

Chapter 2

Chapter 2 A

Configuring a Network Operating System

Chapter 2 – Cisco IOS

IOS stands for Internetwork Operating System

It is a family of software used on most **Cisco** Systems routers and current **Cisco** network switches.

IOS is a package of routing, switching, internetworking and telecommunications functions integrated into a multitasking operating system.

Chapter 2 - Scope

2.0 Introduction

2.1 IOS Bootcamp

2.2 Getting Basic

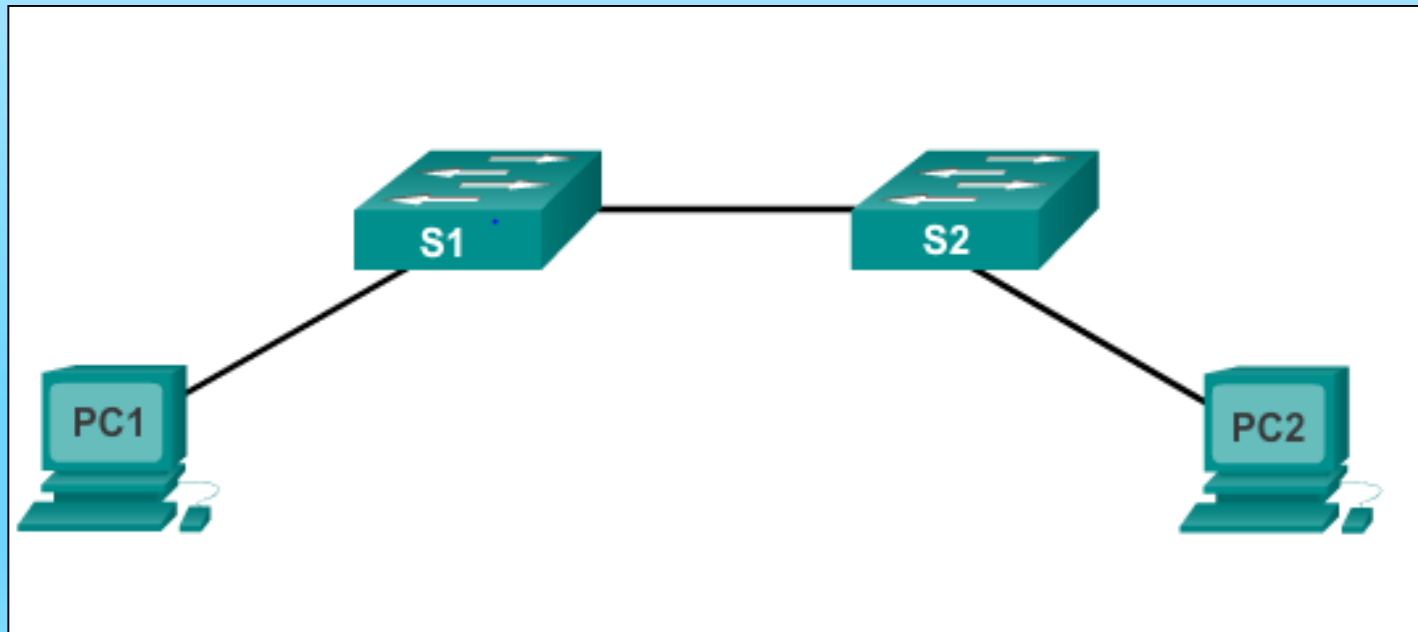
2.3 Addressing Schemes

2.4 Summary

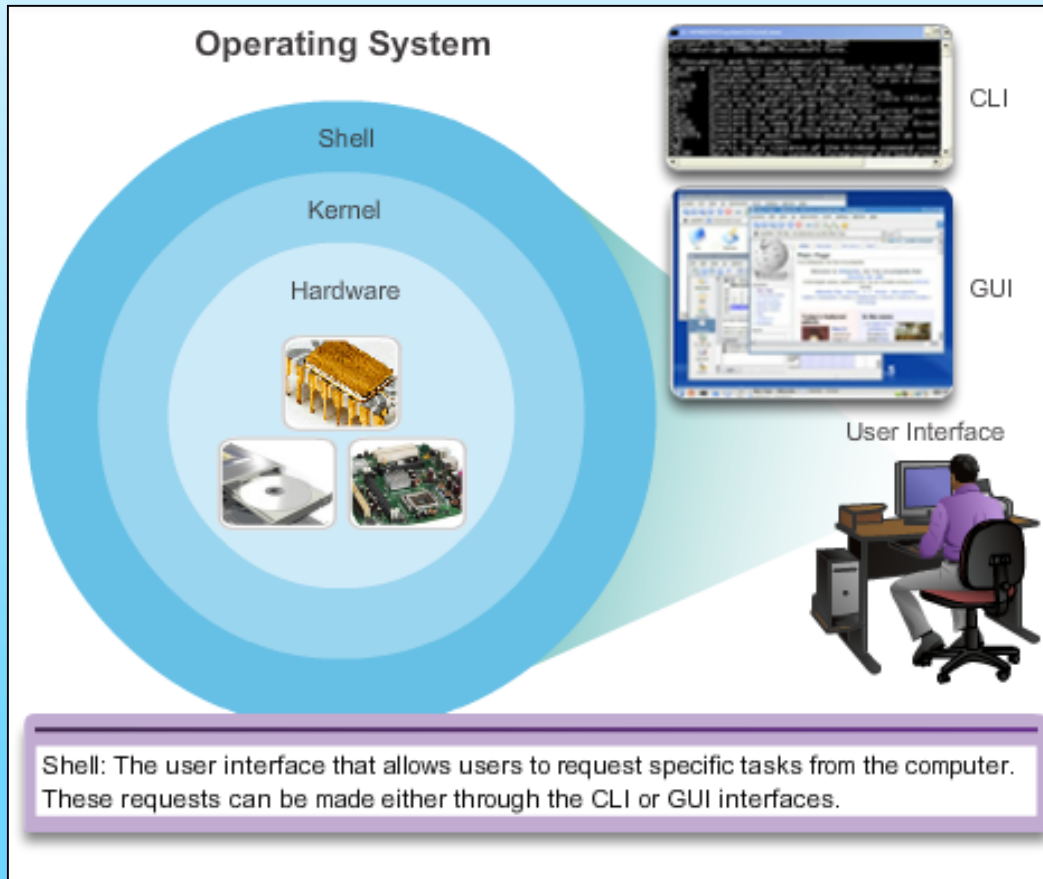
Cisco IOS

Operating Systems

- All networking equipment are dependent on Operating Systems
- The OS on home routers is usually called firmware
- Cisco IOS – **A** collection of network operating systems used on Cisco devices



Operating Systems



An OS consists of:

