

**Laboratory 2a:**  
**Getting to know Cisco Ethernet LAN Switches**

**LEARNING OUTCOMES**

Upon completion of this laboratory exercise, you should be able to:

- Establish console session with a Cisco switch
- Navigate between CLI modes - user, privileged and configuration
- Configure basic switch settings
- Troubleshoot a Cisco switch
- Initialise and reload a switch

**REQUIRED HARDWARE**

- 1 x Rack of Cisco network devices
- 1 x Box of Cables containing
  - USB-to-DB9/DB9-to-RJ45 console cables
  - Ethernet cables
- 2 x Laptops

**REQUIRED SOFTWARE**

- Tera Term 4.105 <https://ttssh2.osdn.jp/>
- Driver for USB-Serial (USB-to-DB9/DB9-to-RJ45) console cable if needed

**PART 1: ESTABLISHING CONSOLE SESSION WITH A CISCO SWITCH**

- 1.1 As introduced in Lecture 2, Ethernet (IEEE 802.3) is the standard data link layer technology for today's Local Area Network (LAN) and a switch is the basic building block for LAN, hence called switched LAN.
- 1.2 When you buy a switch, take it out of the box and power it up, it can work immediately without any configuration.
- 1.3 Nevertheless, as a potential future network engineer, you need to be able to configure switches and troubleshoot problems if they occur. In addition, you will most likely need to configure the security features (to be covered in ICT2203 Network Security) to prevent malicious attackers from compromising the network.

- 1.4 Hence, in this lab, you are going to learn to configure Cisco switches, specifically the Cisco Catalyst 2960 series (family) of switches which are layer 2 switches commonly used as access switches for connecting PCs in enterprise networks.
- 1.5 Depending on the models, each switch typically has 24 or 48 RJ-45 UTP 10/100 ports or 10/100/1000 ports which can autonegotiate the use of 10Base-T, 100Base-T Ethernet or 1000Base-T Ethernet. Examples of Cisco Catalyst 2960 Plus and 2960-X which you will be using in the lab are shown below:

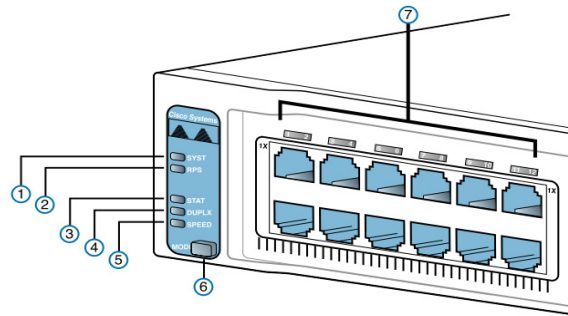


Cisco Catalyst 2960 Plus



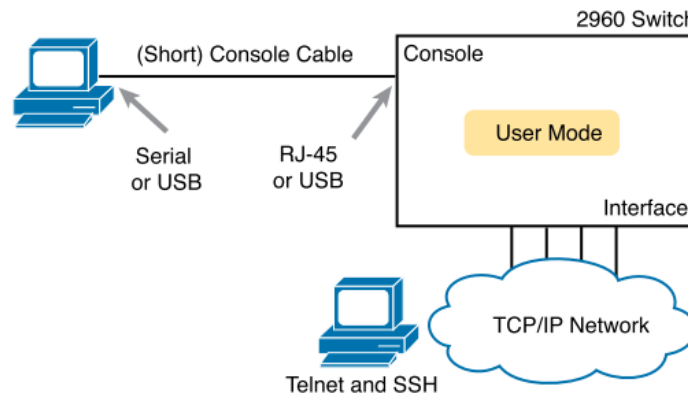
Cisco Catalyst 2960-X

- 1.6 On the switch are numerous LEDs to provide status and troubleshooting information. The example for Catalyst 2960 Plus is shown below which is similar for Catalyst 2960-X.

