**Department of Computer Science**

**CEL222: Computer Networks**

**Class: BSCS-4CD**

**CLO1: Understand the fundamental Building blocks of Computer networks**

**Networks i.e., Layered approach and protocols that make**

**networking possible**

**Lab 9: The Cisco Router User Interface**

**Time: 11:30 to 02:30**

**Date: 9, 11-05-2023**

**Lab Instructor: Ms. Nadia Kalsoom**

**The Cisco Router User Interface**

**1. Objective**

* To get familiarization with Routers
* To learn how to connect a router for configuration
* To learn about the different Configuration modes of Routers
* To learn editing and help features.

**2. Resources Required**

* Computer
* Packet Tracer (version 5 or higher)

**3. Introduction**

The Cisco Internetwork Operating System (IOS) is the kernel of Cisco routers and most switches. In case you didn’t know, a kernel is the basic, indispensable part of an operating system that allocates resources and manages things such as low-level hardware interfaces and security. Cisco has created something called CiscoFusion, which is supposed to make all Cisco devices run the same operating system. But they don’t, because Cisco has acquired devices that they haven’t designed and built themselves. Almost all Cisco routers run the same IOS, in contrast to about half of their switches. The good news is that that number is growing pretty fast.

In this section, I’ll show you the Cisco IOS and how to configure a Cisco router step-bystep, using setup mode. In the next section, I’ll show you how to do this using the command-line interface (CLI).

**Cisco Router IOS**

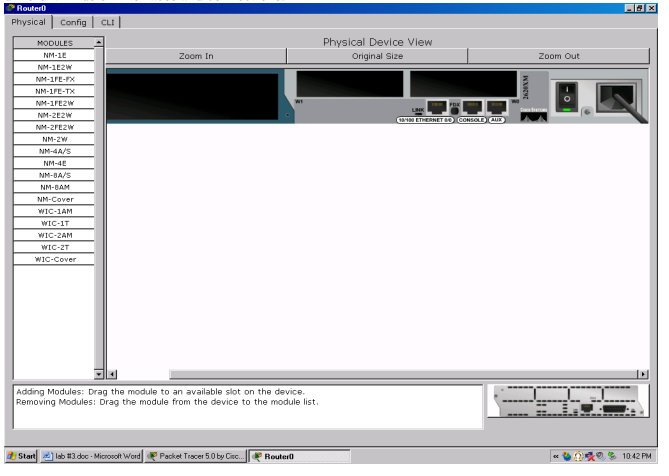
The Cisco IOS was created to deliver network services and enable networked applications. It runs on most Cisco routers and, on an ever-increasing number of Cisco Catalyst switches, such as the Catalyst 2950. Some of the important things that the Cisco router IOS software is responsible for include

• Carrying network protocols and functions  
• Connecting high-speed traffic between devices  
• Adding security to control access and stop unauthorized network use  
• providing scalability for ease of network growth and redundancy  
• Supplying ­network reliability for connecting to network resources

You can access the Cisco IOS through the console port of a router, from a modem into the auxiliary (or Aux) port, or even through Telnet. Access to the IOS command line is called an EXEC session.

**Connecting to a Cisco Router**

You can connect to a Cisco router to configure it, verify its configuration, and check  
statistics. There are different ways to do this, but most often, the first place you would connect to is the console port. The console port is usually an RJ-45 (8-pin modular) connection located at the back of the router—by default, there’s no password set. You can also connect to a Cisco router through an auxiliary port —which is really the same thing as a console port, so it follows that you can use it as one. But this auxiliary port also allows you to configure modem commands so that a modem can be connected to the router. This is a cool feature—it lets you dial up a remote router and attach to the auxiliary port if the router is down and you need to configure it “out-of-band” (meaning “out-of-the-network”). “In-band” means the opposite—configuring the router through the network. The third way to connect to a Cisco router is in-band, through the program Telnet. Telnet is a terminal emulation program that acts as though it’s a dumb terminal. You can use Telnet to connect to any active interface on a router, such as an Ethernet or  
serial port. Figure shows an illustration of a 2600 Series Cisco router. Pay close attention to all the different kinds of interfaces and connections.