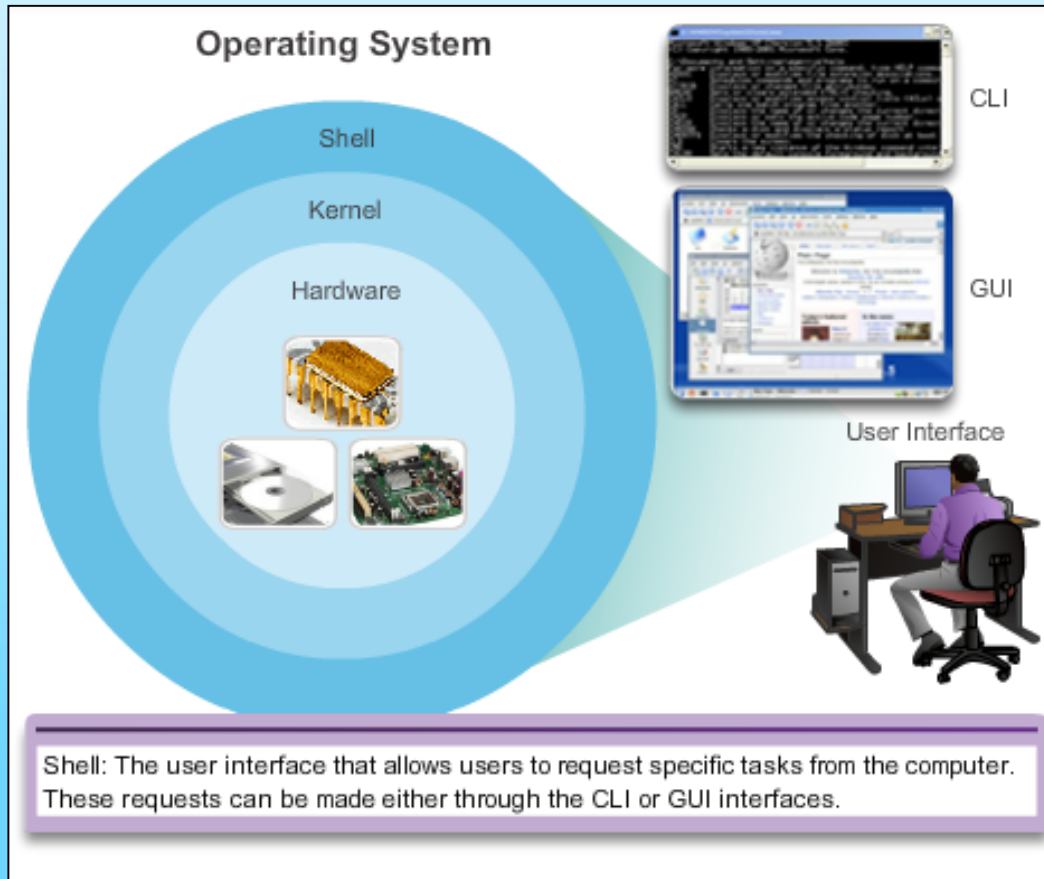
- Shell
- Kernel
- Hardware

The shell allows users to interact with the system via CLI and GUI

CLI – Command Line Interface
GUI – Graphical User Interface

Cisco IOS

Operating Systems



The kernel allows communication between software and hardware. It also manages hardware resources to meet software requirements

Hardware refers to the physical part of a computer, including all underlying electronics

Purpose of OS

- PC operating systems (Windows 8 and OS X) perform technical functions that enable:
 - Use of a mouse
 - Viewing of output on video display units
 - Entering of text using input devices
- Switch or router IOS provides options to:
 - Configure interfaces
 - Enable routing and switching functions
- All networking devices come with a default IOS
- Possible to upgrade the IOS version or feature set
- In this course, primary focus is **Cisco IOS Release 15.x**

Location of the Cisco IOS

Cisco IOS is stored in **Flash**

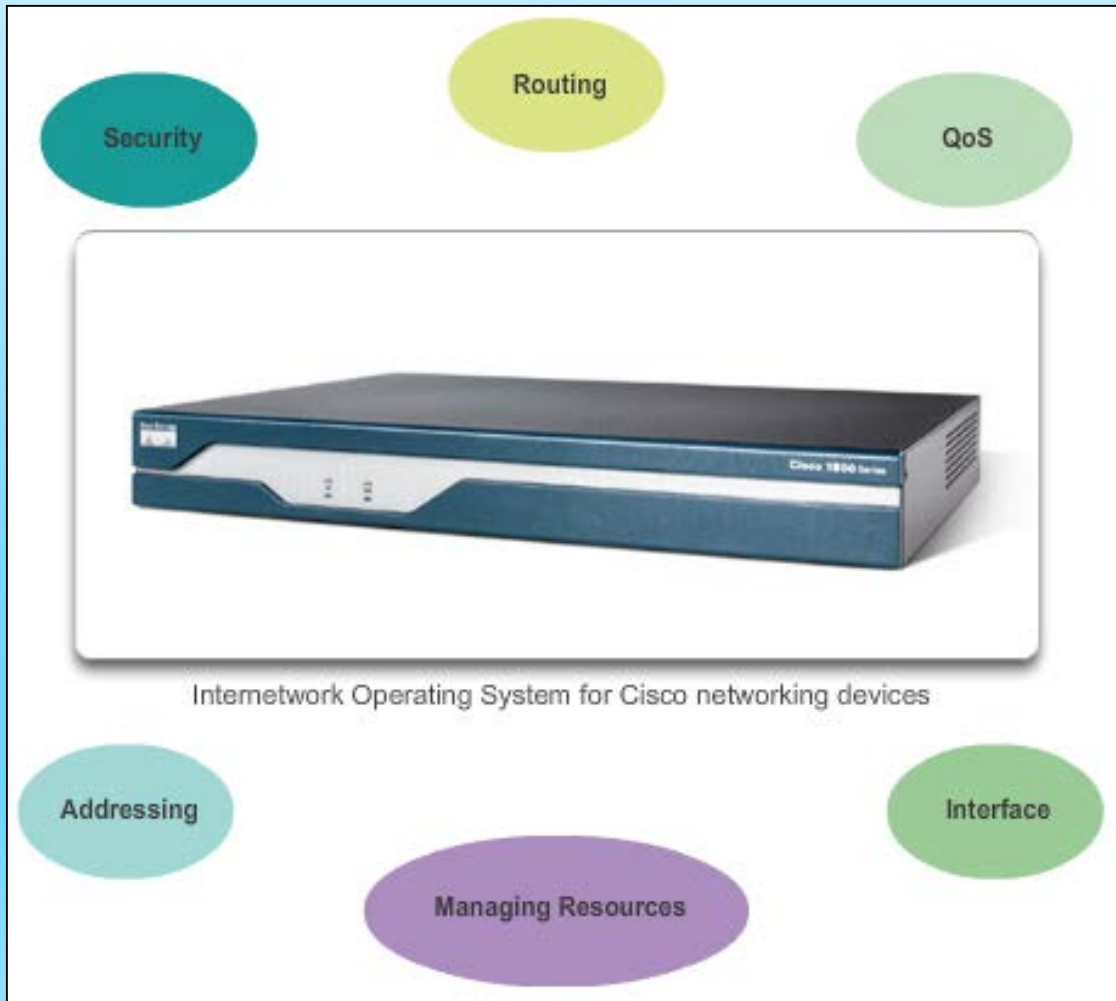
- Non-volatile storage - data not lost when electrical power is lost
- Data can be changed or overwritten as needed
- Can be used to store multiple versions of IOS
- IOS copied from flash to volatile RAM
- Quantity of flash and RAM memory determines IOS that can be used



Cisco IOS

IOS Functions

These are the major functions performed or enabled by Cisco routers and switches.