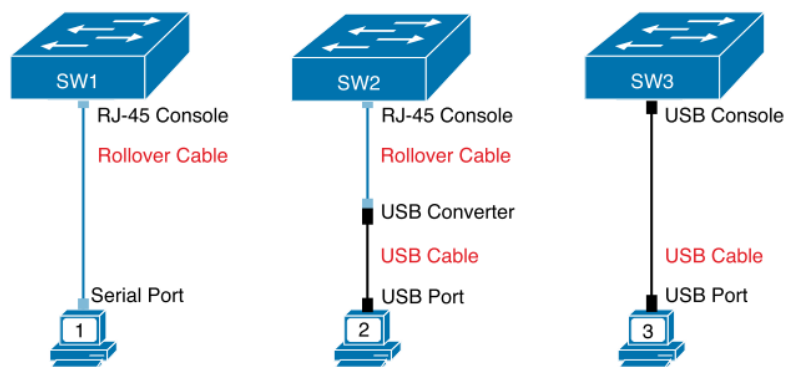


Number in Figure	Name	Description
1	SYST (system)	Implies the overall system status.
2	RPS (Redundant Power Supply)	Suggests the status of the extra (redundant) power supply.
3	STAT (Status)	If on (green), implies that each port LED implies that port's status.
4	DUPLX (duplex)	If on (green), each port LED implies that port's duplex (on/green is full; off means half).
5	SPEED	If on (green), each port LED implies the speed of that port, as follows: off means 10 Mbps, solid green means 100 Mbps, and flashing green means 1 Gbps.
6	MODE	A button that cycles the meaning of the LEDs through three states (STAT, DUPLX, SPEED).
7	Port	LED that has different meanings, depending on the port mode as toggled using the mode button.

- 1.7 Like any computer hardware, a Cisco switch needs an operating system to function, which is called the Internetwork Operating System (IOS).
- 1.8 The IOS can be configured using command-line interface (CLI), which is a text-based interface in which user enters a text command and presses Enter to send the command to the switch to execute.
- 1.9 The CLI can be accessed through three methods – the console, Telnet, and Secure Shell (SSH).



- 1.10 By default, a switch only allows console access. Telnet and SSH accesses require some configurations and preferably with an understanding of security. Hence, we'll only discuss console access in ICT1010 Computer Networks, and defer Telnet and SSH accesses to ICT2203 Network Security.
- 1.11 The console is a physical port on the switch built specifically to allow access to the CLI. Traditionally, a DB9-to-RJ45 console cable (aka rollover cable) is used to connect the serial COM port on the PC to the console port of the switch.
- 1.12 However, with many PCs, especially laptops, having only USB ports, there are now newer ways to connect to the console port of the switches:



(Note: When using USB-to-DB9/DB9-to-RJ45 (USB converter) or USB-to-miniB cables, you may need to install required drivers if your PC/laptop does not have them pre-installed.)

- 1.13 For the Cisco Catalyst 2960 Plus switches, only RJ-45 console port is supported which can be found at the back panel, whereas for the Catalyst 2960-X switches which are newer switches, both RJ-45 and USB console ports are supported which can be found at the front panel as shown:



RJ-45 Console

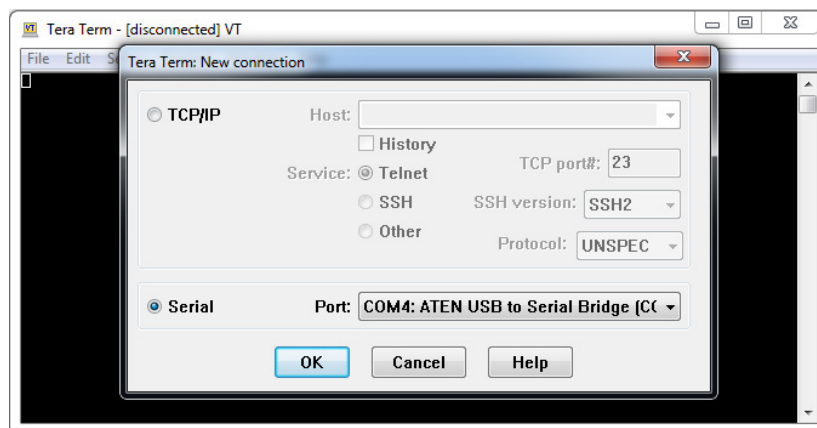
Back panel of Catalyst 2960 Plus



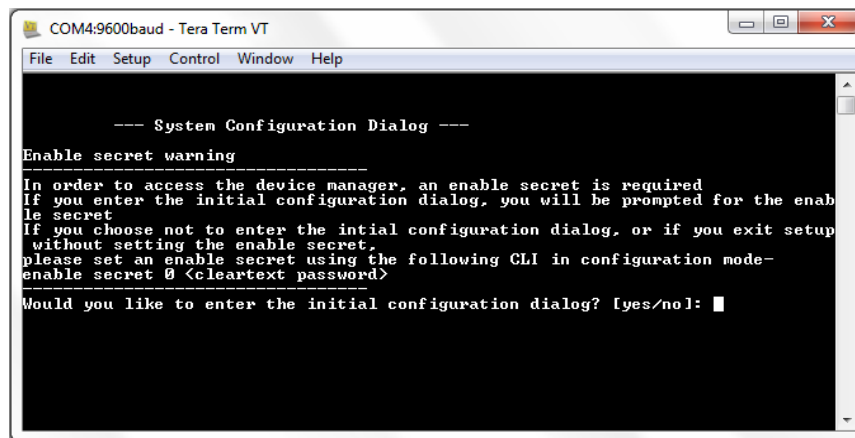
RJ-45 Console

Front panel of Catalyst 2960-X

- 1.14 Now, connect the lab PC or your laptop to the console port of the 2960 Plus or 2960-X switch using the USB-to-DB9/DB9-to-RJ45 cable which is still the most common method in use today.
- 1.15 Once connected, start a terminal emulation program such as Tera Term in your PC/laptop. Click 'Serial' and select the COM port (number may vary) corresponding to ATEN USB to Serial Bridge, example as shown, to establish a console session.



