Cisco Router:

- Router is a hardware device work on Layer 3 or Network Layer of OSI Model.
- Router connects minimum of two networks generally find at the gateway.
- Router is used to interconnect two more different LANs with each other.
- Router is used to connect a LAN with WAN, Router is used to control broadcast.
- Router divide broadcast domains create routing table to store network information.
- Router is a device which select best path on the basis of routing protocol.
- Cisco Switches create a network and Cisco Routers connect different networks.
- Router uses a combination of hardware and software to "route" data.
- Routers segment large networks into logical segments called subnets.
- Router is networking device that forwards data packets between computer networks.
- Router is a layer 3 device used to forward packet from one network to another.
- Router perform various functions such as Static Routing and Dynamic Routing.
- Router also perform other various functions such as NAT, ACL, Inter VLAN Routing etc.

Router Hardware Part:

CPU (Central Processing Unit): Execute Instruction/Run Application Programs (IOS Execute)

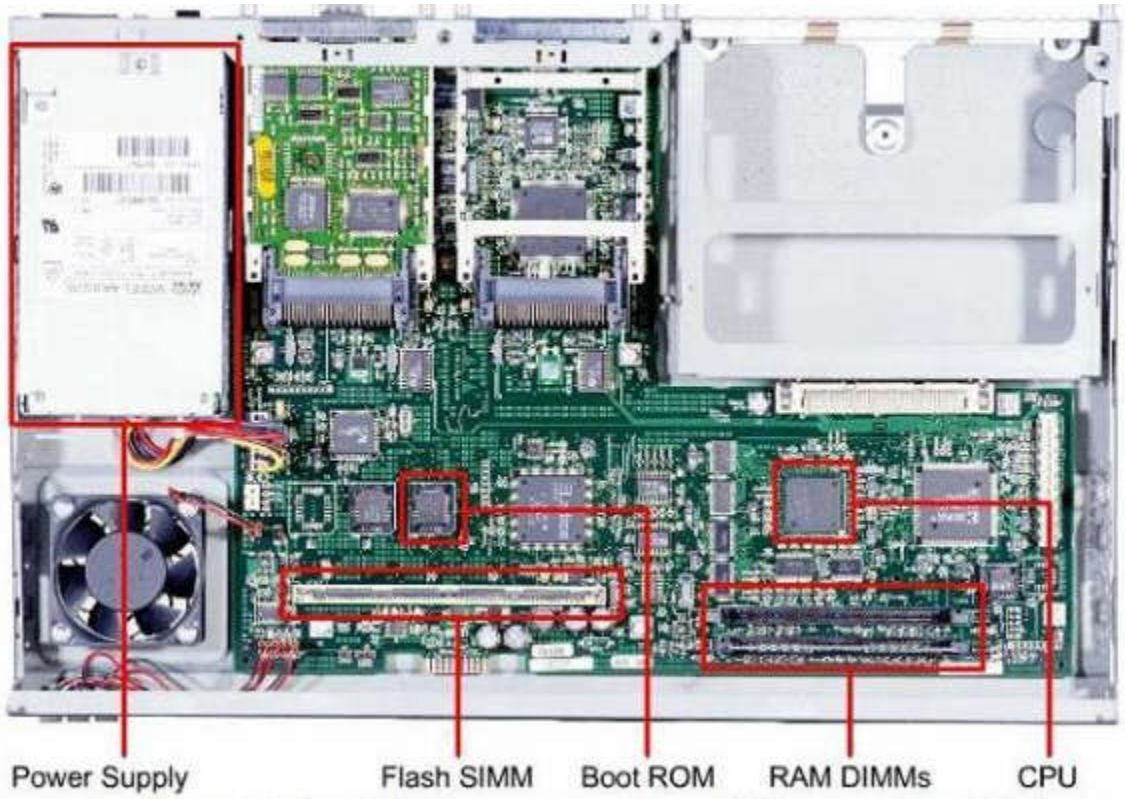
RAM (Random Access Memory): Temporary Memory/it is also called Volatile Memory, Routing table, ARP Cache, Running Configuration File and IOS Loaded in RAM