- Security
- Routing
- QoS
- Addressing
- Managing Resources
- Interface

Routing

- **Routing** is the process of selecting best paths in a network.
- Routing is performed for many kinds of networks, including the telephone network (circuit switching), electronic data networks (such as the Internet), and transportation networks.

QoS

Quality of Service (QoS) refers to the capability of a network to provide better service to selected network traffic

Accessing a Cisco IOS Device – Console Access Methods

Cisco devices have no displays built in. To access and interact with them, we need to connect them to video display units.

Accessing a Cisco IOS Device

Most common methods to access the CLI
(Command Line Interface) environment are:

- Console Port Method
- Telnet or SSH (**S**ecure **S**hell) Method (remote)
- AUX port Method (remote)

Console Access Methods

Console RJ-45 Port Method

- Device is accessible even if no networking services have been configured (out-of-band)
- Need a special console cable
- Allows configuration commands to be entered
- Should be configured with passwords to prevent unauthorized access
- Device should be located in a secure room so console port cannot be easily accessed



Accessing a Cisco IOS Device

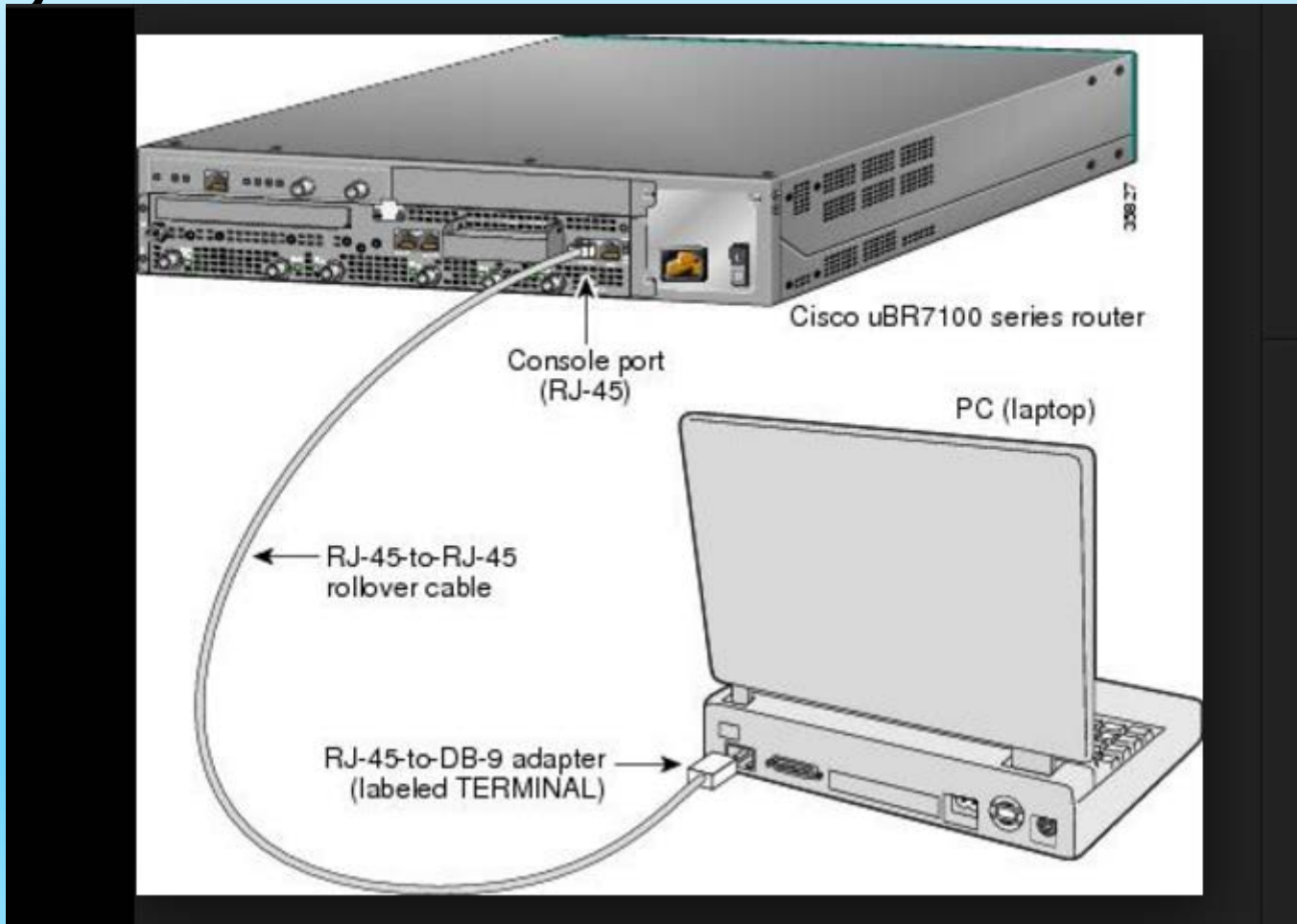
Out-of-Band

- Out-of-band access allows you to see your equipment without network connections.
- Out-of-band means ‘outside normal band’
- It provides you with a **backup path** in case of network communication failure.
- For instance, an equipment operates on LAN. When network is down, you can use your smartphone to access the equipment.