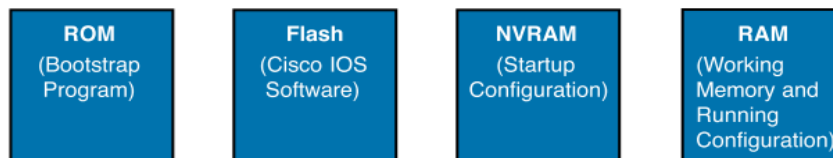
- 1.16 Next, click the 'OK' button, and press the 'Enter' key. If you can see the terminal output below, you have established a console session with the switch successfully and are ready to proceed to the next part of this lab.



1.17 Enter 'no' and continue to Part 2 to understand why.

## **PART 2: NAVIGATING BETWEEN CLI MODES - USER, PRIVILEGED AND CONFIGURATION**

2.1 There are four types of memory found inside a Cisco switch:

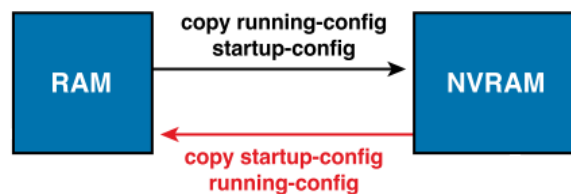


- ROM: Read-only memory stores the bootstrap program that is loaded when power-up. This bootstrap program will then load the Cisco IOS from the Flash into RAM, at which point Cisco IOS takes over the operation of the switch.
- Flash: Either a chip or a removable memory card, flash memory stores the Cisco IOS. Flash memory can also be used to store any other files, including backup copies of configuration files.
- NVRAM: Non-Volatile RAM stores the startup configuration file that is used when the switch is first powered up or when the switch is reloaded (by issuing a reload command).
- RAM: RAM is for working storage, as well as for storing the running configuration file.

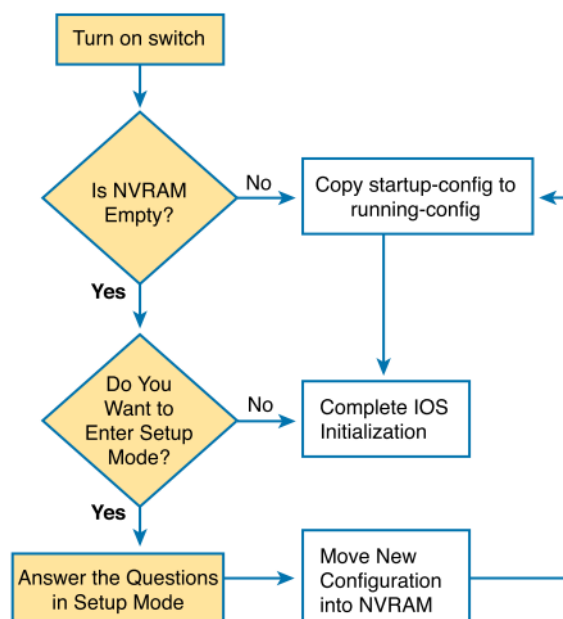
- 2.2 The startup config in the NVRAM and the running config in the RAM are for the following purposes:

Configuration Filename	Purpose	Where It Is Stored
Startup config	Stores the initial configuration used anytime the switch reloads Cisco IOS.	NVRAM
Running config	Stores the currently used configuration commands. This file changes dynamically when someone enters commands in configuration mode.	RAM

- 2.3 When you configure the switch, you only change the running config in the RAM. If you turn off power to the switch, all configurations in the running config will be gone as expected of RAM.
- 2.4 If you want to keep your configuration, you'll have to copy the running config into NVRAM, overwriting the old startup config (if it exists) by executing the copy command:



- 2.5 As shown in the flow-chart below, when a switch is first power on, it'll be initialised according to the configurations in the startup config if it exists. If the startup config does not exist, the switch will ask if you want to enter into the initial configuration dialog (aka setup mode).

