthernet 0/0 of router-1 and switch –2 to FastEthernet 0/0 of router-2.
6. Interconnect router-1 and router-2 with the help of a cross cable on their FastEthernet 0/1 interfaces.
7. Check the connectivity of Network-1 and Network-2

### Phase 3

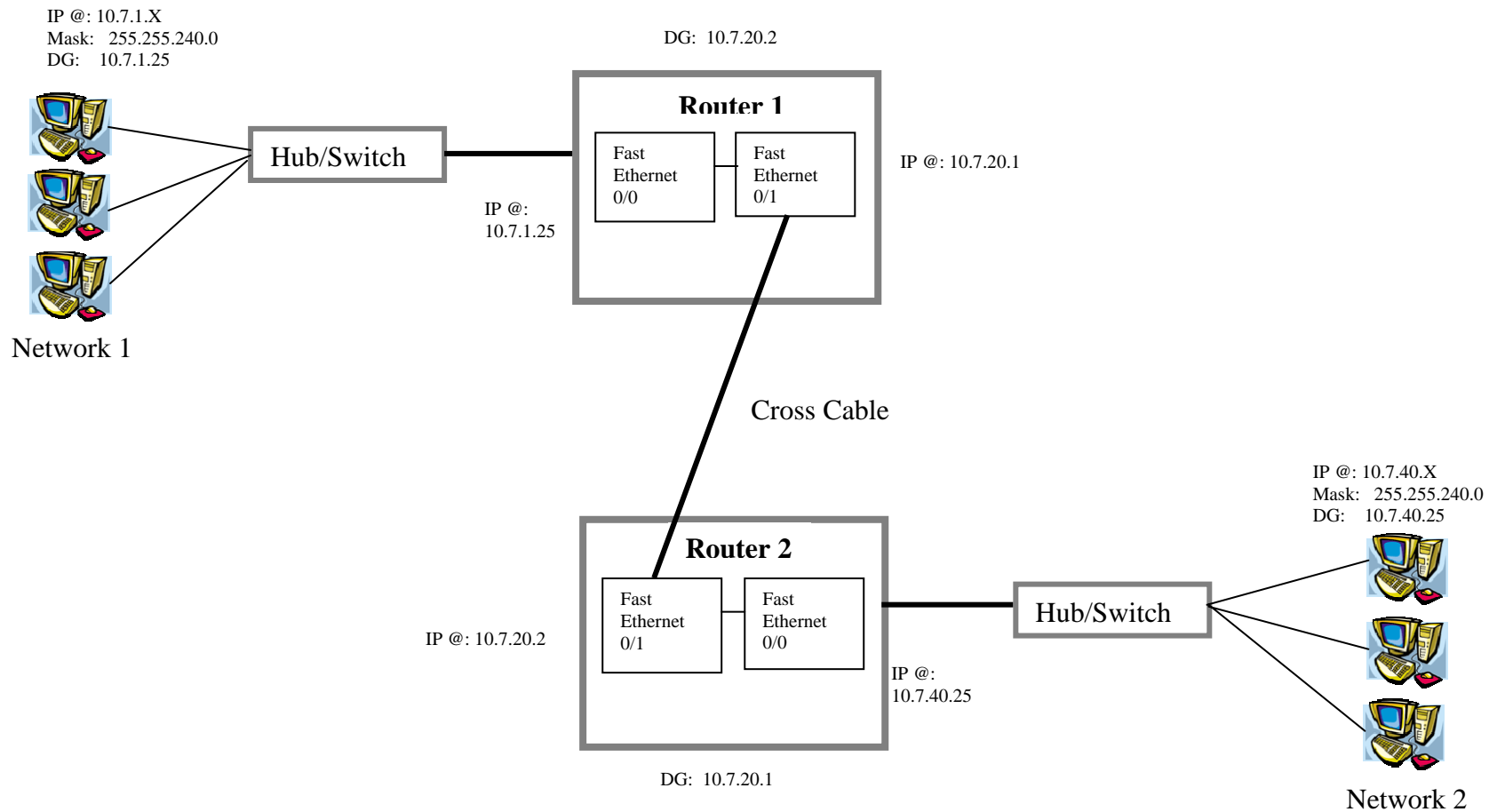
1. Connect Network-3 to switch-3 and then to FastEthernet 0/1 interface of router-1.
2. Connect FastEthernet 0/1 of router-2 to switch –3 with the help of a straight cable.
3. Check the connectivity of Network-1, Network-2 and Network-3.