**4. Procedure**

**Bringing Up a Router**

When you first bring up a Cisco router, it will run a power-on self-test (POST). If it  
passes, it will then look for and load the Cisco IOS from flash memory—if an IOS file is present. (Just in case you don’t know, flash memory is an electronically erasable programmable read-only memory— an EEPROM.) After that, the IOS loads and looks for a valid configuration—the startup-config— that’s stored by default in nonvolatile RAM, or NVRAM.

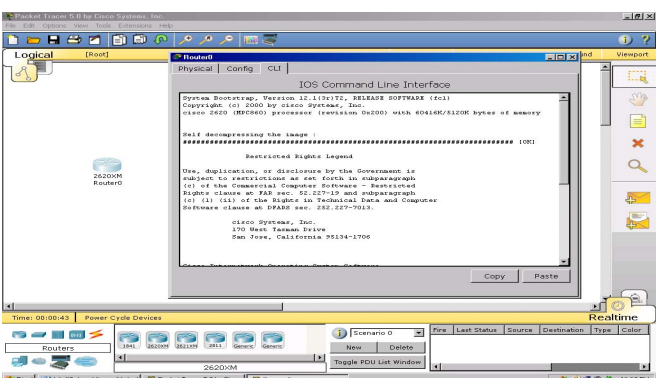
The following messages appear when you first boot or reload a router:

**System Bootstrap, Version 12.2(13)T, RELEASE SOFTWARE (fc1)  
Copyright (c) 2000 by cisco Systems, Inc.  
C2600 platform with 32768 Kbytes of main memory**

This is the first part of the router boot process output. It’s information about the bootstrap program that first runs the POST, and then tells the router how to load, which by default is to find the IOS in flash memory.

The next part shows us that the IOS is being decompressed into RAM:

**program load complete, entry point: 0x80008000, size:  
0x43b7fc  
Self decompressing the image :**



This step doesn’t happen the same way for all routers. The output you’re being shown is from a particular 2600. It’s telling us that the IOS is being loaded into RAM. (The 2500 series router runs the IOS from flash memory—it doesn’t load the IOS into RAM.) After the IOS is decompressed into RAM, the IOS is then loaded and starts running the router, as shown below (notice that the IOS version is stated as version 12.2[13]):

**Cisco Internetwork Operating System Software  
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(13),  
RELEASE SOFTWARE (fc1)  
Copyright (c) 1986-2001 by cisco Systems, Inc.  
Compiled Tue 17-Dec-03 04:55 by kellythw  
Image text-base: 0x80008088, data-base: 0x8080853C**

Once the IOS is loaded, the information learned from the POST will be displayed next, as shown here

**cisco 2621 (MPC860) processor (revision 0x101) with  
26624K/6144K bytes of memory.  
Processor board ID JAD050697JB (146699779)  
M860 processor: part number 0, mask 49  
Bridging software.  
X.25 software, Version 3.0.0.  
2 FastEthernet/IEEE 802.3 interface(s)  
1 Serial network interface(s)  
32K bytes of non-volatile configuration memory.  
8192K bytes of processor board System flash (Read/Write)**

Once the IOS is loaded, and up and running, a valid configuration will be loaded from VRAM.

If there isn’t a configuration in NVRAM, the router will go into setup mode —a step-bystep process to help you configure the router. You can also enter setup mode at any time from the command line by typing the command setup from something called privileged mode, which I’ll get to in a minute. Setup mode only covers some global commands, but it can be really helpful if you don’t know how to configure certain protocols, such as bridging or DECnet.

**Setup Mode**

You have two options when using setup mode: Basic Management and Extended Setup.  
Basic Management only gives you enough configurations to allow connectivity to the router, but Extended Setup gives you the power to configure some global parameters as well as interface configuration parameters. To enter setup mode, just say “yes” or “y” to the following question:

**--- System Configuration Dialog ---  
Would you like to enter the initial configuration dialog? [yes/no]: y  
At any point you may enter a question mark '?' for help.  
Use ctrl-c to abort configuration dialog at any prompt.  
Default settings are in square brackets '[]'.**

Notice the two lines above that say you can use Ctrl+C to abort configuration dialog at any prompt, and that the default settings are in square brackets: [].  
Basic Management setup configures only enough connectivity for management of the system. But since you can do so much more with Extended Setup, this mode will ask you to configure each interface on the system, as seen here:

**Would you like to enter basic management setup?[yes/no]: n  
First, would you like to see the current interface summary? [yes]: [Enter]**

**Any interface listed with OK? value "NO" does not have a valid configuration  
Interface IP-Address OK? Method Status  
Protocol  
FastEthernet0/0 unassigned NO unset up up  
FastEthernet0/1 unassigned NO unset up up  
Configuring global parameters:  
Enter host name [Router]: Todd  
The enable secret is a password used to protect access to privileged EXEC and  
configuration modes. This password, after entered, becomes encrypted in the  
configuration. Enter enable secret: todd  
The enable password is used when you do not specify an enable secret  
password, with some older software versions, and some boot images. Enter  
enable password: todd**  
**% Please choose a password that is different from the enable secret  
Enter enable password: todd1**

There’s something I want you to look at. Did you notice that setup mode asks you to configure two enable passwords? you should know that you really only use the enable secret password. The enable password is for pre-10.3 IOS routers (really old routers).  
Even so, you must configure the password when in setup mode, and it has to be different. It will never be used if the enable secret is configured, though.  
The next password is for setting up Telnet sessions to the router. The reason setup mode has you configure a Telnet (or VTY, which stands for Virtual TeleType) password is because you can’t telnet into a router by default if a password for the VTY lines hasn’t been set. Here is how you do that:

**The virtual terminal password is used to protect access to the router over a  
network interface.  
Enter virtual terminal password: todd  
Configure SNMP Network Management? [yes]:[Enter] or [no]  
Community string [public]:[no]  
Configure DECnet? [no]:[Enter]  
Configure AppleTalk? [no]:[Enter]  
Configure IP? [yes]:[Enter]  
Configure IGRP routing? [yes]:no  
Configure RIP routing? [no]:[Enter]  
Configure bridging? [no]:[Enter]  
Configure IPX? [no]:[Enter]**

The preceding commands can help you configure a protocol if you’re not sure which  
commands you need to configure. But if you use the command-line interface (CLI) instead of setup mode, you’ll have a lot more flexibility. If you have an Async modem card installed in your router, you can have setup mode configure the modems for you, as seen here:

**Async lines accept incoming modems calls. If you will  
have users dialing in via modems, configure these lines.  
Configure Async lines? [yes]:n**

If your router has an ISDN BRI interface, you’ll be prompted for the ISDN switch type to be configured. Take a look at the router output:

**BRI interface needs isdn switch-type to be configured  
Valid switch types are:**  
**[0] none..........Only if you don't want to configure BRI  
[1] basic-1tr6....1TR6 switch type for Germany  
[2] basic-5ess....AT&T 5ESS switch type for the US/Canada  
[3] basic-dms100..Northern DMS-100 switch type for  
US/Canada  
[4] basic-net3....NET3 switch type for UK and Europe  
[5] basic-ni......National ISDN switch type  
[6] basic-ts013...TS013 switch type for Australia  
[7] ntt...........NTT switch type for Japan  
[8] vn3...........VN3 and VN4 switch types for France  
Choose ISDN BRI Switch Type [2]:2**

The next section of the Extended Setup is configuring the interfaces. We only have two Fast Ethernet interfaces on this router: FastEthernet 0/0 and FastEthernet 0/1:

**Configuring interface parameters:**  
**Do you want to configure FastEthernet0/0 interface? [yes]:[Enter]  
Use the 100 Base-TX (RJ-45) connector? [yes]:[Enter]  
Operate in full-duplex mode? [no]: y and [Enter]  
Configure IP on this interface? [yes]:[Enter]  
IP address for this interface: 1.1.1.1  
Subnet mask for this interface [255.0.0.0]: 255.255.0.0  
Class A network is 1.0.0.0, 16 subnet bits; mask is /16  
Do you want to configure FastEthernet0/1 interface? [yes]:[Enter]  
Use the 100 Base-TX (RJ-45) connector? [yes]:[Enter]  
Operate in full-duplex mode? [no]:y and [Enter]  
Configure IP on this interface? [yes]:[Enter]  
IP address for this interface: 2.2.2.2  
Subnet mask for this interface [255.0.0.0]: 255.255.0.0  
Class A network is 2.0.0.0, 16 subnet bits; mask is /16**