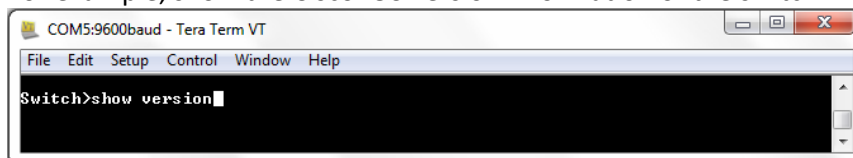


- 2.6 Basically, the initial configuration dialog (setup mode) will ask a series of questions to gather some basic configuration parameters. After that, the IOS will build a configuration file, saves it as the startup config, and also loads it onto the running config to start using the new configuration.
- 2.7 However in practice, most network engineers seldom use the initial configuration dialog mainly because it supports only some basic switch configurations.
- 2.8 Instead, configuration of a switch is typically done in the configuration mode which you will be learning in Part 3.
- 2.9 This explains why you are asked to answer 'no' to the initial configuration dialog in Part 1, which will bring you to the default user EXEC mode (or simply user mode) that allows you to look around the switch but not configure anything.



(Notice the prompt '>' which indicates you are in the user mode.)

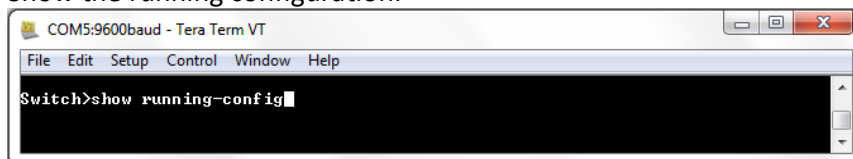
- 2.10 To begin, let's explore the most commonly used command – show. The show command has a large variety of options, and with those options, you can find the status of almost every feature of Cisco IOS.
- 2.11 For example, show the Cisco IOS version information of the switch.



What is the Cisco IOS version that the switch is running?

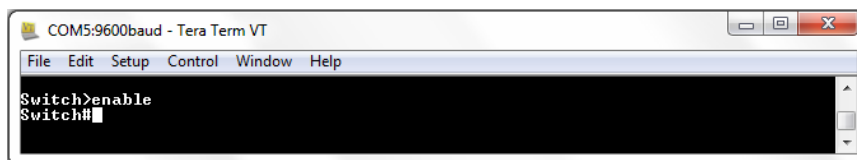
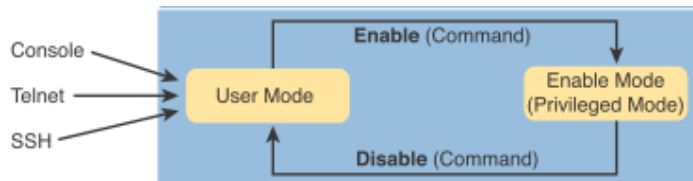
What is the system image filename?

- 2.12 Show the running configuration.



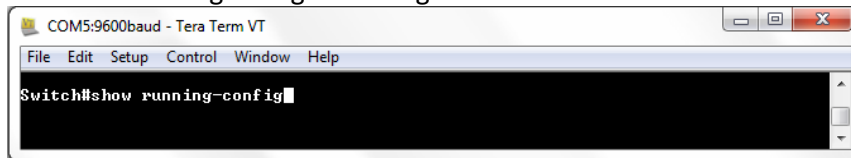
What problem do you encounter?

- 2.13 You'll notice that the `show running-config` command is not available in the user mode because it will show all sensitive configuration information which may compromise security.
- 2.14 So, from the user mode, enter the 'enable' command to move to enable mode, also known as privileged EXEC mode or simply privileged mode:



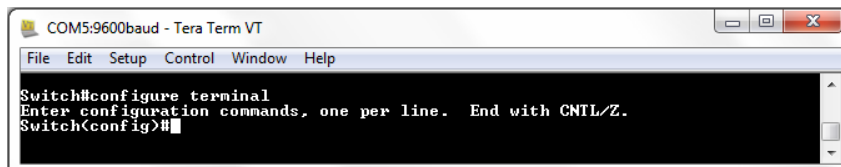
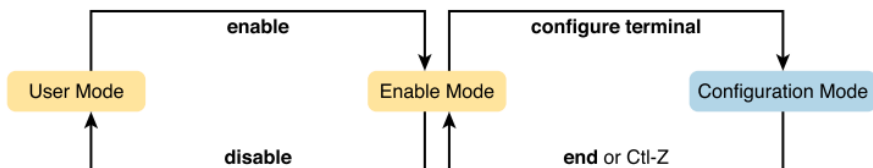
(Notice the prompt changes from '>' to '#' to indicate privileged mode.)

- 2.15 Show the running configuration again.



Are you able to show the existing running-config now?