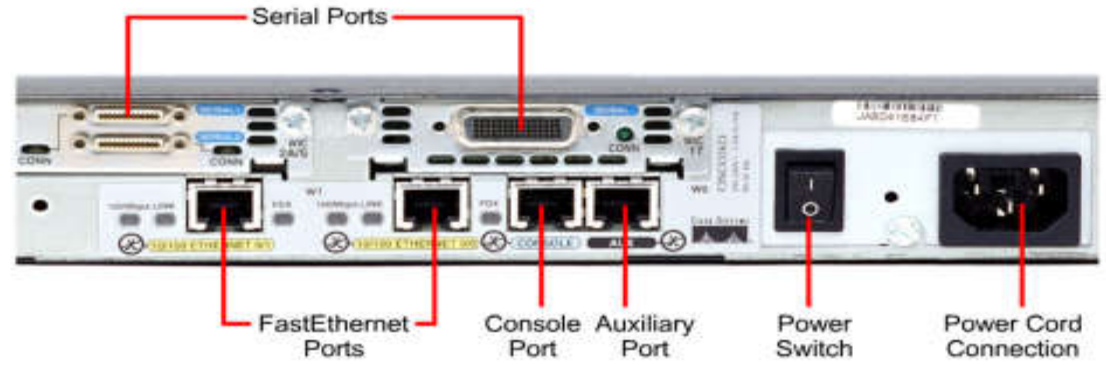
NVRAM (Non Volatile Random Access Memory): Permanent Memory, NVRAM store backup of running configuration file with the name of Startup Configuration File Permanent,

Flash Memory: Permanent Memory, IOS stored in Flash Memory in compress form, Flash Memory Size (32MB, 64MB, 128MB, 256MB, 512MB), Flash memory can be upgrade as per environment requirements,

ROM (Read Only Memory): Permanent Memory, it stores Bootstrap Programs, Scale Down Version of IOS (Mini IOS), Diagnostic Applications/Programs.

CLI: The Cisco IOS command-line interface (CLI) is the primary user interface used for configuring, monitoring, and maintaining Cisco devices. This user interface allows you to directly and simply execute Cisco IOS commands, whether using a router console or terminal, or using remote access methods.





Router Memory:

ROM (Read-Only Memory):

- ROM stand for Read Only Memory also called Permanent Memory.
- ROM used to store Bootstrap Programs, Mini IOS & Diagnostic Applications.
- Bootstrap program is loaded when the device first powers on.
- it is used to find IOS image & manage the process of loading the IOS into RAM.

RAM (Random Access Memory):

- RAM stand for Random Access Memory also called Volatile Memory.
- Routing table, ARP Cache, Running Configuration File & IOS loaded in RAM.
- This type of memory loses its content when the device loses power.

NVRAM (Nonvolatile RAM):

- NVRAM stand for Non Volatile Random Access Memory.
- NVRAM is Permanent Memory used to store startup configuration file.
- This type of memory retains its content even after the device loses power.

Flash Memory:

- Flash Memory is also Permanent Memory like NVRAM.
- Flash Memory stored Cisco Operating System IOS in compress format.
- Flash Memory also store IOS software images and other files.
- This type of memory retains its content even after the device loses power.
- Flash Memory normal size are 32MB, 64MB, 128 MB, 256 MB & 512 MB.
- Flash Memory can be upgraded as per environment requirements.


```
Cisco 7206VXR (NPE400) processor (revision A) with 491520K/32768K bytes of memory.
Processor board ID 4279256517
R7000 CPU at 150MHz, Implementation 39, Rev 2.1, 256KB L2 Cache
6 slot VXR midplane, Version 2.1

Last reset from power-on

2 FastEthernet interfaces
509K bytes of NVRAM.

131072K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).
```

