Intoduction to Routers

CN, 2018

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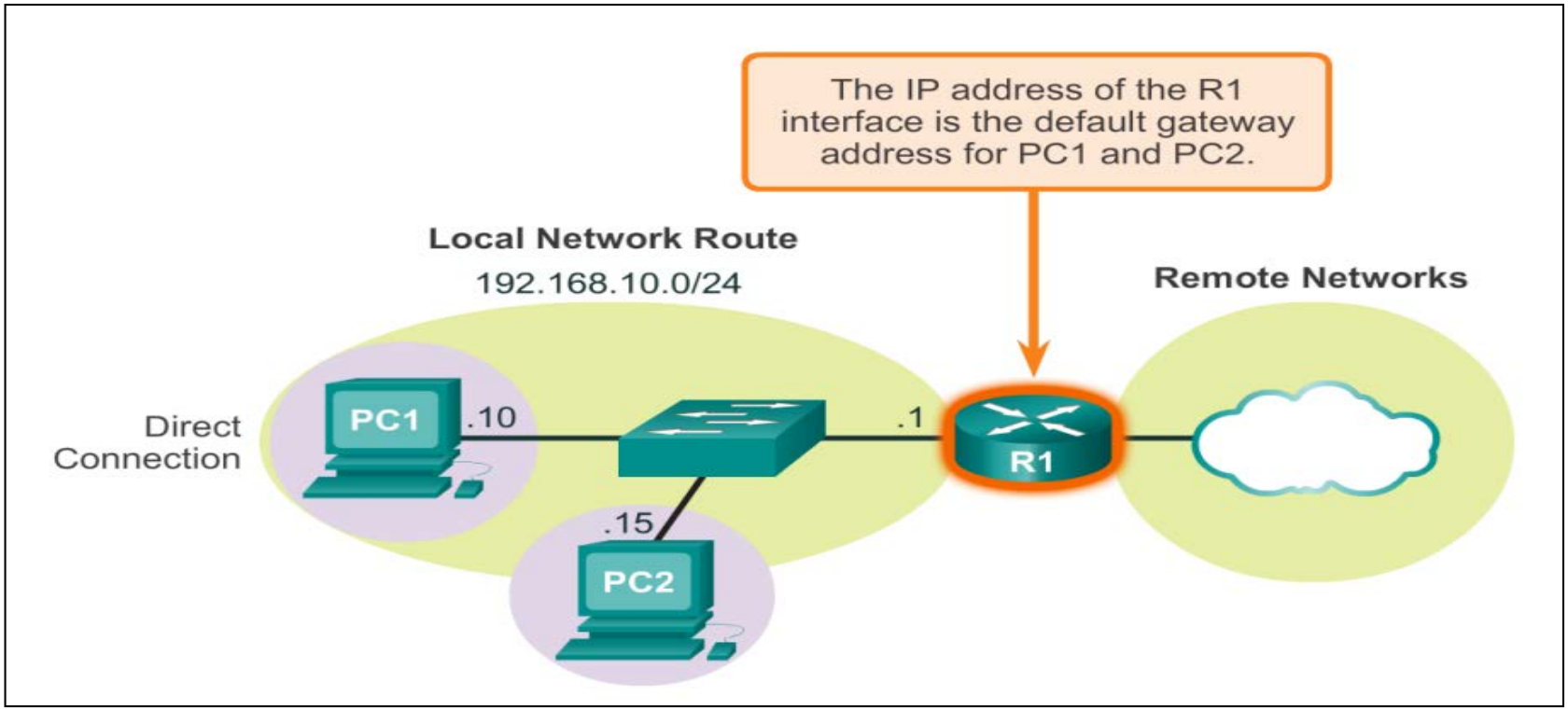
Network devices

- **Routers** offer many services, including internetworking and **WAN interface** ports
- **Modems** include interfaces

  voice services, channel service units/digital service units (CSU/DSUs) that interface T1/E1 services, and Terminal Adapters/Network Termination 1 (TA/NT1s) that interface Integrated Services Digital Network (ISDN) services.

