1. What is a Cisco Router?

A **Cisco router** is a network device designed to **connect multiple networks** and forward data packets between them. It operates at **Layer 3 (Network Layer)** of the OSI model and uses **IP addressing and routing protocols** to decide the best path for data transmission.

Routers play a crucial role in both **home networks** and **enterprise-level networks**, enabling communication between devices across different networks or subnets.

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2. Main Uses of a Router

- **Network Connection:** Connects a local network (LAN) to other networks like the internet (WAN).
- **Path Selection:** Determines the best path for data using routing protocols (e.g., OSPF, EIGRP, RIP).
- **NAT (Network Address Translation):** Allows multiple devices with private IP addresses to share a single public IP for internet access.
- **Security:** Implements ACLs (Access Control Lists), firewall features, and VPN (Virtual Private Network) tunnels.
- **QoS (Quality of Service):** Prioritizes network traffic (e.g., VoIP over regular data).
- **Inter-VLAN Routing:** Connects devices in different VLANs.
- **Load Balancing & Failover:** Provides high availability for enterprise networks.

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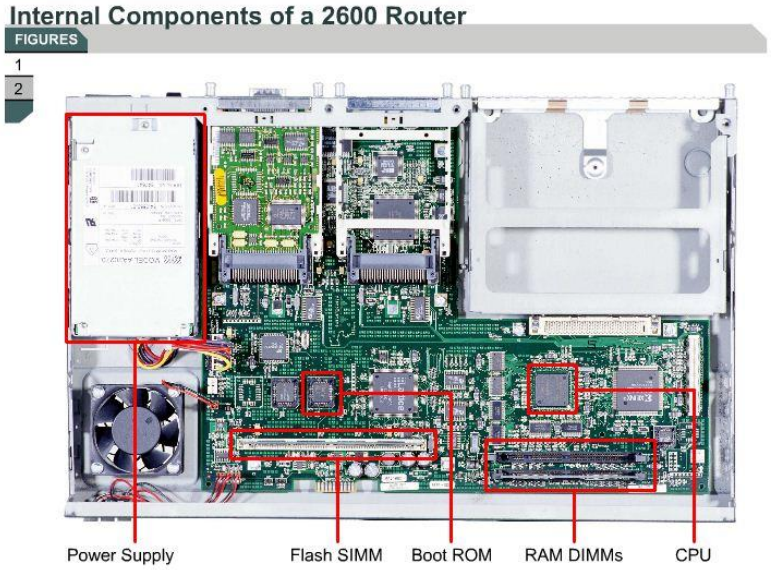
3. Internal Components of a Cisco Router



A Cisco router is like a small computer with dedicated hardware for networking.

The key components are:

(a) Cisco IOS (Internetwork Operating System)

- This is the **operating system** that runs on all Cisco devices.
- It controls routing, switching, security policies, and network services.
- Stored in **Flash Memory**.

(b) RAM (Random Access Memory)

- Stores the **running configuration** (active settings).
- Holds routing tables, ARP tables, and packet buffers.
- **Volatile memory** – data is lost when the router is powered off.

(c) NVRAM (Non-Volatile RAM)

- Stores the **startup configuration** (loaded when the router boots).
- Data remains intact even when power is off.

(d) Flash Memory

- Stores the **IOS image (system software)** and backup copies of IOS.
- Can be upgraded or replaced when new IOS versions are needed.

(e) ROM (Read-Only Memory)

- Contains the **bootstrap program** (responsible for loading IOS).
- Used for basic diagnostic tests during startup.

(f) Interfaces (Ports)

- **GigabitEthernet / FastEthernet:** For LAN or WAN connections.
- **Serial Interfaces:** For WAN links (older setups).
- **Console Port:** For CLI configuration (via terminal software).
- **Auxiliary Port:** Backup for remote modem access.

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4. Cisco Router Boot Process (How it Starts)

1. **POST (Power-On Self-Test)** – Checks hardware.
2. **Bootstrap Program (from ROM)** – Loads IOS.
3. **IOS Load (from Flash)** – Operating system starts.

4. **Load Startup Config (from NVRAM)** – Applies saved settings.
5. **Router Ready** – Accepts CLI commands.