This configuration is very basic, but it will allow you to get a router up and running quickly. Notice the mask is displayed as /16, which means 16 out of 32 bits are being used. The Extended Setup will now show the running configuration created:

**The following configuration command script was created:  
hostname Todd  
enable secret 5 $1$B0wu$5F0m/EDdtRkQ4vy4a8qwC/  
enable password todd1  
line vty 0 4  
password todd  
snmp-server community public  
!  
no decnet routing  
no appletalk routing  
ip routing  
no bridge 1  
no ipx routing  
!  
interface FastEthernet0/0  
media-type 100BaseX  
full-duplex  
ip address 1.1.1.1 255.255.0.0  
no mop enabled  
!  
interface FastEthernet0/1  
media-type 100BaseX  
full-duplex  
ip address 2.2.2.2 255.255.0.0  
no mop enabled  
dialer-list 1 protocol ip permit  
dialer-list 1 protocol ipx permit  
!  
end  
[0] Go to the IOS command prompt without saving this  
config.  
[1] Return back to the setup without saving this config.  
[2] Save this configuration to nvram and exit.  
Enter your selection [2]:0**

**Command-Line Interface**

Because it’s so much more flexible, the command-line interface (CLI) truly is the best way to configure a router. I sometimes refer to the CLI as “Cash Line Interface” because if you can create advanced configurations on Cisco routers and switches using the CLI, then you’ll get the cash!

To use the CLI, just say No to enter the initial configuration dialog. After you do that, the router will respond with messages that tell you all about the status of each and every one of the router’s interfaces. Here’s an example:

**Would you like to enter the initial configuration dialog? [yes]:n  
Would you like to terminate autoinstall? [yes]:[Enter]  
Press RETURN to get started!**  
**00:00:42: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed  
state to up  
00:00:42: %LINK-3-UPDOWN: Interface Serial0/0, changed  
state to down  
00:00:42: %LINK-3-UPDOWN: Interface Serial0/1, changed  
state to down  
00:00:42: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
FastEthernet0/0, changed state to up  
00:00:42: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
Serial0/0, changed state to down  
00:00:42: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
Serial0/1, changed state to down  
00:01:30: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
FastEthernet0/0, changed state to down  
00:01:31: %LINK-5-CHANGED: Interface Serial0/0, changed  
state to administratively down  
00:01:31: %LINK-5-CHANGED: Interface FastEthernet0/0, changed  
state to administratively down  
00:01:31: %LINK-5-CHANGED: Interface Serial0/1, changed  
state to administratively down  
00:01:32: %IP-5-WEBINST\_KILL: Terminating DNS process  
00:01:38: %SYS-5-RESTART: System restarted --  
Cisco Internetwork Operating System Software  
IOS (tm) 2600 Software (2600-BIN-M), Version 12.2(13),  
RELEASE SOFTWARE (fc1)  
Copyright (c) 1986-2003 by cisco Systems, Inc.  
Compiled Tue 04-Jan-03 19:23 by dschwart**

**Logging into the Router**

After the interface status messages appear and you press Enter, the Router> prompt will appear. This is called user exec mode (user mode) and it’s mostly used to view statistics, but it’s also a stepping-stone to logging into privileged mode. You can only view and change the configuration of a Cisco router in privileged exec mode (privileged mode), which you get into with the enable command. Here’s how:

**Router>  
Router>enable  
Router#**  
You now end up with a Router# prompt, which indicates that you’re in privileged mode, where you can both view and change the router’s configuration. You can go back from privileged mode into user mode by using the disable command, as seen here:  
**Router#disable  
Router>**

At this point, you can type logout to exit the console:

**Router>logout  
Router con0 is now available  
Press RETURN to get started.**

Or you could just type logout or exit from the privileged-mode prompt to log out:

**Router>en  
Router#logout  
Router con0 is now available  
Press RETURN to get started.**

**Overview of Router Modes**

To configure from a CLI, you can make global changes to the router by typing **configure terminal** (or **config t** for short), which puts you in global configurationmode and changes what’s known as the running-config. A global command (a command run from global config) is set only once and affects the entire router.

You can type **config** from the privileged-mode prompt and then just press Enter to take the default of terminal, as seen here:

Router#**config**

Configuring from terminal, memory, or network [terminal]? ***[Enter]*** Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#

At this point, you make changes that affect the router as a whole (globally), hence the term global configuration mode.