Accessing a Cisco IOS Device

Console Access Methods

Console Port with Laptop connected for CLI to be displayed

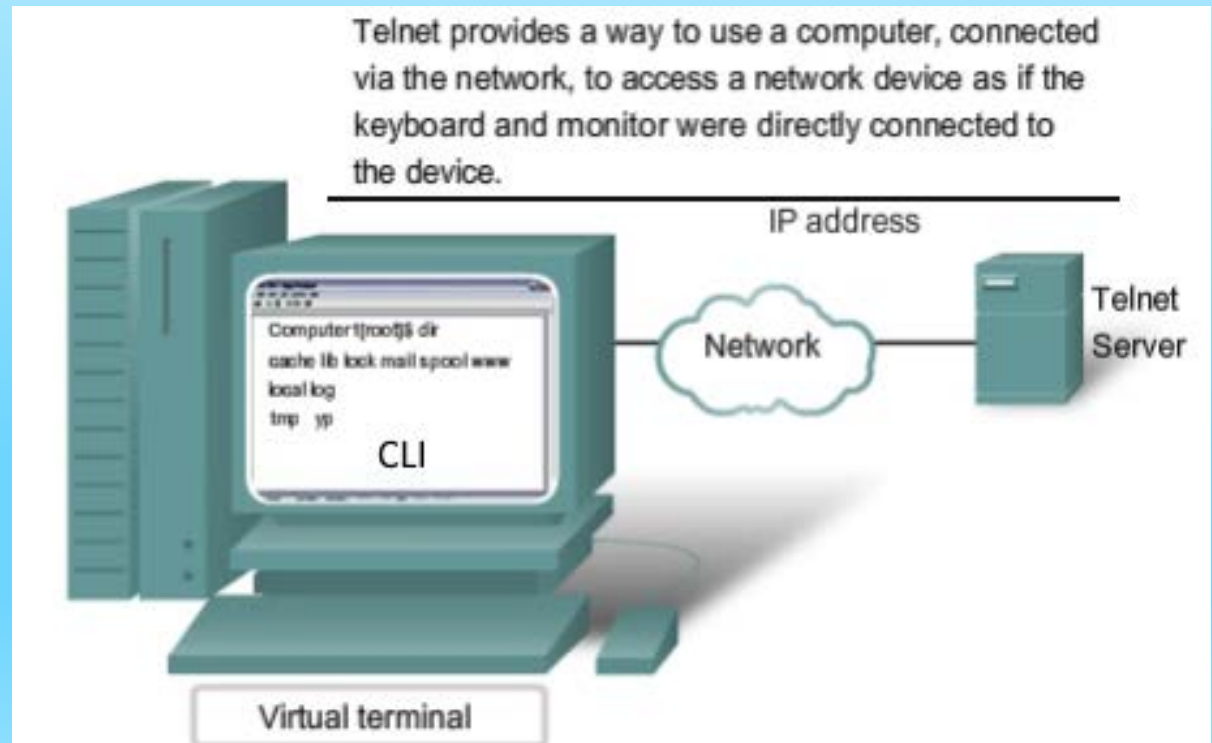


Accessing a Cisco IOS Device

Telnet Method

Telnet Method

- Method for **remotely** accessing the CLI over a network
- Require active networking services and one active interface that is configured

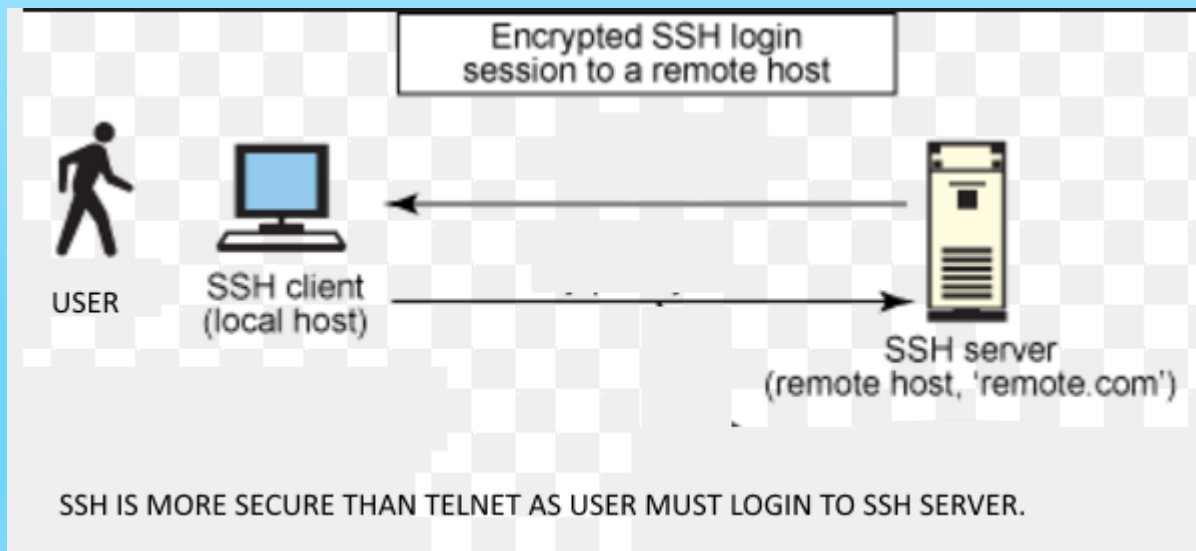


Accessing a Cisco IOS Device

SSH Method

Secure Shell (SSH)

- **Remote** login similar to Telnet, but utilizes **more security**
- Stronger password authentication
- Uses encryption when transporting data



Terminal Emulation

Terminal emulation is the ability to make one computer **terminal**, typically a PC, appear to look like another, usually older type of **terminal**.

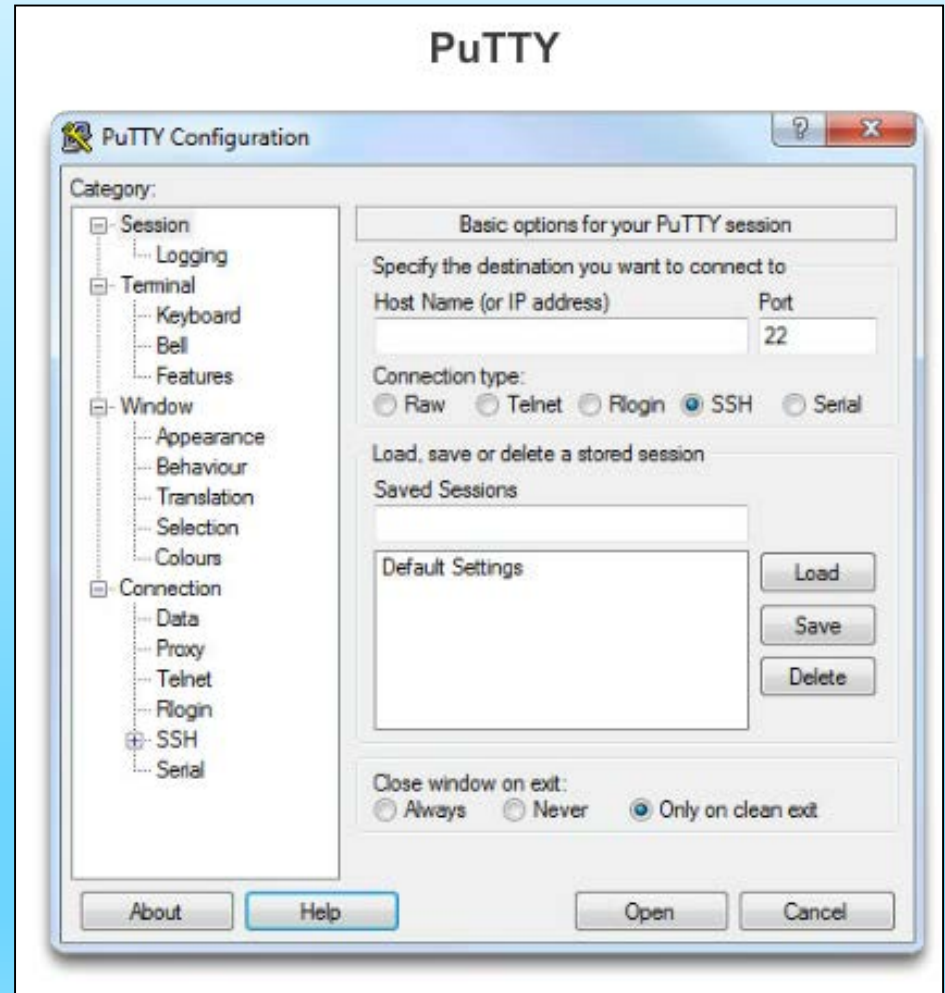
For example, a terminal emulation software is needed on Windows 10 to display a program that runs on Windows 3.1