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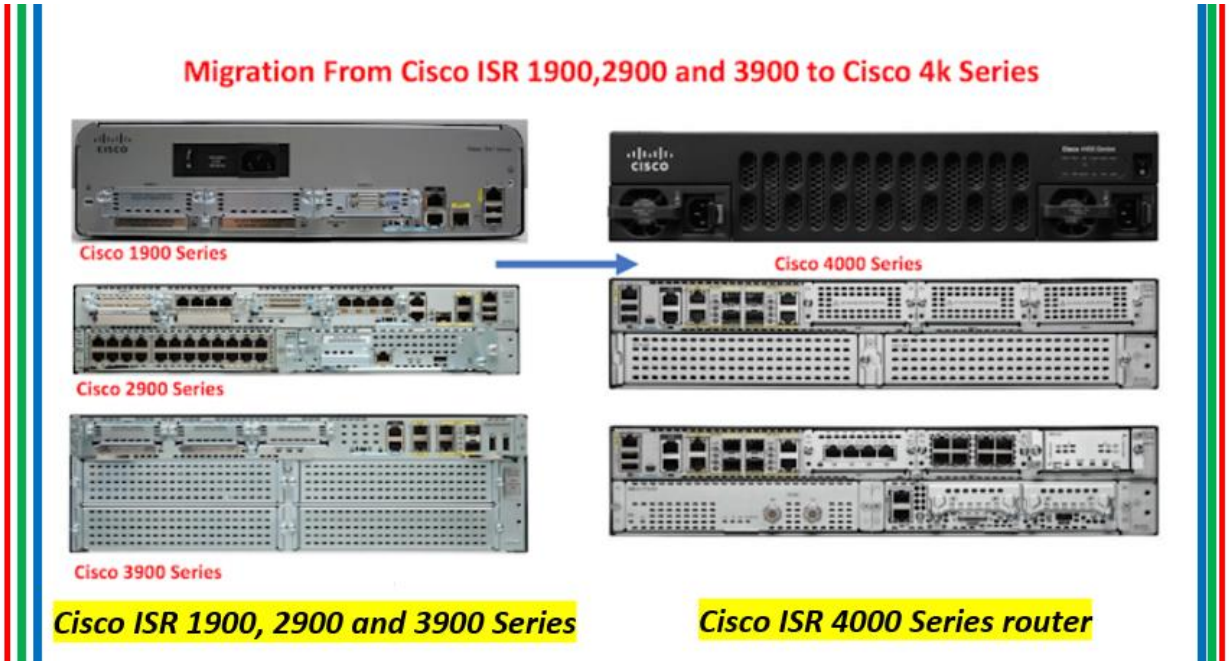
5. Popular Cisco Router Series

Cisco offers routers for all sizes of networks. Some popular series are:

- **Cisco 800 Series:** Compact routers for small businesses and home networks.
- **Cisco 1900 Series (ISR):** Integrated Services Routers for small to medium enterprises.
- **Cisco 2900 Series:** More powerful ISR routers with modular options.
- **Cisco 3900 Series:** Enterprise routers with high performance and expansion slots.
- **Cisco ASR Series:** Aggregation Services Routers for ISPs, data centers, and large-scale networks.



- **Cisco Catalyst 8000 Series:** Next-generation SD-WAN and cloud-ready routers.

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6. Basic Cisco Router Commands

To check information about a router, you can use:

```
sql
CopyEdit
Router> show version
Router> show running-config
Router> show ip route
```

1. User EXEC Mode

- **Prompt:** `Router>`
- **Purpose:** This is the first mode when you log into the router. It provides **basic monitoring commands**, but you **cannot make any configuration changes**.
- **Example Commands:**

  ```
  Router> ping
  ```

```
Router> show version
Router> show ip interface brief
```

- **How to enter?**
  Just press **Enter** when you access the router through the console or Telnet/SSH.

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2. Privileged EXEC Mode

- **Prompt:** `Router#`
- **Purpose:** Provides **full access to monitoring commands** and allows entering configuration mode.
- **How to enter?**
  From User EXEC Mode:

```
Router> enable
Router#
```

-
-
-
-
- **Example Commands:**

```
Router# show running-config
Router# show startup-config
Router# copy running-config startup-config
```

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3. Global Configuration Mode

- **Prompt:** `Router(config)#`
- **Purpose:** This is where you can make **configuration changes** to the router.
- **How to enter?**
  From Privileged EXEC Mode:

```
Router# configure terminal
Router(config)#
```