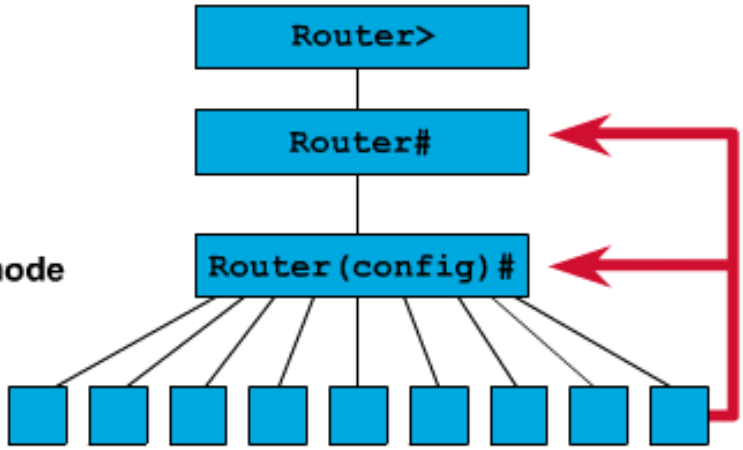
RAM

NVRAM (Nonvolatile RAM)

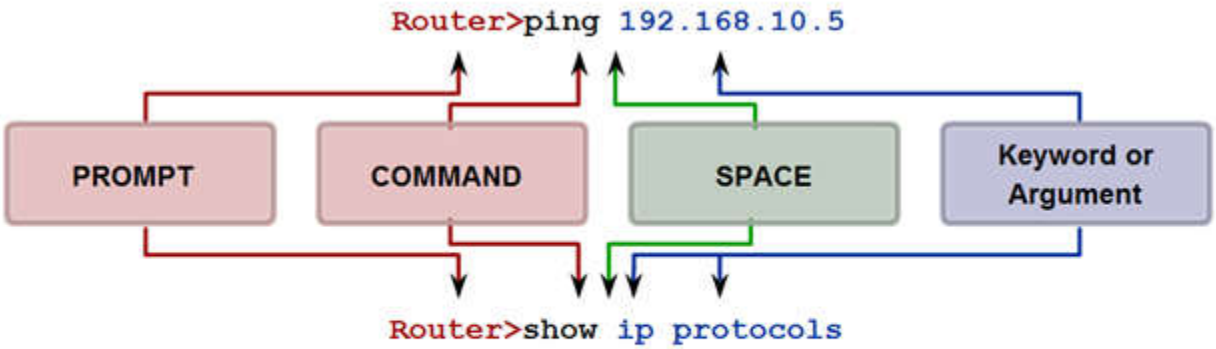
Flash Memory

Router Modes:

- User Exec mode
- Privileged Exec mode
- Global configuration mode
- Specific Configuration modes



Basic Command Structure:



Prompt commands are followed by a space and then the keyword or arguments.

Command Syntax Check Help

The IOS returns a help message indicating that required keywords or arguments were left off the end of the command:

```
Switch#>clock set
% Incomplete command.
Switch#clock set 19:50:00
% Incomplete command.
```

The IOS returns a help message to indicate that there were not enough characters entered for the command interpreter to recognize the command.

```
Switch#c
% Ambiguous command:'c'
```

The IOS returns a "^" to indicate where the command interpreter can not decipher the command:

```
Switch#clock set 19:50:00 25 6
                           ^
% Invalid input detected at '^' marker.
```

Cisco Operating Systems:

IOS (Internetwork Operating System):

- Cisco IOS (Originally Internetwork Operating System) is a family of software.
- IOS is an Operating System used on Cisco devices, such as routers and switches.
- Multitasking OS that implements and controls logic and functions of a Cisco device.
- Cisco IOS runs as a single image and all processes share the same memory space.
- To configure a Cisco device running IOS, the Command-Line Interface (CLI) is used.
- CLI comes with predefined number of commands to configure routing & switching.
- The CLI is usually accessed from local or remote Computer running Telnet or SSH.
- The IOS is usually stored as a system image within a router or switch flash memory.
- Not all Cisco products routers or switches run IOS (Internetwork Operating System).
- Cisco IOS all its processes run in the same address space on the same hardware.
- In Cisco IOS the OS and all running processes share the same memory and CPU.

```
R1#show version
Cisco IOS Software, 7200 Software (C7200-ADVENTERPRISEK9_SNA-M)
 SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2009 by Cisco Systems, Inc.
Compiled Wed 30-Sep-09 07:48 by prod_rel_team
```