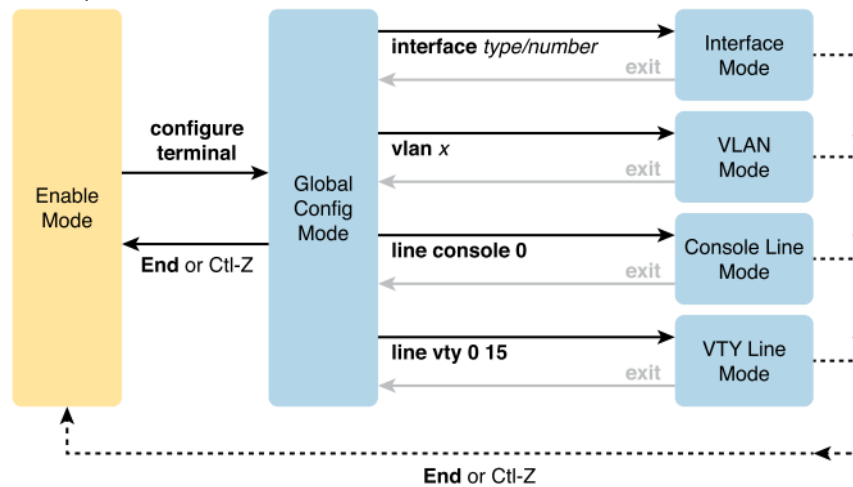
- 2.16 To be able to configure the switch, you need to further move from the enable mode to configuration mode by entering the 'configure terminal' command:



(Notice the prompt changes again to indicate global configuration mode.)

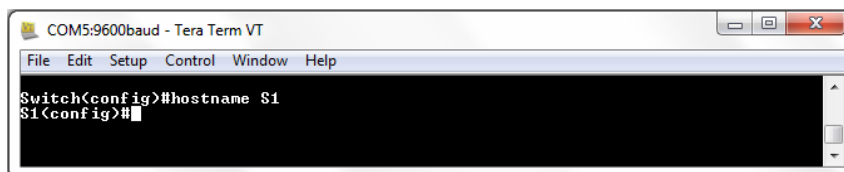


- 2.17 In fact, global configuration mode has a number of submodes. Examples of submodes are interface mode, VLAN mode, etc which you will be learning in subsequent labs.



### PART 3: CONFIGURING BASIC SWITCH SETTINGS

- 3.1 In this lab, you'll learn basic configuration commands in the global configuration mode, starting with the hostname command to change the switch name.

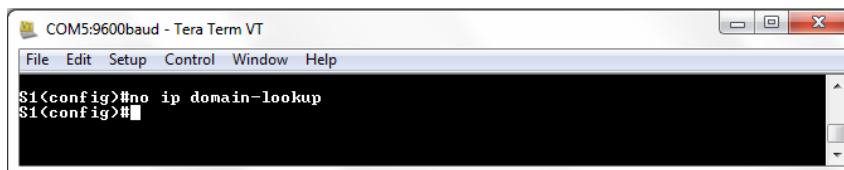


```

COM5:9600baud - Tera Term VT
File Edit Setup Control Window Help
Switch(config)#hostname S1
S1(config)#
  
```

(Notice the prompt changes to reflect the new hostname.)

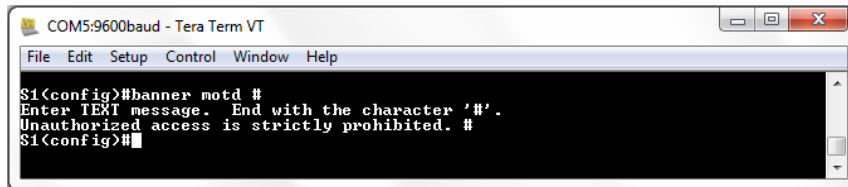
- 3.2 To prevent the switch from attempting to translate incorrectly entered commands as though they were hostnames, disable the Domain Name System (DNS) lookup.



```

COM5:9600baud - Tera Term VT
File Edit Setup Control Window Help
S1(config)#no ip domain-lookup
S1(config)#
  
```

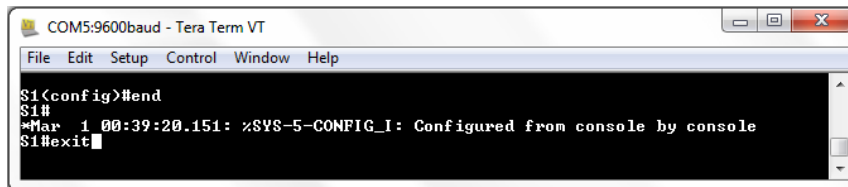
- 3.3 Next, a login banner, known as the message of the day (MOTD) banner, may be configured to warn anyone of unauthorized access as follows:



```
COM5:9600baud - Tera Term VT
File Edit Setup Control Window Help
S1(config)#banner motd #
Enter TEXT message. End with the character '#'.
Unauthorized access is strictly prohibited. #
S1(config)#
```