Accessing a Cisco IOS Device

Terminal Emulation Programs

Software available for connecting to a networking device:

- PuTTY
- Tera Term
- SecureCRT
- HyperTerminal
- OS X Terminal



Cisco IOS Command Modes

Navigating the IOS

Cisco IOS Command Modes

IOS provides group of commands used for monitoring, configuring and maintaining cisco devices.

For security and easy administration, IOS commands are divided in the set of different command modes.

Each command mode has its own set of commands. Which commands are available to use, depends upon the mode you are in.

Navigating the IOS

Cisco IOS Command Modes

Primary Modes

- User EXEC Mode
- Privileged EXEC Mode

Other Modes

- Global Configuration Mode
- Interface Configuration Mode
- Sub Interface Configuration Mode
- Setup Mode
- ROM Monitor Mode

Navigating the IOS

Cisco IOS Modes of Operation

IOS Mode Hierarchical Structure

User EXEC Command-Router>

ping
show (limited)
enable
etc.

Privileged EXEC Commands-Router#

all User EXEC commands
debug commands
reload
configure
etc.

Global Configuration Commands-Router(config)#

hostname
enable secret
ip route

interface ethernet
serial
dsl
etc.

router rip
ospf
eigrp
etc.

line vty
console
etc.

Interface Commands-Router(config-if)#

ip address
ipv6 address
encapsulation
shutdown/no shutdown
etc.

Routing Engine Commands-Router(config-router)#

network
version
auto summary
etc.

Line Commands-Router(config-line)#

password
login
modem commands
etc.

Navigating the IOS

Primary Modes

User EXEC Mode

Limited examination of router.
Remote access.

```
switch>  
Router>
```

The **User EXEC** mode allows only a limited number of basic monitoring commands and is often referred to as view-only mode.

The **Privileged EXEC** mode, by default, allows all monitoring commands, as well as execution of configuration and management commands.

Privileged EXEC Mode

Detailed examination of router. Debugging and testing. File manipulation. Remote access.

```
switch#  
Router#
```

Navigating the IOS

Global Configuration Mode and Submodes

Privileged EXEC Mode

Privileged EXEC Mode

Detailed examination of router, Debugging and testing.
File manipulation. Remote access.

```
Switch#  
Router#
```



Global Configuration Mode

Global configuration commands.

```
Switch(config)#  
Router(config)#
```



Other Configuration Modes

Specific service or interface configurations.

```
Switch(config-mode)#  
Router(config-mode)#
```

IOS Prompt Structure

```
Router>ping 192.168.10.5  
  
Router#show running-config  
  
Router (config)#Interface FastEthernet 0/0  
  
Router (config-if)#ip address 192.168.10.1 255.255.255.0
```

The prompt changes to denote the current CLI mode.

```
Switch>ping 192.168.10.9  
  
Switch#show running-config  
  
Switch (config)#Interface FastEthernet 0/1  
  
Switch (config-if)#Description connection to WEST LAN4
```

Navigating the IOS

Navigating Between IOS Modes

The commands 'enable' switches to Privileged EXEC mode.
'disable' switches back to EXEC mode.

```
Router con0 is now available.
```

```
Press RETURN to get started.
```

```
User Access Verification
```

```
Password:
```

```
Router>
```

User EXEC Mode Prompt

```
Router>enable
```

```
Password:
```

```
Router#
```

Privileged EXEC Mode Prompt

```
Router#disable
```

```
Router>
```

User EXEC Mode Prompt

```
Router>exit
```

Router

Navigating the IOS

Navigating Between IOS Modes (cont.)

```
Switch> enable
Switch# configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)# interface vlan 1
Switch(config-if)# exit
Switch(config)# exit
Switch#
```

```
Switch# configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)# line vty 0 4
Switch(config-line)# interface fastethernet 0/1
Switch(config-if)# end
Switch#
```

```
Switch# configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)# vlan 1
Switch(config-vlan)# end
Switch#
```

END OF CHAPTER 2A

REVIEW

1. **IOS** stands for _____.

REVIEW

1. **IOS** stands for **Internetwork Operating System**

It is a family of software used on most **Cisco** Systems routers and current **Cisco** network switches.

Review

2. The OS on home routers is usually called _____.

Review

2. The OS on home routers is usually called **firmware**.

Review

3. An OS consists of:

- ?
- ?
- ?

Review

3. An OS consists of:

- Shell
- Kernel
- Hardware

Review

4. The shell
allows users to
interact with the
system via CLI
and GUI

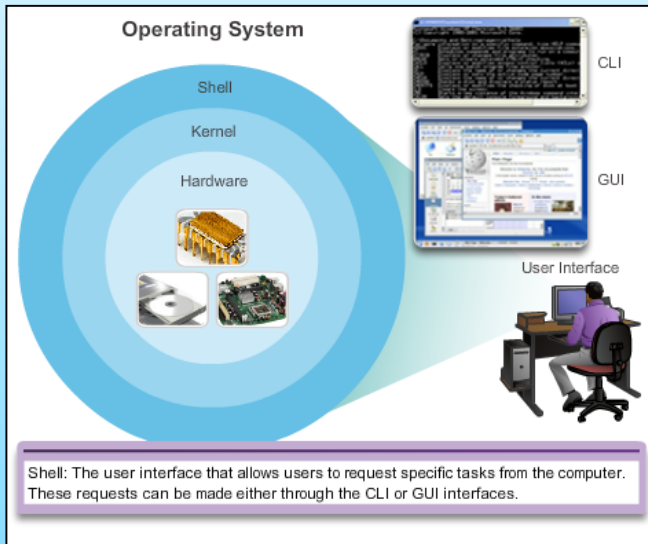
CLI stands for _____
GUI stands for _____