**CLI Prompts**

It’s really important that you understand the different prompts you can find when configuring a router. Knowing these well will help you navigate and recognize where you are at any time within configuration mode. In this section, I’m going to demonstrate the prompts that are used on a Cisco router. (Always check your prompts before making any changes to a router’s configuration!). These command prompts really are the ones you’ll use most in real life.

**Interfaces**

To make changes to an interface, you use the interface command from global configuration mode:

Router(config)#**interface ?**

**Async Async interface**

**BVI Bridge-Group Virtual Interface**

**CTunnel CTunnel interface**

**Dialer Dialer interface**

**FastEthernet FastEthernet IEEE 802.3**

**Group-Async Async Group interface**

**Lex Lex interface**

**Loopback Loopback interface**

**MFR Multilink Frame Relay bundle interface**

**Multilink Multilink-group interface**

**Null Null interface**

**Serial Serial**

**Tunnel Tunnel interface**

**Vif PGM Multicast Host interface**

**Virtual-Template Virtual Template interface**

**Virtual-TokenRing Virtual TokenRing**

**range interface range command**

Router(config)#**interface fastethernet 0/0**

Router(config-if)#

Did you notice that the prompt changed to Router(config-if)#? This tells you that you’re in *interface configuration mode*. And wouldn’t it be nice if the prompt also gave you an indication of what interface you were configuring? Well, at least for now we’ll have to live without the prompt information, because it doesn’t. One thing is for sure: You really have to pay attention when configuring a router!

**Subinterfaces**

Subinterfaces allow you to create logical interfaces within the router. The prompt then changes to Router(config-subif)#, as shown below:

Router(config)#**int fastethernet0/0.?**

<0-4294967295> FastEthernet interface number

Router(config)#**int fastethernet0/0.1**

Router(config-subif)#

**Line Commands**

To configure user-mode passwords, use the line command. The prompt then becomes

Router(config-line)# as shown below:

Router#**config t**

Enter configuration commands, one per line. End with CNTL/Z. Router(config)#**line ?**

<0-70> First Line number

**aux Auxiliary line**

**console Primary terminal line**

**tty Terminal controller**

**vty Virtual terminal**

**x/y Slot/Port for Modems**

Router(config)#**line console 0**

Router(config-line)#

**Editing and Help Features**

You can use the Cisco advanced editing features to help you configure your router. If you type in a question mark (**?**) at any prompt, you’ll be given a list of all the commands available from that prompt:

Router#**?**

Exec commands:

**access-enable Create a temporary Access-List entry**

**access-profile Apply user-profile to interface**

**access-template Create a temporary Access-List entry**

**bfe For manual emergency modes setting**

**clear Reset functions**

**clock Manage the system clock**

**configure Enter configuration mode**

**connect Open a terminal connection**

**copy Copy configuration or image data**

**debug Debugging functions (see also 'undebug')**

**disable Turn off privileged commands**

**disconnect Disconnect an existing network connection**

**enable Turn on privileged commands**

**erase Erase flash or configuration memory**

**exit Exit from the EXEC**

**help Description of the interactive help system**

**lock Lock the terminal**

**login Log in as a particular user**

**logout Exit from the EXEC**

**mrinfo Request neighbor and version information from a multicast**

**router**

--More—

Plus, at this point you can press the spacebar to get another page of information, or you can press Enter to go one command at a time. You can also press Q (or any other key, for that matter) to quit and return to the prompt.

Here’s a shortcut: To find commands that start with a certain letter, use the letter and the question mark with no space between them:

Router#**c?**

clear clock configure connect copy

Router#**c**

By typing **c?**, we received a response listing all the commands that start with *c*. Also notice that the Router# prompt reappears after the list of commands is displayed. This can be helpful when you have long commands and need the next possible command. It would be pretty lame if you had to retype the entire command every time you used a question mark!