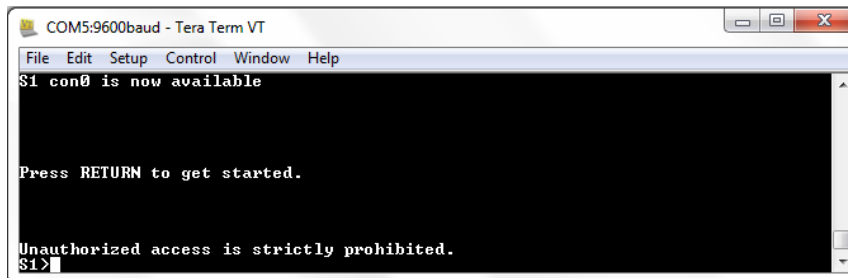
Note that the banner motd command requires the use of a delimiter to identify the end of the message. The delimiter can be any character as long as it does not occur in the message. In practice, symbols such as # are often used.

- 3.4 To verify MOTD configuration is done successfully, exit and re-establish a console session with the switch as follows:



```
COM5:9600baud - Tera Term VT
File Edit Setup Control Window Help
S1(config)#end
S1#
*Mar 1 00:39:20.151: %SYS-5-CONFIG_I: Configured from console by console
S1#exit
```

Note that the end command is to return from configuration mode to enable mode, and the exit command is to end the console session with the switch.



```
COM5:9600baud - Tera Term VT
File Edit Setup Control Window Help
S1 con0 is now available

Press RETURN to get started.

Unauthorized access is strictly prohibited.
S1>
```

- 3.5 There are too many commands to learn all of them. Instead, you should know how to get command help, especially the use of ‘?’:

What You Enter	What Help You Get
<code>?</code>	Help for all commands available in this mode.
<code>help</code>	Text describing how to get help. No actual command help is given.
<code>Command ?</code>	Text help describing all the first parameter options for the command.
<code>command parm?</code>	This style of help lists all parameters beginning with the <b>parameter typed so far</b> . (Notice that there is no space between <i>parm</i> and the <i>?</i> .)
<code>command parm&lt;Tab&gt;</code>	If you press the Tab key midword, the CLI either spells the rest of this parameter at the command line or does nothing. If the CLI does nothing, it means that this string of characters represents more than one possible next parameter, so the CLI does not know which one to spell out.
<code>command parm1 ?</code>	If a space is inserted before the question mark, the CLI lists all the next parameters and gives a brief explanation of each.

- 3.6 In addition, you may wish to know the key sequences to help you navigate around the commands that you’ve entered:

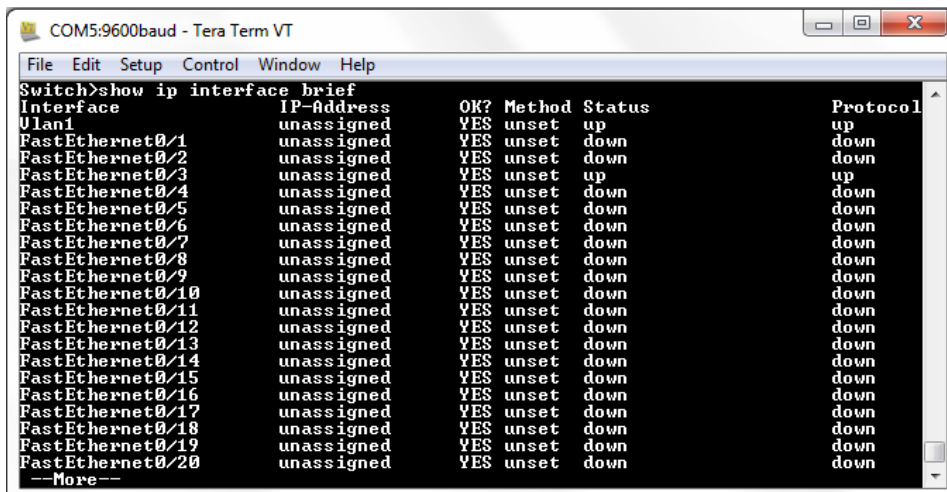
Keyboard Command	What Happens
Up arrow or Ctrl-P	This displays the most recently used command. If you press it again, the next most recent command appears, until the history buffer is exhausted. (The P stands for previous.)
Down arrow or Ctrl-N	If you have gone too far back into the history buffer, these keys take you forward to the more recently entered commands. (The N stands for next.)
Left arrow or Ctrl-B	This moves the cursor backward in the currently displayed command without deleting characters. (The B stands for back.)
Right arrow or Ctrl-F	This moves the cursor forward in the currently displayed command without deleting characters. (The F stands for forward.)
Backspace	This moves the cursor backward in the currently displayed command, deleting characters.
Ctrl-A	This moves the cursor directly to the first character of the currently displayed command.
Ctrl-E	This moves the cursor directly to the end of the currently displayed command.
Ctrl-R	This redisplay the command line with all characters. It’s useful when messages clutter the screen.
Ctrl-D	This deletes a single character.
Ctrl-Shift-6	Interrupts the current command.