- **Communication servers** concentrate dial in and dial out user communication

Host Packet Forwarding Decision



Host Routing Tables

Default Gateway

- Hosts must maintain their own, local, **routing table** to ensure that network layer packets are directed to the correct **destination network**
- The local table of the host typically contains:
- **Direct connection**
- **Local network route**
- **Local default route**

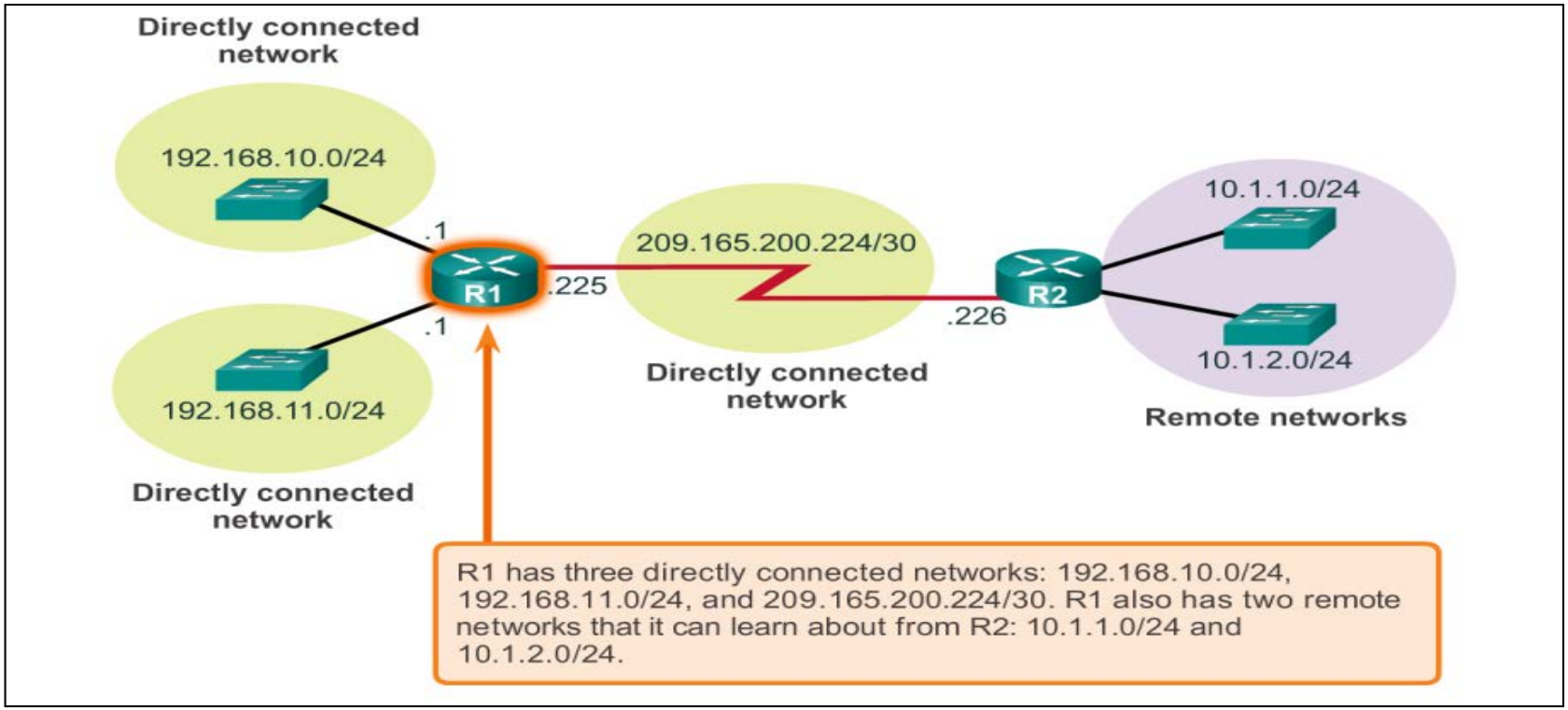
Host Routing Tables

IPv4 Host Routing Table


```
C:\Users\PC1>netstat -r

<Output omitted>

IPv4 Route Table
===========================================================================
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0    192.168.10.1    192.168.10.10     25
        127.0.0.0        255.0.0.0         On-link         127.0.0.1    306
        127.0.0.1  255.255.255.255         On-link         127.0.0.1    306
  127.255.255.255  255.255.255.255         On-link         127.0.0.1    306
    192.168.10.0    255.255.255.0         On-link    192.168.10.10    281
   192.168.10.10  255.255.255.255         On-link    192.168.10.10    281
  192.168.10.255  255.255.255.255         On-link    192.168.10.10    281
        224.0.0.0        240.0.0.0         On-link         127.0.0.1    306
        224.0.0.0        240.0.0.0         On-link    192.168.10.10    281
  255.255.255.255  255.255.255.255         On-link         127.0.0.1    306
  255.255.255.255  255.255.255.255         On-link    192.168.10.10    281
===========================================================================

<Output omitted>
```

