Cisco Routers for the Small Business: A Practical Guide for IT Professionals

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Getting to Know Your Router

In this book, I assume that you have one of Cisco's 800 Series or SOHO Series broadband routers on hand. You can use other Cisco models, but an 800 series running Cisco Internetworking Operating System (IOS) version 12.4 will be referenced in my examples. The 800 series routers are great, low-cost devices that have all the functionality small businesses need, with the added benefits that Cisco's IOS has to offer.

The Cisco IOS has a Command Line Interface (CLI) that allows you to type in special commands to configure your router. The CLI is a powerful tool that gives you full control of your router's features and is the key to understanding any Cisco IOS router or switch. As you work your way through this book, I will be introducing all of the CLI commands that will allow you to set up and configure your router for a small business. You'll be a Cisco pro in no time at all!

Understanding Your Ports

Cisco routers are essentially small computers. As such, they have all the basic software and hardware components of a PC. In addition to the IOS, they have hardware components such as a processor and memory. They also have several ports (interfaces) that allow you to connect other hardware components, such as workstations and switches as well as cable modems and DSL modems. Before we get started, it's important that you know a little bit about your equipment, so take it out of the box and have a look.

The Console Port

On the back of your router, you will find a port labeled "Console." This is sometimes referred to as the *management port*. It has an RJ45 connector that looks like a regular Ethernet port, but it's not. The console port is used in conjunction with a *console cable*, and allows you to configure your router from a PC. The console cable, which is usually blue, should have arrived with your router. It has an RJ45 connector on one end—which looks like a fat phone connector—and a DB9 female serial port connector on the other. The serial port end plugs into your PC's serial port, and the RJ45 plugs into the console

port on the back of your router. You'll learn more about the console port in the section, "Connecting to Your Router," later in this chapter.

LAN Ethernet Ports (E0 or VLAN1)

There are four Ethernet switch ports on the back of your router. On Cisco SOHO91 and 831 series routers, these ports are collectively labeled "Ethernet 10/100 BaseT Computers (E0)." On the newer 850 and 870 series routers they're labeled "LAN FE0, FE1, FE2, FE3." These ports are used by your workstations, or if you have more than four PC's, as an uplink to another Ethernet switch. What's important to note here is the IOS refers to all four ports as *e0*, or *vlan1*, depending on the model of your Cisco router. Later, when you're configuring your router with the CLI, you will be referring to those ports as either *interface e0* or *interface vlan1*.

WAN Ethernet Port (E1 or FA4)

There's one more port on the back of your router, which on Cisco SOHO91 or 831 series routers is labeled "Ethernet 10 BaseT Internet (E1)." On the newer 850 or 870 series routers, it's labeled "WAN FE4." This is the port where you will plug in your broadband device, which is usually a DSL modem or cable modem. It's important to remember that it is referred to by the Cisco IOS as either *interface e1* (on older models), or *interface fa4* (on the newer 850 and 870 series).

■**Note** It's odd, but Cisco chose to use different interface label names (on the back of the routers) than the names used to configure the interfaces themselves. For example, the label for the WAN port is FE4, but when you configure it using the IOS, it's referenced as FA4.

There are a lot of Cisco router models to choose from, and many of them use different names for their LAN and WAN interfaces. To simplify this introduction, I will be using early 800 series interface naming. The names are: e0 for the LAN interfaces and e1 for the WAN interface. In later chapters, I will introduce the 851 series router and use vlan1 for the LAN interfaces and fa4 for the WAN interface.

Connecting to Your Router

Cisco provides several methods to connect to and manage their routers. One method is the Security Device Manager (SDM). The SDM is a web-based interface that is accessed from a Java-enabled web browser. When you configure a router from the SDM, you fill in

web-based forms and access options from drop-down menus to configure the features of the router. When you're finished providing the configuration information, you save the data, which is converted to Cisco IOS commands that are then delivered to the IOS.

This may sound convenient, and when it works it is, but the reality is that the SDM interface is cumbersome and very unreliable. Often it will hang during the delivery of the IOS commands, delivering only some of the configuration to the router or none at all. When that happens, you need to start over. Also, the SDM only allows you to configure basic features of the Cisco IOS, even though the IOS version of the router supports a much more advanced feature set. Because of the problematic nature and limitations of the SDM, I won't be discussing it in this book, but it is something you should be aware of.

