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.
2.0 Introduction
2.1 IOS Bootcamp
2.2 Getting Basic
2.3 Addressing Schemes
2.4 Summary
2.1 IOS Bootcamp
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
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
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.
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
Cisco IOS

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.
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 (Secure SHell) Method (remote)
- AUX port Method (remote)
Accessing a Cisco IOS Device

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

- 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

SSH is more secure than Telnet as user must login to SSH server.
Accessing a Cisco IOS Device

AUX Access Method

Aux Port

- Out-of-band connection is available
- Dial-up modem is connected to Aux port
- Modem uses telephone line
- Does not require configuring of network services
- Can be used like console port – connect directly to a PC/laptop
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
IOS provides a group of commands used for monitoring, configuring, and maintaining Cisco devices.

For security and easy administration, IOS commands are divided into 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 Commands-Router (config-if)#**
  - interface ethernet
  - serial
  - dsl
  - etc.
  - ip address
  - ipv6 address
  - encapsulation
  - shutdown/no shutdown
  - etc.

- **Routing Engine Commands-Router (config-router)#**
  - router rip
  - ospf
  - eigrp
  - etc.
  - network
  - version
  - auto summary
  - etc.

- **Line Commands-Router (config-line)#**
  - line vty
  - console
  - etc.
  - 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.

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**Privileged EXEC Mode**

```
Switch#
Router#
```
Navigating the IOS
Global Configuration Mode and Submodes

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.
Navigating the IOS

Navigating Between IOS Modes (cont.)

Switch> enable
Switch# configure terminal
Enter configuration commands, one per line.
End with CNTRL/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 CNTRL/Z.
Switch(config)# line vty 0 4
Switch(config-line)# interface fastethernet 0/1
Switch(config-if)# end
Switch(config-if)#
Switch#
END OF CHAPTER 2A
1. **IOS** stands for ________________________________.
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
4. The shell allows users to interact with the system via CLI and GUI

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

CLI – Command Line Interface
GUI – Graphical User Interface
5. The kernel allows communication between ________ and __________
5. The kernel allows communication between software and hardware. It also manages hardware resources to meet software requirements.
6. Hardware refers to the __________ of a computer, including all underlying electronics.
6. Hardware refers to the physical parts of a computer, including all underlying electronics.
Cisco IOS Review

7. Cisco IOS is stored in ________ storage
7. Cisco IOS is stored in Flash storage
8. Non-volatile means ________________________________.
8. Non-volatile means data are not lost when electrical power is lost.
9. What are the 6 functions performed or enabled by Cisco routers and switches?
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.
11. Does Cisco devices have display units?
11. Does Cisco devices have display units?

No
12. Three methods to access the CLI (Command Line Interface) environment of Cisco devices are:
  - ?
  - ?
  - ?
12. Three methods to access the CLI (Command Line Interface) environment of Cisco devices are:

- Console Port Method
- Telnet or SSH (Secure SHell) Method (remote)
- AUX port Method (remote)
13. The Console Port is a ________ port.

It can be connected to another ________ port using a ________ cable.
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
15. Secure Shell (SSH) method is similar to Telnet method, but uses ______________ and stronger __________ authentication.

It also uses ______________ when transporting data.
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.
16. For the Aux Port Method, a ___________ modem or a __________ can be used.

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

**Out-of-band** connection is available.
17. ‘Out-of-band’ is a feature of a device that allows you to see your equipment without ______________.
17. ‘Out-of-band’ is a feature of a device that allows you to see your equipment without network connections.
Terminal emulation is the ability to make
______________________________.
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.
19. What are some terminal emulation software?
19. What are some terminal emulation software?

- PuTTY
- Tera Term
- SecureCRT
- HyperTerminal
- OS X Terminal
20. Cisco IOS has a few command modes. Name two Primary Modes.
20. Cisco IOS has a few command modes. Name two Primary Modes

- User EXEC Mode
- Privileged EXEC Mode
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