Review

4. The shell
allows users to
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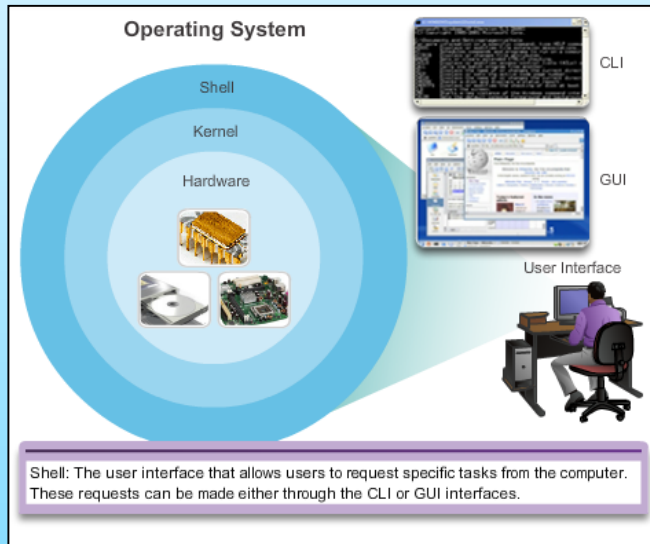
CLI – Command Line Interface
GUI – Graphical User Interface

Cisco IOS Operating Systems



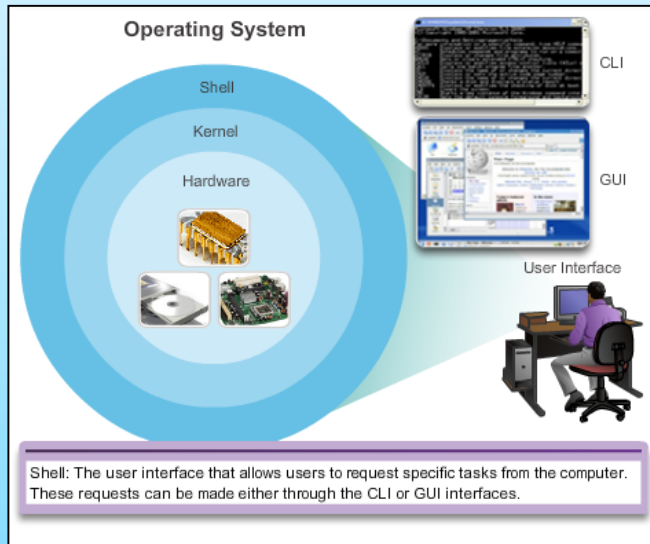
5. The kernel allows communication between _____ and _____

Cisco IOS Operating Systems



5. The kernel allows communication between software and hardware. It also manages hardware resources to meet software requirements

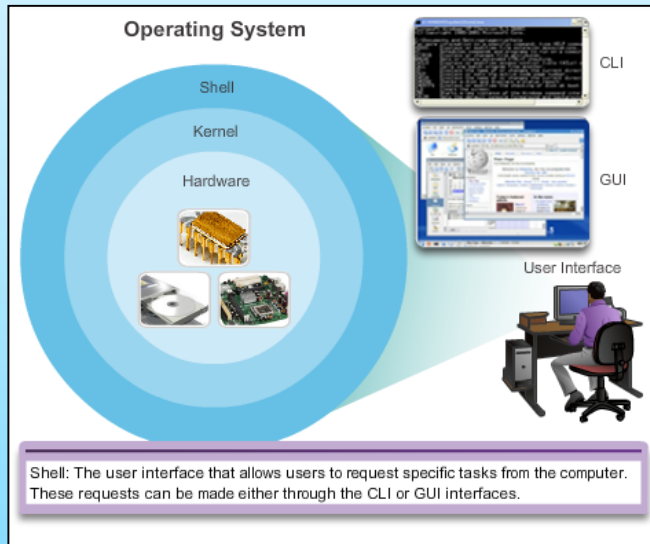
Cisco IOS Operating Systems



6. Hardware
refers to the _____ of
a computer,
including all
underlying
electronics

Cisco IOS

Operating Systems



6. Hardware refers to the physical parts of a computer, including all underlying electronics

Cisco IOS Review

7. Cisco IOS is stored in _____ **storage**

Cisco IOS Review

7. Cisco IOS is stored in **Flash** storage



Cisco IOS Review

8. Non-volatile means _____.



Cisco IOS Review

8. Non-volatile means data are not lost when electrical power is lost.



Cisco IOS Review

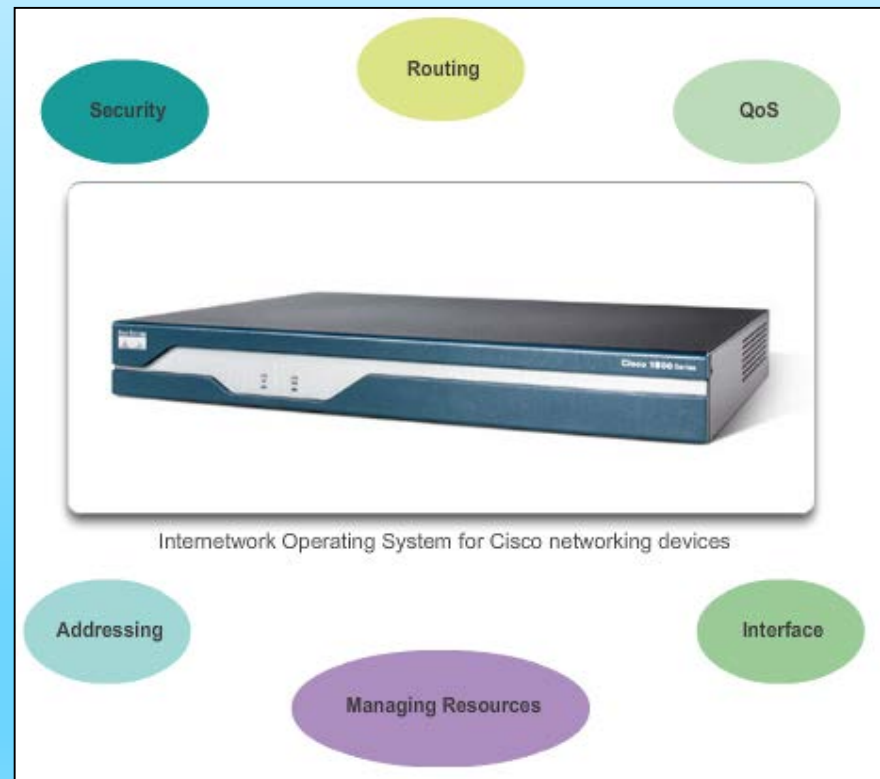
9. What are the 6 functions performed or enabled by Cisco routers and switches?

Cisco IOS

Review

9. What are the 6 functions performed or enabled by Cisco routers and switches?

- Security
- Routing
- QoS
- Addressing
- Managing Resources
- Interface



Review

10. What is the meaning of routing?

Review

- **Routing** is the process of selecting best paths in a network.

Review

11. Does Cisco devices have display units?

Review

11. Does Cisco devices have display units?

No

Review

12. Three methods to access the CLI

(Command Line Interface) environment of Cisco devices are:

- ?
- ?
- ?

