

Network Device and Configuration

Chapter Two

Network Devices Basic Configuration

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Network Devices

- Network devices are components used to connect computers or other electronic devices together so that they can share files or resources like printers or fax machines.
- Devices used to set up a Local Area Network (LAN) are the most common type of network devices used by the public.
- A LAN requires a hub, switch, router etc.

Router

- Routers are networking devices operating at layer 3 or a network layer of the OSI model.
- It has the same basic components as a standard desktop PC.
- However, routers are designed to perform some very specific functions.
- As with a computer, a router or switch cannot function without an operating system.
- This Operating System is known as **Internetwork Operating System (IOS)**.
- Routers/Switches need the IOS to run configuration files.
- These configuration files contain the instructions and parameters that control the flow of traffic in and out of the routers/switches.

Functions of routers

Router connects multiple networks

- It has multiple interfaces that each belongs to a different IP network.
- Each network that a router connects to typically requires a separate interface.
- These interfaces are used to connect a combination of both Local Area Networks (LANs) and Wide Area Networks (WANs).

Routers determine the best path

- It direct packets destined for local and remote networks by: determining the best path to send packets and forwarding packets toward their destination.
- The router uses its routing table to determine the best path to forward the packet.

Router Components

Hardware Components

- CPU: CPU executes operating system instructions
- Router Memory Components
- Interfaces and Lines

Software Components

- IOS

Router Memory Components

ROM

- Stores bootstrap program and basic operating system software.
- Maintains instructions for power-on self test (POST) diagnostics.
- Mini IOS: a fallback utility that contains a stripped down version of IOS.

RAM

- Contains the running copy of configuration file.
- Provides temporary memory for the configuration file of the router while the router is powered on.
- Any changes that are done in the configuration are stored in the RAM till it is saved to the NVRAM.
- Loses content when router is powered down or restarted.
- RAM stores the routing table, cache entries, IP packets buffer etc.

Router Memory Components

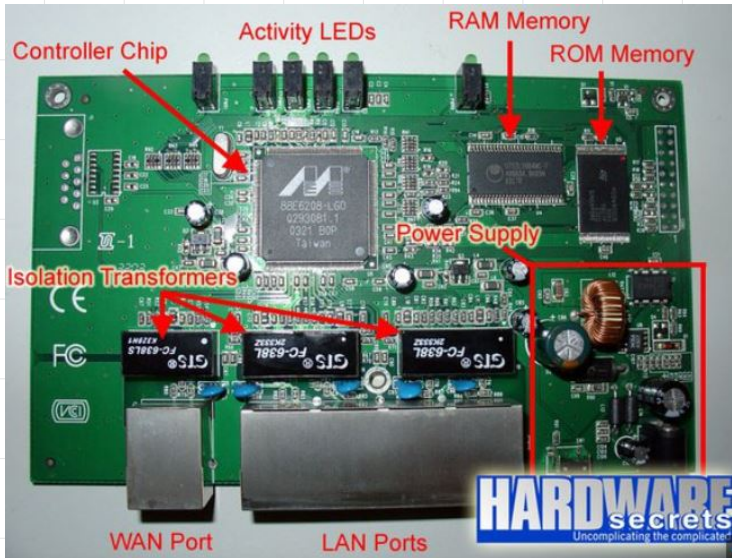
Non-Volatile RAM

- Stores startup configuration.
- Retains content when router is powered down or restarted.

FLASH Memory

- Holds the operating system image (IOS).
- Allows software to be updated without removing and replacing chips on the processor.
- Retains content when router is powered down or restarted.
- Is a type of electronically erasable, programmable ROM (EEP-ROM).

Router Component



Interfaces and Lines

- Cisco devices contain two distinctly different types of ports, interfaces and lines.