Where X = Your PC number

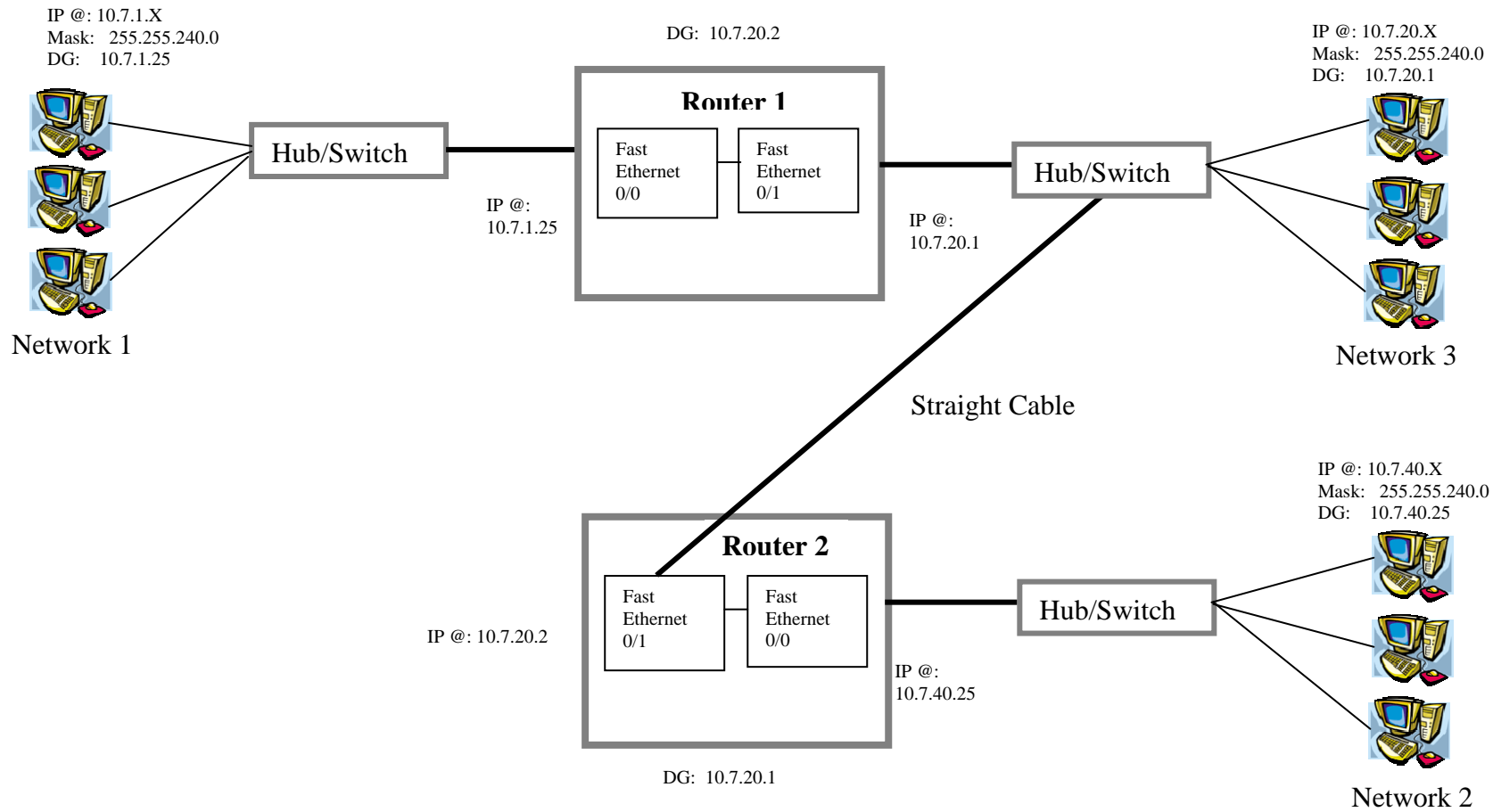
**Figure 1**





Where X = Your PC number

Figure 2



Where X = Your PC number

Figure 3