Review

12. Three methods to access the CLI

(Command Line Interface) environment of Cisco devices are:

- Console Port Method
- Telnet or SSH (**S**ecure **S**hell) Method (remote)
- AUX port Method (remote)

Review

13. The Console Port is a _____ port.

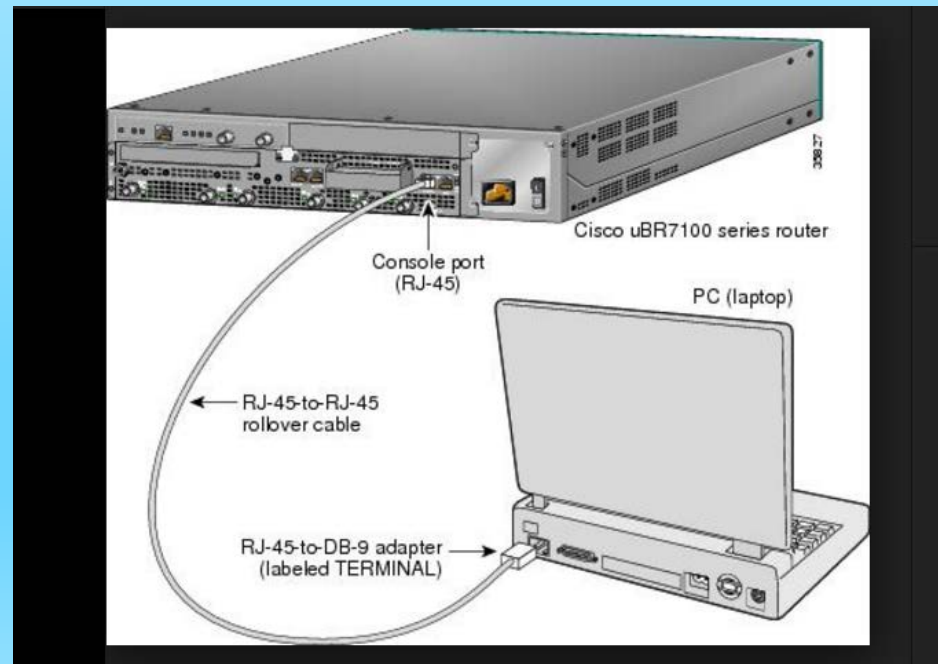
**It can be connected to another _____ port using a
_____ cable.**

Review

13. The Console Port is a **RJ-45** port.

It can be connected to another **RJ-45** port using a

rollover cable.

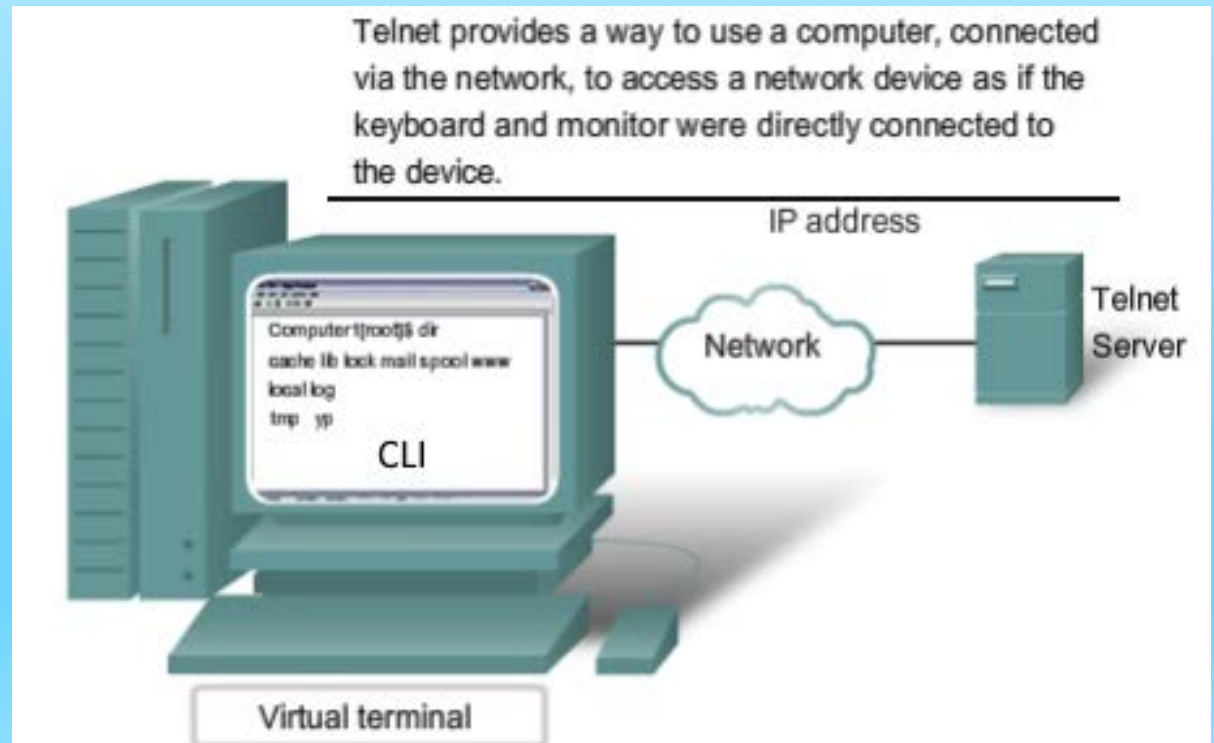


Review

14. Telnet Method is a Method for _____.

Review

14. **Telnet Method** is a Method for **remotely accessing the CLI over a network**



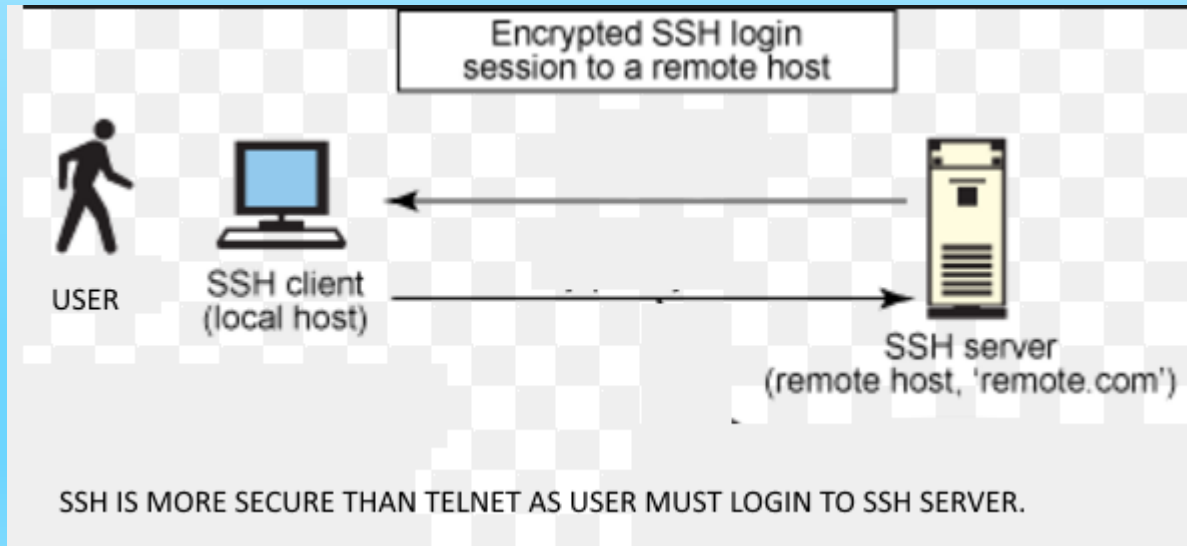
Review

15. Secure Shell (SSH) method is similar to Telnet method, but uses _____ and stronger _____ authentication.

It also uses _____ when transporting data.