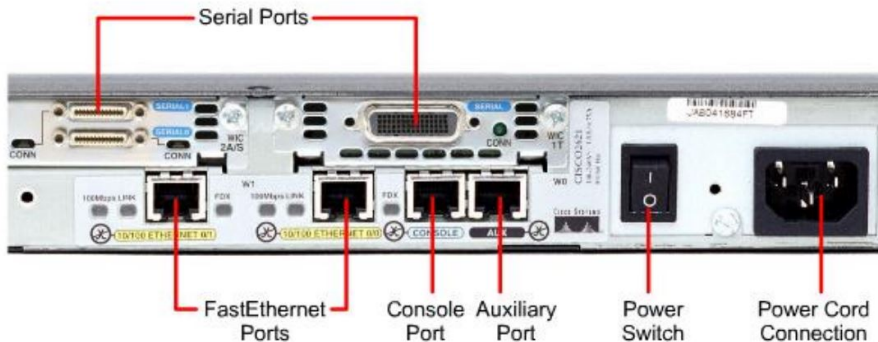
Interfaces

- Interfaces connect routers and switches to each other.
- In other words, traffic is actually routed or switched across interfaces.
- Examples of interfaces include: Serial Ethernet, Fast Ethernet, Token Ring, ATM, ISDN BRI, Loopback interfaces etc.

Lines

- Lines identify ports that allow us to connect into, and then configure, Cisco devices.
- The most common examples of lines include: Console ports, Auxiliary ports and VTY (telnet) ports.

Router External Component



Interfaces and Lines

- Router interfaces are grouped into three major categories

Category of Interfaces	Interfaces	Function
LAN Interfaces	Ethernet , Fast Ethernet Ports, Gigabit	Used to connect router to LAN network
WAN Interfaces	Serial Port	Used to connect routers to external networks that interconnect LANs.
Management Interfaces	Console, Auxiliary Ports	Used for configuration purpose

Using Lines to Configure the IOS

- Three methods (or lines) exist to configure Cisco IOS devices: Console ports, Auxiliary ports and VTY (telnet) ports.
- The **console port** is generally a RJ-45 connector, and requires a rollover cable to connect.
- The opposite side of the rollover cable connects to a PC's serial port using a serial terminal adapter.
- From the PC, software such as HyperTerminal is required to make a connection from the local serial port to the router console port.

Using Lines to Configure the IOS

- The following settings are necessary for a successful connection:
 - Bits per second - 9600 baud
 - Data bits - 8
 - Parity - None
 - Stop bits - 1
 - Flow Control – Hardware or none in software or cisco packet tracer.
- **Auxiliary port** is most commonly used as a backup console port, but it can also be used as a dial-up port for remote router management and many other functions.

Using Lines to Configure the IOS

- **Telnet**, and now **SSH**, are the most common methods of remote access to routers and switches.
- There are two requirements before a router/switch will accept a VTY connection:
 - An IP address must be configured on an interface
 - At least one VTY port must be configured with a password

Internetwork Operating System (IOS)

- Cisco IOS manages the hardware and software resources of the router, including memory allocation, processes, security, and file systems.
- Cisco IOS is a multitasking operating system that is integrated with routing, switching, internetworking, and telecommunications functions.
- Cisco creates many different types of IOS images, depending upon the model of the router and the features within the IOS.

Internetwork Operating System (IOS)

- Typically the more features in the IOS, the larger the IOS image, and therefore, the more flash and RAM that is required to store and load the IOS.
- For example, some features include the ability to run IPv6 or the ability for the router to perform NAT (Network Address Translation).
- A router provide a graphical user interface (GUI), but the command line interface (CLI) is a much more common method of configuring Cisco routers.

Router Boot-up-Process

- **There are four major phases to the boot-up process:**

Performing the POST

- The POST (Power-On Self Test) process is used to test router hardware.
- When the router is powered on, software on the ROM chip conducts POST.
- During self-test, router executes diagnostics from ROM on several hardware components including the CPU, RAM, and NVRAM.
- After POST has been completed, router executes bootstrap program.

Router Boot-up-Process

Loading the Bootstrap Program

- After the POST, the bootstrap program is copied from ROM into RAM.
- Once in RAM, the CPU executes the instructions in the bootstrap program.
- Bootstrap read configuration register value to determine how the router will boot up.
- The default configuration register value is 0x2102 it tells the router to load the IOS image from flash memory and to load configuration file from NVRAM.
- The main task of the bootstrap program is to locate the Cisco IOS and load it into RAM.