Router Routing Tables

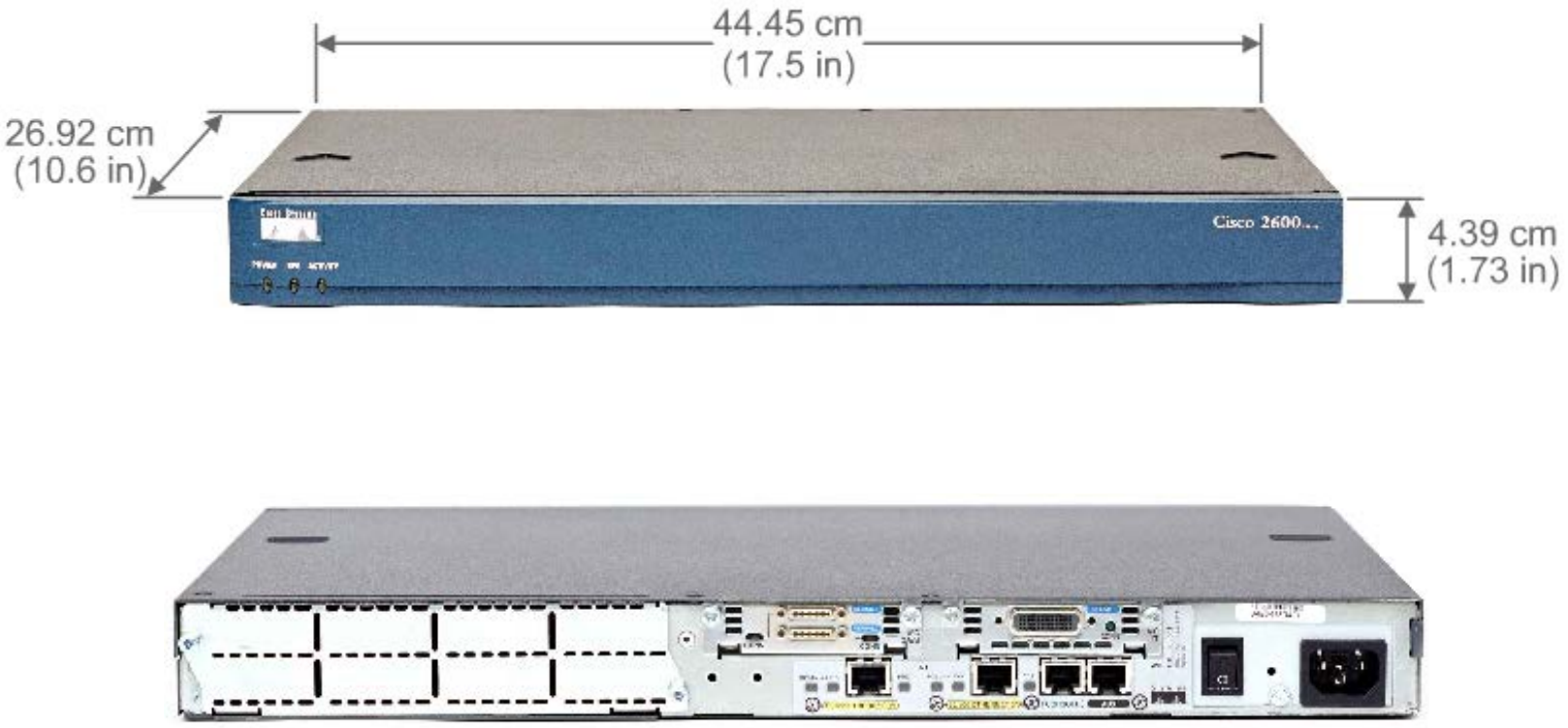
Router Packet Forwarding Decision



Routers


Sister Cities
Eilat
Jakarta
Giza
Athens 6925 mi
Berlin 5759 mi
Lusaka 10,007 mi
Split 6386 mi
7406 mi Makati

Router



WAN connections

- Two types of physical **serial cables.**
- Both cables use a large Winchester 15 Pin connector on the network end.
- This end of the cable is used as a **V.35 connection** to a Physical layer device such as a **CSU/DSU**.