Review

15. Secure Shell (SSH) method is similar to Telnet method, but uses more security and stronger password authentication. It also uses **encryption when transporting data**



Review

16. For the Aux Port Method, a _____ modem or a _____ can be used.

_____ connection is available.

Review

16. For the Aux Port Method, a **dial-up** modem or a **laptop** can be used.

Out-of-band connection is available.



Accessing a Cisco IOS Device

Review

17. 'Out-of-band' is a feature of a device that allows you to see your equipment without _____.

Accessing a Cisco IOS Device

Review

17. 'Out-of-band' is a feature of a device that allows you to see your equipment without **network connections**.

Accessing a Cisco IOS Device

Terminal Emulation

Terminal emulation is the ability to make

Review

18. Terminal emulation is the ability to make one computer **terminal look like another** type of **terminal**.

For example, a terminal emulation software is needed on Windows 10 to display a program that runs on Windows 3.1

Review

19. What are some terminal emulation software?

Review

19. What are some terminal emulation software?

- PuTTY
- Tera Term
- SecureCRT
- HyperTerminal
- OS X Terminal

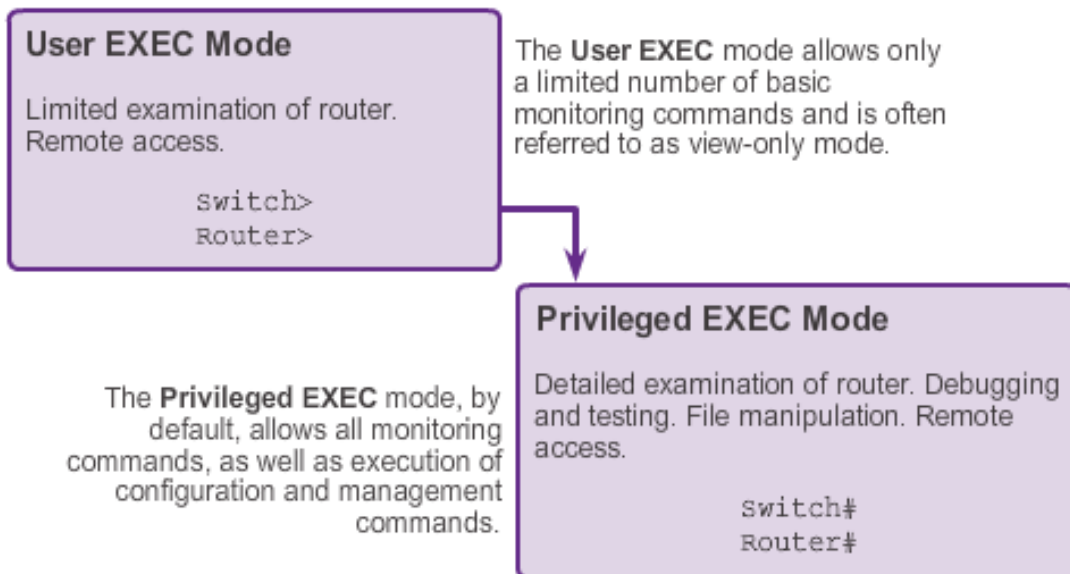
Review

20. Cisco IOS has a few command modes. Name two Primary Modes.

Review

20. Cisco IOS has a few command modes. Name two Primary Modes

- User EXEC Mode
- Privileged EXEC Mode



Review

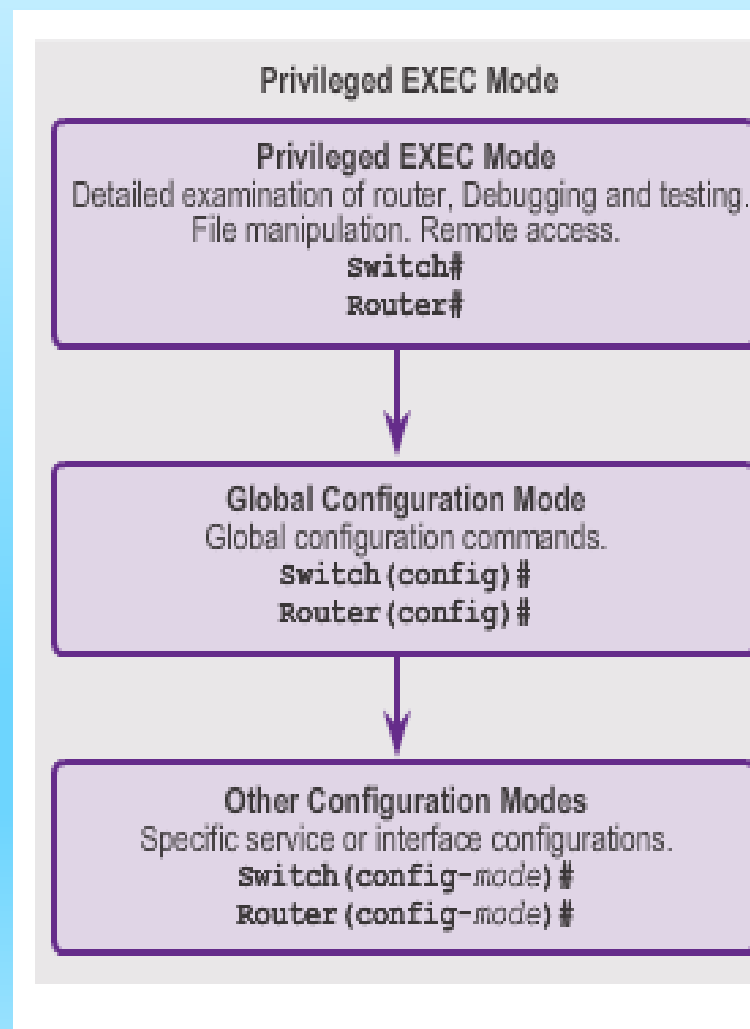
21. Cisco IOS has a few command modes. Name five other modes.

Review

21. Cisco IOS has a few command modes. Name five other modes.

Other Modes

- Global Configuration Mode
- Interface Configuration Mode
- Sub Interface Configuration Mode
- Setup Mode
- ROM Monitor Mode



END OF CHAPTER 2A