#### PART 4: TROUBLESHOOTING A CISCO SWITCH

- 4.1 If a switch fails to forward frames, a good starting point to troubleshoot is to find out whether the switch ports/interfaces are working.
- 4.2 To display whether the switch interfaces are in functioning or nonworking states, Cisco switches use two different but equivalent sets of interface status codes summarised as follows:

Line Status	Protocol Status	Interface Status	Typical Root Cause
Administratively Down	Down	disabled	The interface is configured with the <b>shutdown</b> command.
Down	Down	notconnect	No cable; bad cable; wrong cable pinouts; the speeds are mismatched on the two connected devices; the device on the other end of the cable is (a) powered off, (b) <b>shutdown</b> , or (c) error disabled.
Up	Down	notconnect	An interface up/down state is not expected on LAN switch physical interfaces.
Down	Down (err-disabled)	err-disabled	Port security has disabled the interface.
Up	Up	connected	The interface is working.

- 4.3 For example, the `show ip interface brief` command displays the states of the interfaces using the two-code status – line status and protocol status, which refer to whether Layer 1 is working (line status) and whether Layer 2 is working (protocol status):

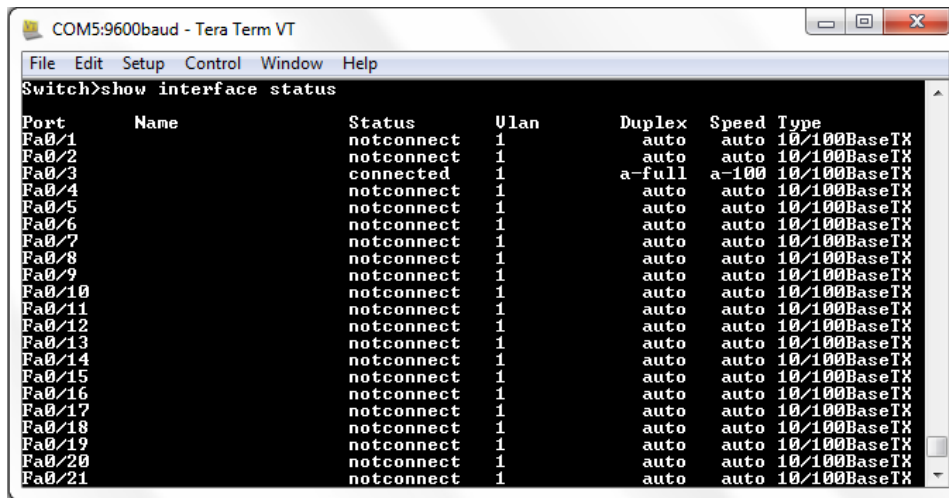


```

Switch>show ip interface brief
Interface          IP-Address      OK? Method Status  Protocol
Vlan1              unassigned     YES unset  up      up
FastEthernet0/1    unassigned     YES unset  down    down
FastEthernet0/2    unassigned     YES unset  down    down
FastEthernet0/3    unassigned     YES unset  up      up
FastEthernet0/4    unassigned     YES unset  down    down
FastEthernet0/5    unassigned     YES unset  down    down
FastEthernet0/6    unassigned     YES unset  down    down
FastEthernet0/7    unassigned     YES unset  down    down
FastEthernet0/8    unassigned     YES unset  down    down
FastEthernet0/9    unassigned     YES unset  down    down
FastEthernet0/10   unassigned     YES unset  down    down
FastEthernet0/11   unassigned     YES unset  down    down
FastEthernet0/12   unassigned     YES unset  down    down
FastEthernet0/13   unassigned     YES unset  down    down
FastEthernet0/14   unassigned     YES unset  down    down
FastEthernet0/15   unassigned     YES unset  down    down
FastEthernet0/16   unassigned     YES unset  down    down
FastEthernet0/17   unassigned     YES unset  down    down
FastEthernet0/18   unassigned     YES unset  down    down
FastEthernet0/19   unassigned     YES unset  down    down
FastEthernet0/20   unassigned     YES unset  down    down
--More--