You can also access the router from a PC using a telnet or SSH application via one of the router's Ethernet ports. Because telnet and SSH are TCP/IP applications, the router must have an IP address and other configuration options set before using this connection method (I will be discussing this in Chapter 2). When you use telnet or SSH to access the router, you need to configure it using the CLI.

Another method used to connect to and configure your router is the console port on the back of the router. The console port allows you to configure your router when it has no IP address or other configuration information. Using a console cable that plugs into a PC, you can gain access to the Cisco CLI and issue IOS commands to configure the router.

Attach the Console Cable

The first time you connect to your router, you'll want to use the console port. The console port allows you to log in to your router via a PC *before* you have set up the router and assigned it an IP address. After you complete the router's basic IP setup, you can use telnet or the SSH application to connect to it from any PC on your network.

Locate the console cable provided with your router, plug the DB9 serial port into your PC, and plug the other end into the console port on the back of your router. If you have a PC or laptop that does not have a serial port, then you will need to purchase a USB-to-Serial adapter. These are inexpensive and can be found at any computer supply store.

Configure Hyper Terminal

Before you can log in, you need a terminal emulation program to allow you to interact with the router. All computers running Windows come with Hyper Terminal, which works nicely for our purposes. If you are using a Unix PC, then you may want to look into minicom, kermit, or some other UNIX terminal application. On a Windows workstation, the Hyper Terminal application is located in the following directory:

```
All Programs/ Accessories/ Communications/ Hyper Terminal.
```

Start Hyper Terminal, name your connection, and then click OK, as shown in Figure 1-1. I've named my connection "Cisco Console," but any name will do.
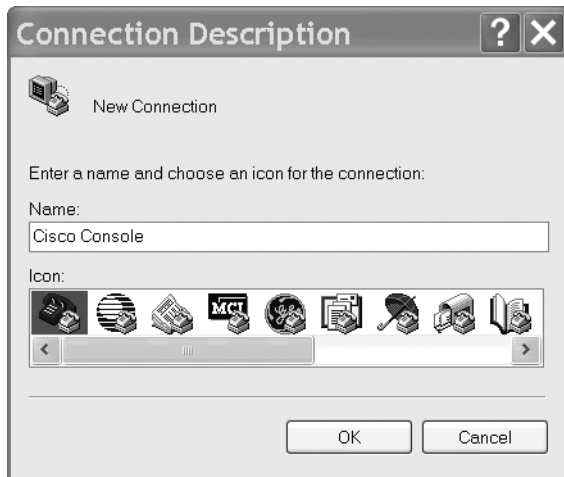
Figure 1-1. *Creating a connection description for Hyper Terminal*

Now, select the COM port (serial communication port) that you're using with the console cable on your PC, and then click OK. This is usually COM1, but it could be COM2, COM3, or even COM4. This will depend on what hardware is installed in your PC. Figure 1-2 shows COM1 as the selected port.

Figure 1-2. *Selecting COM1 as the targeted serial port*

Next, define the properties of the COM port, then click OK. The default for all Cisco routers is 9600 bits per second, 8 data bits, no parity, and 1 stop bit, as shown in Figure 1-3.
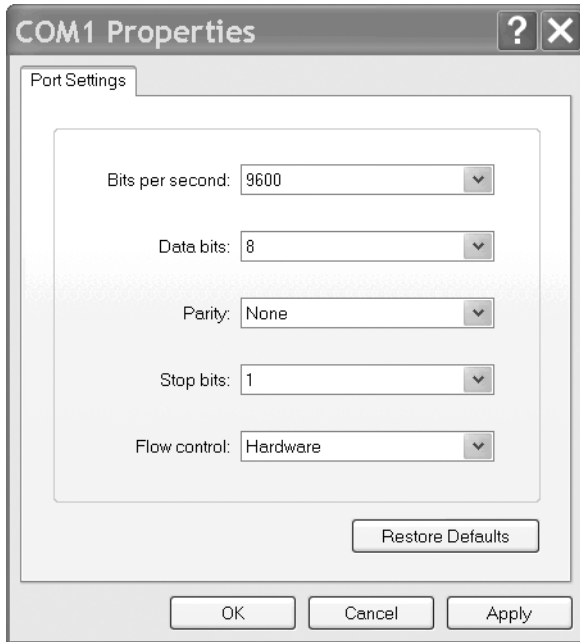
Figure 1-3. *Defining the serial port properties*