To find the next command in a string, type the first command and then a question mark:

Router#**clock ?**

set Set the time and date

Router#**clock set ?** hh:mm:ss Current Time Router#**clock set 10:30:10 ?**

<1-31> Day of the month

MONTH Month of the year

Router#**clock set 10:30:10 28 ?**

MONTH Month of the year

Router#**clock set 10:30:10 28 august ?**

<1993-2035> Year

Router#**clock set 10:30:10 28 august 2003 ?**

<cr>

Router#

By typing the **clock ?** command, you’ll get a list of the next possible parameters and what they do. Notice that you should just keep typing a command, a space, and then a question mark until <cr> (carriage return) is your only option

If you’re typing commands and receive the following:

Router#**clock set 10:30:10**

% Incomplete command.

you’ll know that the command string isn’t done yet. Just press the Up arrow key to redisplay the last command entered, then continue with the command by using your question mark.

Router#**sh te**

% Ambiguous command: "sh te"

it means there are multiple commands that begin with the string you entered and it’s not unique.

Use the question mark to find the command you need:

Router#**sh te?**

tech-support template terminal

Table shows the list of the enhanced editing commands available on a Cisco router.

**Command** **Meaning**

Ctrl+A Moves your cursor to the beginning of the line

Ctrl+E Moves your cursor to the end of the line

Esc+B Moves back one word

Ctrl+B Moves back one character

Ctrl+F Moves forward one character

Esc+F Moves forward one word

Ctrl+D Deletes a single character

Backspace Deletes a single character

Ctrl+R Redisplays a line

Ctrl+U Erases a line

Ctrl+W Erases a word

Ctrl+Z Ends configuration mode and returns to EXEC

Tab Finishes typing a command for you

You can review the router-command history with the commands shown in following Table.

**Command** **Meaning**

Ctrl+F Moves forward one character

Esc+F Moves forward one word

Ctrl+D Deletes a single character

Backspace Deletes a single character

Ctrl+R Redisplays a line

Ctrl+U Erases a line

Ctrl+W Erases a word

Ctrl+Z Ends configuration mode and returns to EXEC

Tab Finishes typing a command for you

**Command** **Meaning**

Ctrl+P or Up arrow Shows last command entered

Ctrl+N or Down arrow Shows previous commands entered

show history Shows last 10 commands entered by default

show terminal Shows terminal configurations and history buffer size

terminal history size Changes buffer size (max 256)

The following example demonstrates the show history command and how to change the history size, as well as how to verify it with the show terminal command.

First, use the show history command to see the last 10 commands that were entered on the router:

Router#**sh history** en

sh history show terminal sh cdp neig sh ver

sh flash sh int fa0 sh history sh int s0/0 sh int s0/1

Now use the show terminal command to verify the terminal history size:

**Gathering Basic Routing Information**

The show version command will provide basic configuration for the system hardware as well as the software version, the names and sources of configuration files, and the boot images.

Here’s an example:

Router#**sh version**

Cisco Internetwork Operating System Software

IOS (tm) C2600 Software (C2600-BIN-M), Version 12.2(13)T1,RELEASE SOFTWARE(fc1)

TAC Support: http://www.cisco.com/tac Copyright (c) 1986-2003 by cisco Systems, Inc.

Compiled Sat 04-Jan-03 05:58 by ccai

Image text-base: 0x80008098, data-base: 0x80C4AD94

The preceding section of output describes the Cisco IOS running on the router. The following section describes the read-only memory (ROM) used, which is used to boot the router:

ROM: System Bootstrap, Version 11.3(2)XA4, RELEASE SOFTWARE (fc1)

The next section shows how long the router has been running, how it was restarted (if you see a system restarted by bus error, that is a very bad thing), where the Cisco IOS was loaded from, and the IOS name. Flash is the default:

Router uptime is 1 week, 2 hours, 39 minutes

System returned to ROM by reload

System image file is "flash:c2600-bin-mz.122-13.T1.bin"

This next section displays the processor, the amount of DRAM and flash memory, and the interfaces the POST found on the router:

cisco 2621 (MPC860) processor (revision 0x101) with 27648K/5120K bytes of memory

Processor board ID JAB0402040J (2308906173) M860 processor: part number 0, mask 49

Bridging software.

X.25 software, Version 3.0.0.

2 FastEthernet/IEEE 802.3 interface(s)

2 Serial network interface(s)

32K bytes of non-volatile configuration memory.

8192K bytes of processor board System flash (Read/Write) Configuration register is 0x2102

**(All the outputs shown above are for example only so your outputs may not match!!)**