- **Example Commands:**

```
Router(config)# hostname R1
Router(config)# interface gigabitEthernet 0/0
Router(config-if)# ip address 192.168.1.1 255.255.255.0
Router(config-if)# no shutdown
```

Summary of Modes

Mode	Prompt	Access Level
User EXEC	`Router>`	Basic view commands only
Privileged EXEC	`Router#`	All show commands, config
Global Config	`Router(config)#`	Change router settings

. Basic Configuration Commands

Accessing Router CLI

- Connect via console cable or SSH.
- Use **3 Modes:**

```
Router>          (User EXEC Mode)
Router#          (Privileged EXEC Mode - use 'enable')
Router(config)# (Global Configuration Mode - use 'configure terminal')
```

Basic Commands

```
Router> enable
Router# configure terminal
Router(config)# hostname R1
Router(config)# interface gigabitEthernet 0/0
Router(config-if)# ip address 192.168.1.1 255.255.255.0
Router(config-if)# no shutdown
Router(config-if)# exit
Router(config)# ip route 0.0.0.0 0.0.0.0 192.168.1.254
Router# copy running-config startup-config
```

1. What is a Cisco Switch?

A **Cisco switch** is a networking device that connects multiple devices (like PCs, printers, servers) within the **same local area network (LAN)**. Unlike routers, switches operate at **Layer 2 (Data Link Layer)** of the OSI model, but some switches (Layer 3 switches) also have routing capabilities.

Switches use **MAC addresses** to forward frames between devices, ensuring efficient data delivery within a LAN.

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2. Main Uses of a Switch

- **Device Connectivity:** Connects computers, printers, access points, and other devices in a LAN.
- **Frame Forwarding:** Uses **MAC address tables** to deliver data only to the intended device.
- **VLAN Segmentation:** Supports Virtual LANs (VLANs) to divide networks for better security and performance.
- **Network Efficiency:** Reduces collisions by creating a separate **collision domain** for each port.
- **Security Features:** Can filter traffic, implement **Port Security**, and prevent unauthorized access.
- **High-Speed Communication:** Offers high data transfer rates (1 Gbps, 10 Gbps, or higher).

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3. Inside a Cisco Switch (Key Components)

(a) Cisco IOS (Internetwork Operating System)

- Like routers, Cisco switches also run on IOS.
- Controls Layer 2 (switching) and Layer 3 (if it's a multilayer switch) functionalities.

(b) RAM

- Stores **running configuration**, MAC address tables, and frame buffers.
- Data is lost when the switch is powered off.

(c) NVRAM

- Stores the **startup configuration file**, which is loaded when the switch boots.

(d) Flash Memory

- Holds the IOS image and backups.
- Can store system logs or custom configurations.

(e) ROM

- Contains the bootstrap and POST (Power-On Self-Test) program.

(f) Interfaces (Ports)

- Multiple Ethernet ports (FastEthernet or GigabitEthernet).
- Console port for CLI configuration.
- Some switches have uplink ports for connecting to routers or other switches.

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4. Types of Cisco Switches

- **Unmanaged Switches:** Basic plug-and-play switches with no configuration (rarely used in enterprise networks).
- **Managed Switches:** Fully configurable switches (VLANs, port security, QoS).
- **Layer 2 Switches:** Operate only at Layer 2 (MAC-based).
- **Layer 3 (Multilayer) Switches:** Can perform both switching and routing.

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5. Popular Cisco Switch Series

- **Cisco Catalyst 1000 Series** – Ideal for small businesses.
- **Cisco Catalyst 2000/2960 Series** – Entry-level managed switches.
- **Cisco Catalyst 3000 Series** – Enterprise-grade access switches.

- **Cisco Catalyst 9000 Series** – Modern high-performance switches with advanced security and automation features.
- **Cisco Nexus Series** – Designed for data centers (high-speed 10/40/100 Gbps).
- **Cisco Meraki Switches** – Cloud-managed switches with simple web-based control.

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6. Basic Cisco Switch Commands

- **View MAC Address Table:**

```
css
CopyEdit
Switch> show mac address-table
```

- **Check Running Config:**

```
arduino
CopyEdit
Switch> show running-config
```

- **View VLANs:**

```
shell
CopyEdit
Switch> show vlan brief
```

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7. Key Difference Between a Switch and a Router

- **Router:** Connects different networks (LAN to WAN) using IP addresses.
- **Switch:** Connects devices within the same network using MAC addresses.