■**Note** Cisco Routers support ANSI (American National Standards Institute) terminal emulation. Hyper Terminal also supports ANSI and defaults to auto detect the terminal emulation type, which works very well with Cisco routers. If you use some other terminal emulation software, you may need to manually set the terminal emulation type. If so, be sure to set it to ANSI to ensure that the terminal software works correctly with your router.

Power Up the Router

After you have your console cable plugged in and have started Hyper Terminal, flip the router's power switch to the *ON* position. If all goes well, you should see the Cisco bootstrap message. If not, you may need to check your Hyper Terminal settings or cable.

At startup, a lot of information is displayed. Notice in the following sample output that the router in question has 64 MB (65536 KB) of main memory. Your router also has system flash memory, which stores a compressed image of the IOS, and web flash memory, which stores other configuration files. During startup, the image file in system flash memory is decompressed and loaded into main memory. While decompressing, pound signs march across the screen to indicate progress.

```
System Bootstrap, Version 12.2(8r)YN, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2002 by Cisco Systems, Inc.
C800/SOHO series (Board ID: 28-130) platform with 65536 Kbytes of main memory

program load complete, entry point: 0x80013000, size: 0x6897e8
Self decompressing the image :
#################################################################################➡
####################[OK]
```

Near the end of startup, other information about your hardware is displayed. You can see from the following output that the router being used is a Cisco SOHO91 router with 2 Ethernet interfaces (e0 and e1 mentioned earlier). The system flash memory (where the IOS is stored) is 8 MB, and the web flash memory is 2 MB.

```
Cisco SOHO91 (MPC857DSL) processor (revision 0x300) with 5893kK/65536K bytes of➡
memory.
Processor board ID AMB080903VX (1784032485), with hardware revision 0000
CPU rev number 7
2 Ethernet interfaces
128K bytes of NVRAM.
8192K bytes of processor board System flash (Read/Write)
2048K bytes of processor board Web flash (Read/Write)

Press RETURN to get started!
```

At this point, depending on how your router is configured, other messages can appear. Pressing the ENTER key should give you the Cisco CLI prompt.

Welcome to the Command Line

The Command Line Interface (CLI) is where you configure your router. The CLI has several prompts, with each one representing a different mode (e.g., *user EXEC mode* and *privileged EXEC mode*). Each mode offers different configuration commands and tools that allow you to manage your router. Before you start configuring your router, I want to introduce a few simple commands to familiarize you with the user interface.

Your First CLI Commands

The first prompt you are presented with is the user EXEC mode prompt. You know you are in user EXEC mode when you see the ">" symbol after the name of your router, which is "Router" by default. There are very few things you can do in user EXEC mode (you cannot configure your router in this mode). Let's try a few commands to get a feel for the CLI. In all of the CLI examples throughout this book, you'll type the bolded information after the prompt on the command line, then press the ENTER key. To begin, try the following show version command:

```
Router> show version
```

Depending on the model of your router and the IOS version that it is running, you will see output similar to this:

```
Cisco IOS Software, SOHO91 Software (SOHO91-K9OY6-M), Version 12.4(5b),➡
RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Wed 19-Apr-06 08:12 by ssearch

ROM: System Bootstrap, Version 12.2(11r)YV3, RELEASE SOFTWARE (fc2)

Router uptime is 1 day, 12 hours, 35 minutes
System returned to ROM by power-on
System image file is "flash:soho91-k9oy6-mz.124-5b.bin"
```

The show version command tells you three important things about your router. The first is the IOS version (12.4(5b) in this case). The second is the router uptime (how long the router has been running). And third, it tells you the name of the compressed image file in system flash memory, which is "soho91-k9oy6-mz.124-5b.bin".