Router: Male Smart Serial

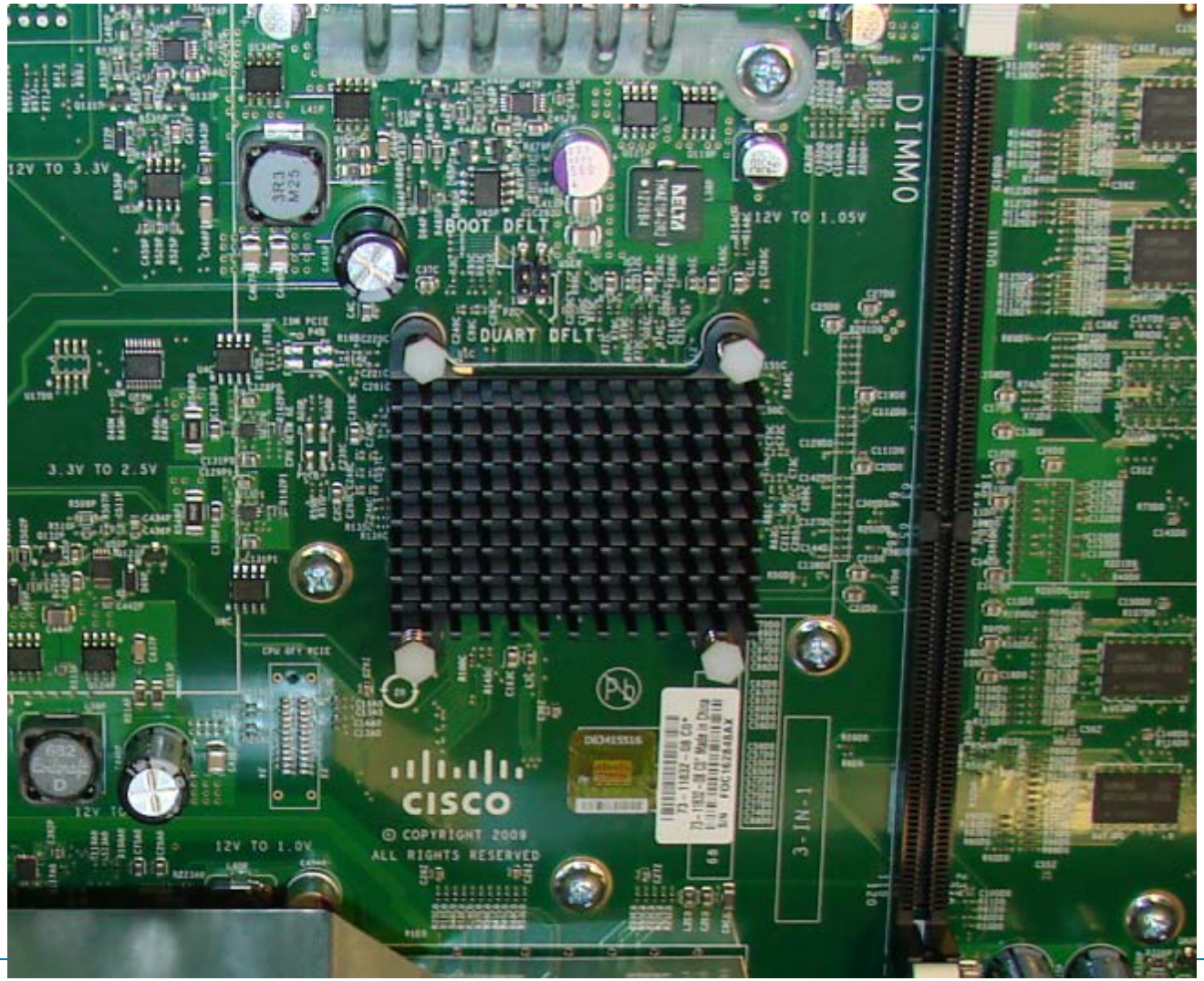
Network: Male Winchester Block Type

Anatomy of a Router

A Router is a Computer

Anatomy of a Router

Router CPU and OS



Anatomy of a Router

Router Memory

Memory	Volatile / Non-Volatile	Stores
RAM	Volatile	• Running IOS • Running configuration file • IP routing and ARP tables • Packet buffer
ROM	Non-Volatile	• Bootup instructions • Basic diagnostic software • Limited IOS
NVRAM	Non-Volatile	• Startup configuration file
Flash	Non-Volatile	• IOS • Other system files