```

- 4.4 In contrast, the show interface status command displays the states of the interfaces using the one-code status – interface status:



Port	Name	Status	Vlan	Duplex	Speed	Type
Fa0/1		notconnect	1	auto	auto	10/100BaseTX
Fa0/2		notconnect	1	auto	auto	10/100BaseTX
Fa0/3		connected	1	a-full	a-100	10/100BaseTX
Fa0/4		notconnect	1	auto	auto	10/100BaseTX
Fa0/5		notconnect	1	auto	auto	10/100BaseTX
Fa0/6		notconnect	1	auto	auto	10/100BaseTX
Fa0/7		notconnect	1	auto	auto	10/100BaseTX
Fa0/8		notconnect	1	auto	auto	10/100BaseTX
Fa0/9		notconnect	1	auto	auto	10/100BaseTX
Fa0/10		notconnect	1	auto	auto	10/100BaseTX
Fa0/11		notconnect	1	auto	auto	10/100BaseTX
Fa0/12		notconnect	1	auto	auto	10/100BaseTX
Fa0/13		notconnect	1	auto	auto	10/100BaseTX
Fa0/14		notconnect	1	auto	auto	10/100BaseTX
Fa0/15		notconnect	1	auto	auto	10/100BaseTX
Fa0/16		notconnect	1	auto	auto	10/100BaseTX
Fa0/17		notconnect	1	auto	auto	10/100BaseTX
Fa0/18		notconnect	1	auto	auto	10/100BaseTX
Fa0/19		notconnect	1	auto	auto	10/100BaseTX
Fa0/20		notconnect	1	auto	auto	10/100BaseTX
Fa0/21		notconnect	1	auto	auto	10/100BaseTX

- 4.5 You'll have a lot of opportunities in ICT1010 to get familiar with the configuration and troubleshooting of Cisco switches and also routers at later lab classes. Enjoy!

## Appendix A Initialize and Reload a Switch

As discussed in Part 2, if startup config exists in the NVRAM when power up, it will be used to initialize the switch which may then interfere with your new configurations and cause your lab results to be different from expected.

So, before starting lab exercises, you may wish to initialize and reload a switch to its default state by performing the following steps:

### Step 1: Connect to the switch.

Console into the switch and enter privileged EXEC mode.

```
Switch> enable
Switch#
```

### Step 2: Determine if there have been any virtual local-area networks (VLANs) created.

Use the **show flash** command to determine if any VLANs have been created on the switch.

```
Switch# show flash

Directory of flash:/

 2  -rwx           1919   Mar 1 1993 00:06:33 +00:00  private-config.text
 3  -rwx           1632   Mar 1 1993 00:06:33 +00:00  config.text
 4  -rwx          13336   Mar 1 1993 00:06:33 +00:00  multiple-fs
 5  -rwx         11607161   Mar 1 1993 02:37:06 +00:00  c2960-lanbasek9-
    mz.150-2.SE.bin
 6  -rwx            616   Mar 1 1993 00:07:13 +00:00  vlan.dat

32514048 bytes total (20886528
bytes free) Switch#
```

### Step 3: Delete the VLAN file.

- a. If the **vlan.dat** file was found in flash, then delete this file.

```
Switch# delete vlan.dat
Delete filename [vlan.dat]?
```

You will be prompted to verify the file name. At this point, you can change the file name or just press Enter if you have entered the name correctly.

- b. When you are prompted to delete this file, press Enter to confirm the deletion. (Pressing any other key will abort the deletion.)

```
Delete flash:/vlan.dat?
[confirm]
```

```
Switch#
```

**Step 4: Erase the startup configuration file.**

Use the **erase startup-config** command to erase the startup configuration file from NVRAM. When you are prompted to remove the configuration file, press Enter to confirm the erase. (Pressing any other key will abort the operation.)

```
Switch# erase startup-config
Erasing the nvram filesystem will remove all configuration files!
Continue? [confirm] [OK]
Erase of nvram:
complete

Switch#
```

**Step 5: Reload the switch.**

Reload the switch to remove any old configuration information from memory. When you are prompted to reload the switch, press Enter to proceed with the reload. (Pressing any other key will abort the reload.)

```
Switch# reload
Proceed with reload? [confirm]
```

**Note:** You may receive a prompt to save the running configuration prior to reloading the switch. Type **no** and press Enter.

```
System configuration has been modified. Save? [yes/no]: no
```

**Step 6: Bypass the initial configuration dialog.**

After the switch reloads, you should see a prompt to enter the initial configuration dialog. Type **no** at the prompt and press Enter.

```
Would you like to enter the initial configuration dialog? [yes/no]: no
Switch>
```