Another way to find out about the compressed image file is to issue the show flash command. This command is a good way to see how much system flash memory the image is using:

```
Router> show flash
```

As you can see from the following output, the show flash command displays a directory of the files in system flash memory and how much space they are using (6.8 MB in this case).

```
System flash directory:
File  Length   Name/status
 1   6855008  soho91-k9oy6-mz.124-5b.bin
[6855072 bytes used, 1271388 available, 8126460 total]
8192K bytes of processor board System flash (Read/Write)
```

The reason this information is important is because someday you may want to upgrade your IOS version, and you need to be sure you have enough memory to hold the new image file. IOS upgrades are a beneficial Cisco service. Sometimes they fix bugs, and other times they add features. In any case, every new version will be larger than the last. I'll discuss upgrading your IOS in Chapter 5.

Another handy command is show ip interface brief. This command tells you basic information about the status of your interfaces and displays their IP addresses.

```
Router> show ip interface brief
```

```
Interface    IP-Address     OK?   Method   Status                           Protocol
Ethernet0    10.10.10.1     YES   NVRAM    up                                     up
Ethernet1    66.238.5.254   YES   NVRAM    up                                     up
```

This output contains a lot of valuable information. You know which IP addresses are assigned to your router. The IP address of the LAN switch ports (Ethernet0) is 10.10.10.1, and the IP address of the Internet port (Ethernet1), sometimes referred to as the WAN port, is 66.238.5.254.

"Status" shows whether an interface has been shut down by an administrator. "Protocol" shows whether a cable may be unplugged.

Let's look at another example of the command. As you can see from the following output, this router has a manually shut down interface (Ethernet0):

```
Router> show ip interface brief
```

```
Interface    IP-Address     OK?   Method   Status                           Protocol
Ethernet0    10.10.10.1     YES   NVRAM    manual administratively down          down
Ethernet1    66.238.5.254   YES   NVRAM    up                                    down
```

First, let's look at interface Ethernet0. It has an IP address (that's good), but the status displays the message "manual administratively down" and the protocol is also "down." This tells us that the interface was manually shut down by an administrator. Next, look at interface Ethernet1. It has an IP address and its status is "up," but the protocol is "down." If the Protocol is down, it may indicate that the Ethernet cable is unplugged or there is something wrong with the cable. Check the cable.

If you want to exit user EXEC mode and log out of the router, simply type **exit** and press the ENTER key:

```
Router> exit
```

Now that you're familiar with how to connect to your router and issue a few simple commands, you're going to enable privileged EXEC mode and learn a few IOS configuration commands.

Turn On Privileged EXEC Mode

Privileged EXEC mode, sometimes referred to as *enable mode*, gives you a lot more commands than user EXEC mode and allows you to begin configuring your router. You know you are in privileged EXEC mode when you see the "#" sign after the name of your router. Let's get started; type **enable**, then press the ENTER key. Notice how the prompt changes in the following example:

```
Router> enable
Router#
```

Set the Date and Time

Now that you're in privileged EXEC mode, let's start by setting the date and time on your router. You use the clock set command and enter the time in a 24 hour format. Therefore, 1:40 PM is entered as 13:40:00. Also, note the European date order format (Day Month Year). To display the time on your router, use the show clock command. Here is an example:

```
Router# clock set 13:40:00 13 April 2007
Router# show clock
```

```
13:40:46.887 AKST Fri Apr 13 2007
```

Get Help

In the Cisco IOS, help is only a question mark away. To see a list of commands, type a question mark, then press the ENTER key. To see a list of command parameters, type the command followed by a question mark, and then press the ENTER key. The following example shows how you can get help on the `clock set` command:

`Router# clock set ?`

```
hh:mm:ss  Current Time
```

In the next example, a question mark has been added after the time parameter. Notice when you use a question mark after a parameter, the IOS displays subsequent parameters that can be used for that command. In this example, the next set of parameters is the day of the month and the month of the year.

`Router# clock set 13:40:00 ?`

```
<1-31>  Day of the month
 MONTH   Month of the year
```

When configuring your router, you can use the question mark at any time to access help with any IOS command or parameter. That ability is an important feature of the Cisco IOS you will quickly become familiar with.