Cisco IOS XE:

- Cisco IOS XE is open & flexible OS optimized for new era of enterprise networks.
- IOS XE use Linux operating system where IOS runs as a separate process on Linux.
- As the single OS for enterprise wired and wireless access, aggregation, core, and WAN.
- Cisco IOS-XE is advanced version of IOS and both IOS and IOS-XE share a lot of same codes.
- Cisco IOS-XE is the "new" Linux based OS Cisco introduced in 2008 with the ASR Routers.
- Cisco IOS-XE comes with many enhancement & more features compared to older version.
- Cisco IOS-XE adds support for symmetric multiprocessing and separate memory spaces.
- It provides improved software architectural strategy, while maintaining all the old benefits.
- Supports multiple CPU cores, control and data plane separation, & platform abstraction.
- Cisco IOS XE looks like and is managed the same way as traditional Cisco IOS Software.

```
Router#show ver
Cisco IOS XE Software, Version 16.07.01
Cisco IOS Software [Fuji], Virtual XE Software
```

Cisco IOS XR:

- Cisco IOS XR OS runs on a number of Cisco's large, service-provider focused platforms.
- IOS XR is Realtime Internetwork Operating System designed for high-end carrier routing.
- XR is mainly for service provider networks but it can also be use in enterprise network.
- Found on Cisco service provider routers such as XR 12000 Series router runs Cisco IOS-XR.
- NX-OS is built on a Linux kernel, IOS-XR is built on the QNX Neutrino Microkernel.
- QNX is similar to UNIX Operating System and is now owned by BlackBerry Company.
- NX-OS is the ability to have single instance of operating system controlling multiple chassis.
- used on high-end Network carrier-grade routers such as the CRS series and ASR9000 series.

```
RP/0/0/CPU0:ios#show version
Thu Oct 17 12:22:25.477 UTC

Cisco IOS XR Software, Version 6.0.1[Default]
Copyright (c) 2016 by Cisco Systems, Inc.
```

Modular Router:

- Modular router means that can plug different interface modules into the router.
- Can add additional any Serial port as well as Ethernet port in to the Router.
- Modular interface series router has choice to install the ports according to requirement.
- In modular interface series router, the interface nomenclature is type slot_#/port_#.
- Example in 1841 router two Ethernet ports are installed, named F 0/0 & FastEthernet 0/1.
- Modular Switches giving you the flexibility if your network needs change.
- SR routers are a particular line of Cisco routers, namely, 800, 1800, 2800, and 3800 series.

Fixed or Non-Modular Router:

- Non-modular router is low-end router and have fixed interfaces or Cards.
- These routers are routers with fixed number of ports & are typically not expandable.
- we cannot add additional serial port as well as Ethernet port in this Router i.e. 2500 Series.
- In fixed or non-modular interface series router, all slots & ports are integrated with device.
- In fixed router, interface numbers always start with 0 goes way up within specific interface.
- In fixed interface series router, the interface nomenclature is type slot_#/ port_#.
- Suppose, fixed interface router has two Ethernet then they named Ethernet 0, Ethernet 1.
- For example, 2503 series router has two fixed serial interfaces; so serial 0 and serial 1.

ISR (Integrated Service Router) Router:

- ISR generally used as internet edge for customers with small/medium networks.
- integrated services architecture that specifies elements to guarantee QoS on networks.
- ISR routers are used to allow video and sound to reach the receiver without interruption.
- ISR include 800, 1900 Series ISR, 2900 Series ISR, 3900 Series ISR, 4000 Series ISR, etc.

ASR (Aggregation Services Routers) Router:

- ASR generally used as internet edge for enterprise networks and service providers.
- ASR consist of 900 Series ASR, 1000 Series ASR, 5000 Series ASR, 9000 Series ASR, etc.
- Cisco's ASR Router series are best suited for enterprises & service providers.

CRS (Carrier Routing System) Router:

- Cisco CRS typically used in (IP/MPLS) core networks and for high-speed peering location.
- Cisco CRS is modular and distributed core router developed by Cisco Systems.
- CRS enables service providers to deliver data, voice, and video services over a scalable IP.