Router Boot-up-Process

Locating and Loading Cisco IOS

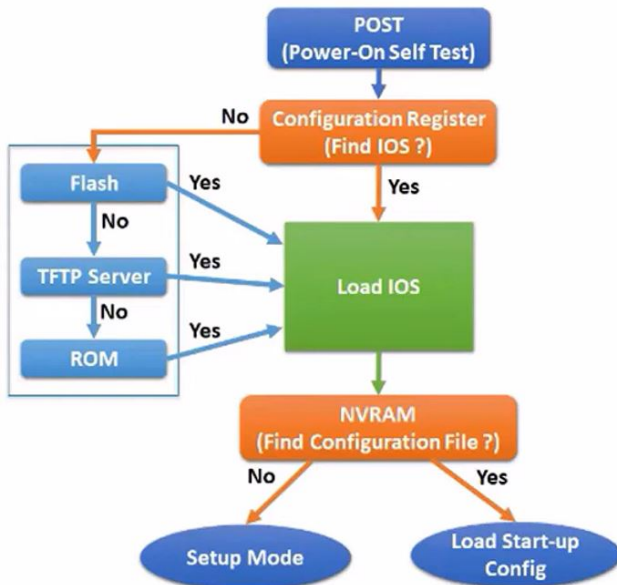
- The IOS is typically stored in flash memory, but can also be stored in other places such as a TFTP (Trivial File Transfer Protocol) server.
- Depending on the value of configuration register, the bootstrap program find and load the IOS.
- If bootstrap fails to load IOS from all possible location it will drop boot sequence in ROMMON (ROM monitor) mode for troubleshooting.
- In ROMMON mode you can boot the device and perform diagnostic tests.

Router Boot-up-Process

Locating and Loading the Configuration File

- After the IOS is loaded, the bootstrap program searches for the startup configuration file, known as startup-config, in NVRAM.
- This file has the previously saved configuration commands and parameters including: interface addresses, routing information, passwords any other configurations saved by the network administrator.
- If the startup configuration file, startup-config, is located in NVRAM, it is copied into RAM as the running configuration file, running-config.
- If the startup configuration file does not exist in NVRAM, the router reverts to setup mode.
- Setup mode is an interactive dialog that allows you to create a basic configuration for the router.

Router Boot-up-Process



Basics configuration of router and switch

- Routers can be configured using either Graphical User Interface (GUI) or Command Line Interface (CLI).
- Router manufacturers provide SDM (Security Device Manager) software along with the router to enable users configure the router graphically.
- SDM Express uses eight configuration steps to assist in creating a basic router configuration: Overview, Basic Configuration, LAN IP Address, DHCP, Internet (WAN), Firewall, Security Settings and Summary.

Cisco IOS Modes of Operation

- The Cisco IOS software provides access to several different command modes.
- For security purposes, the Cisco IOS software provides two levels of access to commands: **user** and **privileged**.
- The unprivileged user mode is called **user EXEC mode**.
- The privileged mode is called **privileged EXEC mode** and requires a password.
- The commands available in user EXEC mode are a subset of the commands available in privileged EXEC mode.

Basics configuration of router and switch

User EXEC mode

- Limited to basic monitoring commands.
- When you are connected to the router, you are started in user EXEC mode.
- The user EXEC commands are a subset of the privileged EXEC commands.

Privileged EXEC mode

- Provides access to all other router commands.
- Privileged commands include the following:
 - Configure – Changes the software configuration.
 - Debug – Display process and hardware event messages.
 - Setup – Enter configuration information at the prompts.

Basics configuration of router and switch

Global configuration mode

- Commands that affect the entire system.
- Configuration mode has a set of sub modes that you use for modifying interface settings, routing protocol settings, line settings, and so forth.
- Use caution with configuration mode because all changes you enter take effect immediately.
- To enter configuration mode, enter the command configure terminal and exit by pressing Ctrl-Z.

Specific configuration modes

- Commands that affect interfaces/processes only.

Basics configuration of router and switch

Mode of operation	Usage	How to Enter the Mode?	Prompt
User EXEC	Change terminal settings on a temporary basis, perform basic tests, and list system information.	First level accessed.	Router>
Privileged EXEC	System administration, set operating parameters.	Router> enable	Router#
Global Config	Modify configuration that affect the system as a whole.	Router# configure terminal	Router(config)#
Interface Config	Modify the operation of an interface.	Router(config)# interface fastethernet 0/0	Router(config-if)#

Thank You!