Using Global Configuration Mode

So far you have learned about user EXEC mode and privileged EXEC mode. The next, and most powerful mode you can use in the Cisco IOS, is *global configuration mode* (a sub-mode of privileged EXEC mode). Global configuration mode allows you to configure pretty much every aspect of your router. While in global configuration mode, you can access even more sub-modes, such as interface configuration mode or VTY configuration mode (I'll be discussing these modes in Chapter 2). What's important to note here is that when you configure your router, you use commands to escalate your privileges on the router, which in turn allows you to access and configure different features of the IOS.

The command to enter global configuration mode is `configure terminal`. You know that you're in global configuration mode when you see the `(config)#` prompt.

Set Your Router's Hostname

Assigning your router a hostname will allow you to easily identify the router on which you're working. When a hostname has been assigned, the name of the router will be displayed on the screen as part of the prompt during the configuration process. If you're an IT consultant who works with multiple clients and routers, the hostname will help you keep track of which client and router you're configuring.

Let's go into global configuration mode and set the hostname for your router:

```
Router> enable
Router# configure terminal
Router(config)# hostname lab-r1
```

And notice the new prompt:

```
lab-r1(config)#
```

The prompt has changed to reflect the newly assigned hostname, "lab-r1."

Set the Privileged EXEC Mode Password

Because privileged EXEC mode is so powerful, it's best to secure it with a password. The Cisco IOS allows you to set several layers of passwords, but this is the big one, and I recommend you set it *before* you put your router online. The following code shows you how to set the privileged EXEC mode password to "cisco":

```
lab-r1> en
lab-r1# config t
lab-r1(config)# enable secret cisco
```

In this example, you might assume I made a typo in the second line, but I didn't. Anyone who's been around the Cisco IOS for any length of time uses abbreviated commands. All IOS commands can be abbreviated, which is great because no one wants to type in "configure terminal" when they can simply type "config t".

Now that you've set your privileged EXEC mode password, try it out. You'll need to log out of privileged EXEC mode and go back to user EXEC mode using the exit command:

```
lab-r1(config)# exit
lab-r1# exit
lab-r1> enable

Password:
```

Did you get a password prompt? Go ahead and type in the password **cisco** to enter privileged EXEC mode again.

Display and Save Your Configuration

The `show running-configuration` command, (abbreviated `sh run`) and the `show startup-configuration` command (abbreviated `sh start`) are two useful commands that are used often when setting up and managing your router. When your router is turned on, the IOS looks for a startup configuration file. If it finds one, it loads the configuration into your router's main memory (running configuration). The running configuration is the active configuration on your router.

The `sh run` command will display all the details of your router's running configuration in main memory. This is where you look to see what features are enabled and how they are configured. Here is how to issue the command:

```
lab-r1# sh run
```

Following this paragraph is a partial example of output from the `show run` command. Use the spacebar to page through the configuration. Try this command now on your router but don't worry if you don't understand the details of the output. Some of the information will be familiar to you, such as the hostname command, while other configuration information will be default settings that may seem cryptic at this time. Not to worry—you'll become familiar with the details of your configuration as you work through this book.

```
Current configuration : 11075 bytes
!
version 12.4
no service pad
service timestamps debug datetime msec
service timestamps log datetime localtime
!
!
hostname lab-r1
!
boot-start-marker
boot-end-marker
.
.
.
```

The `show startup-configuration` command (abbreviated `sh start`) will display the contents of your router's startup configuration.

After you power up your router, the IOS loads into memory and is executed. The first thing the IOS does is look for a startup configuration. If no startup configuration is found, the IOS will start a system configuration dialog that will guide you through basic router setup. However, if a startup configuration is found, it is read and loaded into the router's main memory. Here's how to display the contents of the startup configuration on your router:

`lab-r1# `**`sh start`**

Depending on your router's current configuration, the output of the `sh start` command appears similar to the output of the `sh run` command in the previous example.

The last command I want to introduce you to in this chapter is `copy running-configuration startup-configuration` (abbreviated `copy run start`). It allows you to save your running configuration file so that it loads the next time you start your router. For example,

`lab-r1# `**`copy run start`**

```
Destination filename [startup-config]?  {press ENTER}

Building configuration...
[OK]

lab-r1#
```

Great! Now you know the basics of the Cisco IOS. In Chapter 2, you'll start learning how to setup your router for a small business, so make sure you are comfortable with logging in, changing modes, and entering a few commands before moving on.

Summary

By now you should have a feel for how the CLI works. In this chapter, you've learned about the ports on the back of the router, how to connect to the console port, and how to login using Hyper Terminal. You have also learned about three IOS modes: user EXEC mode, privileged EXEC mode, and configuration mode. You've learned how to get help by typing a question mark, and how to enter a few commands into the router. You have also learned that Cisco commands can be abbreviated.

Here's a quick recap of Chapter 1.

Ports

Your router has three types of ports:

Console Port: Located on the rear of the router, the console port is accessed using a console cable and terminal emulation software, such as Hyper Terminal or minicom. The COM settings are 9600, 8, n, 1 (9600 baud, 8 data bits, no parity and, 1 stop bit) and ANSI terminal emulation.

LAN Ethernet Port (E0): The interface name for the four 10/100 BaseT LAN switch ports on the rear of a Cisco SOHO91 or 831 series router. These ports are used for workstations.

WAN Ethernet Port (E1): The interface name for the 10 BaseT Internet WAN port on the rear of a Cisco SOHO91 or 831 series router. This interface is used by a DSL or cable modem.

Alternatively, the Ethernet port names for Cisco's newer 850 and 870 series routers are

LAN FastEthernet Port (VLAN1): The interface name for the four 10/100 BaseT switch ports on the rear of Cisco 850 and 870 series routers (FE0, FE1, FE2, FE3). These ports are used for workstations.

WAN FastEthernet Port (FA4): The interface name for the 10/100 BaseT Internet WAN port on the rear of Cisco 850 or 870 series routers. This port is used by a DSL modem or a cable modem.

To access your router through the console port, perform the following steps:

1. Plug the console cable into your computer's DB9 serial port and the RJ45 end into the router's console port.

2. Start Hyper Terminal or minicom and set the communication parameters to 9600 baud (bits per second), 8 data bits, no parity, and 1 stop bit.

3. Power on your router and wait for the IOS to load.

4. Press the ENTER key to get a command prompt (Router>).

User EXEC Mode Commands

User EXEC mode has very *limited* functionality. You cannot configure your router in this mode. You know you are in user EXEC mode when you see the > symbol after the name of your router. Some useful commands in this mode follow:

`show version`—Displays basic information about your IOS version and router hardware.

`show flash`—Displays the name and size of your compressed IOS image file.

`show ip interface brief`—Displays basic information about the status of your interfaces and displays their IP addresses. Router and protocol status information that you might see includes the following:

- Router status of "manual administratively down" indicates the interface has been shut down by an administrator.

- Router status of "up," but Protocol "down" indicates a cable problem. Check if the cable is unplugged.

`show clock`—Displays the date and time on your router.

`exit`—Exits the current mode returning you to the previous mode.

Privileged EXEC Mode Commands

The privileged EXEC mode allows you to configure your router. Due to its expanded capabilities, this mode should be password protected. You know you are in privileged EXEC mode when you see the # sign after the name of your router. Some useful commands related to or in that mode are:

`enable`—Enters privileged EXEC mode from user EXEC mode.

`clock set 13:40:00 13 April 2007`—Allows you to set the date and time on your router.

`show clock`—Displays the date and time on your router.

Global Configuration Mode Commands

Global configuration mode is the most powerful mode available to you on a Cisco router. From this mode you can configure most every aspect of your router. You know you are in global configuration mode when you see `(config)#` in the prompt after the name of your router. Some global configuration mode commands related to, or used in that mode are:

`configure terminal`—Enters global configuration mode, which is a sub-mode of privileged EXEC mode.

`hostame lab-r1`—Allows you to set the hostname on your router. In this example it's set to `lab-r1`.

`enable secret cisco`—Allows you to set the privileged EXEC mode password on your router. In this example, it has been set to `cisco`.

Display and Save Your Configuration

Issue the following commands from privileged EXEC mode to display and save your router's configuration:

`sh run`—Displays all the details of your router's running, or active, configuration.

`sh start`—Displays all the details of the startup configuration that will be loaded at startup.

`copy run start`—Saves your running configuration file to a startup configuration file, which will be loaded the next time you issue the `reload` command or power-cycle your router.