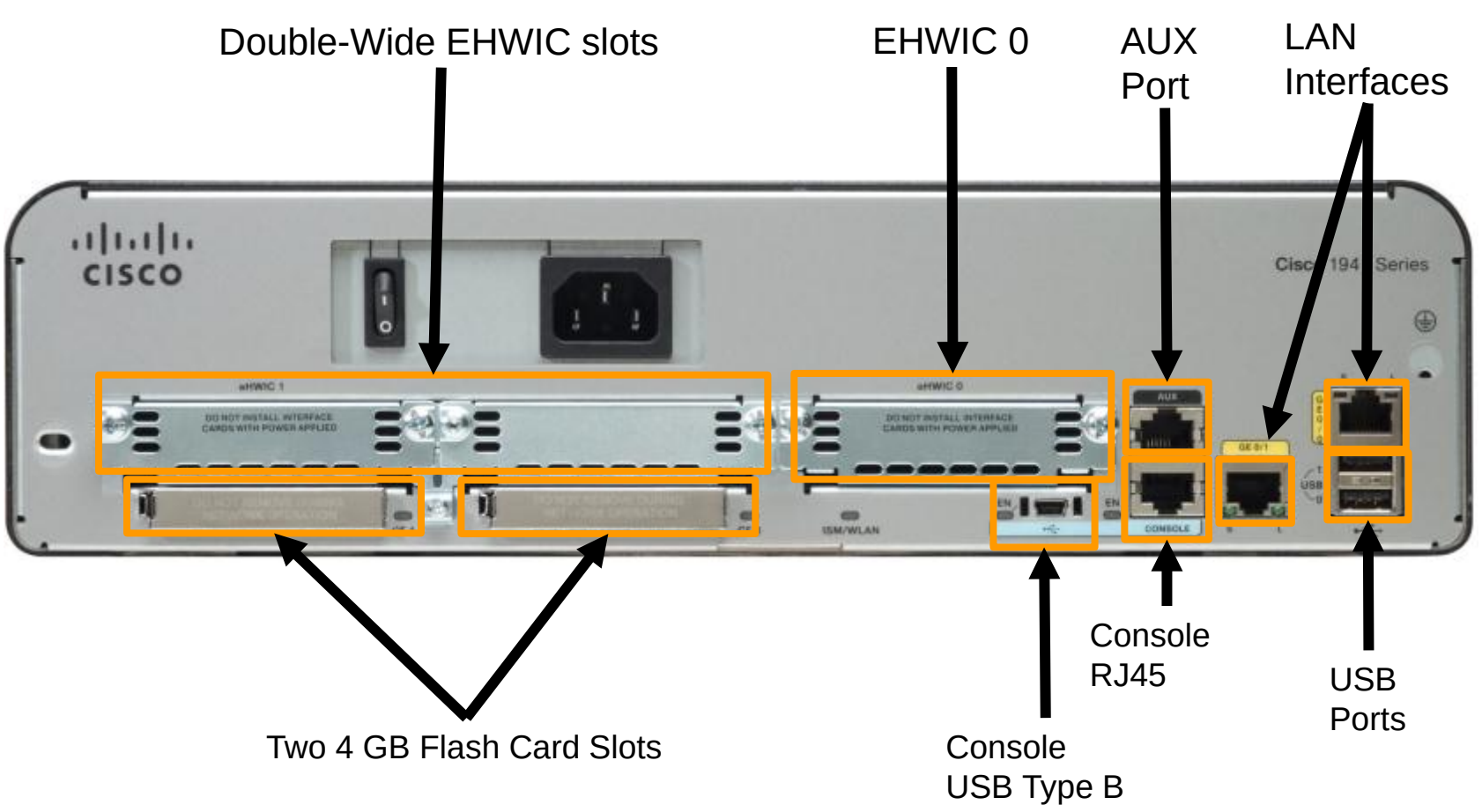
Anatomy of a Router

Inside a Router

1. Power Supply
2. Shield for WIC
3. Fan
4. SDRAM
5. NVRAM
6. CPU
7. Advanced Integration Module (AIM)

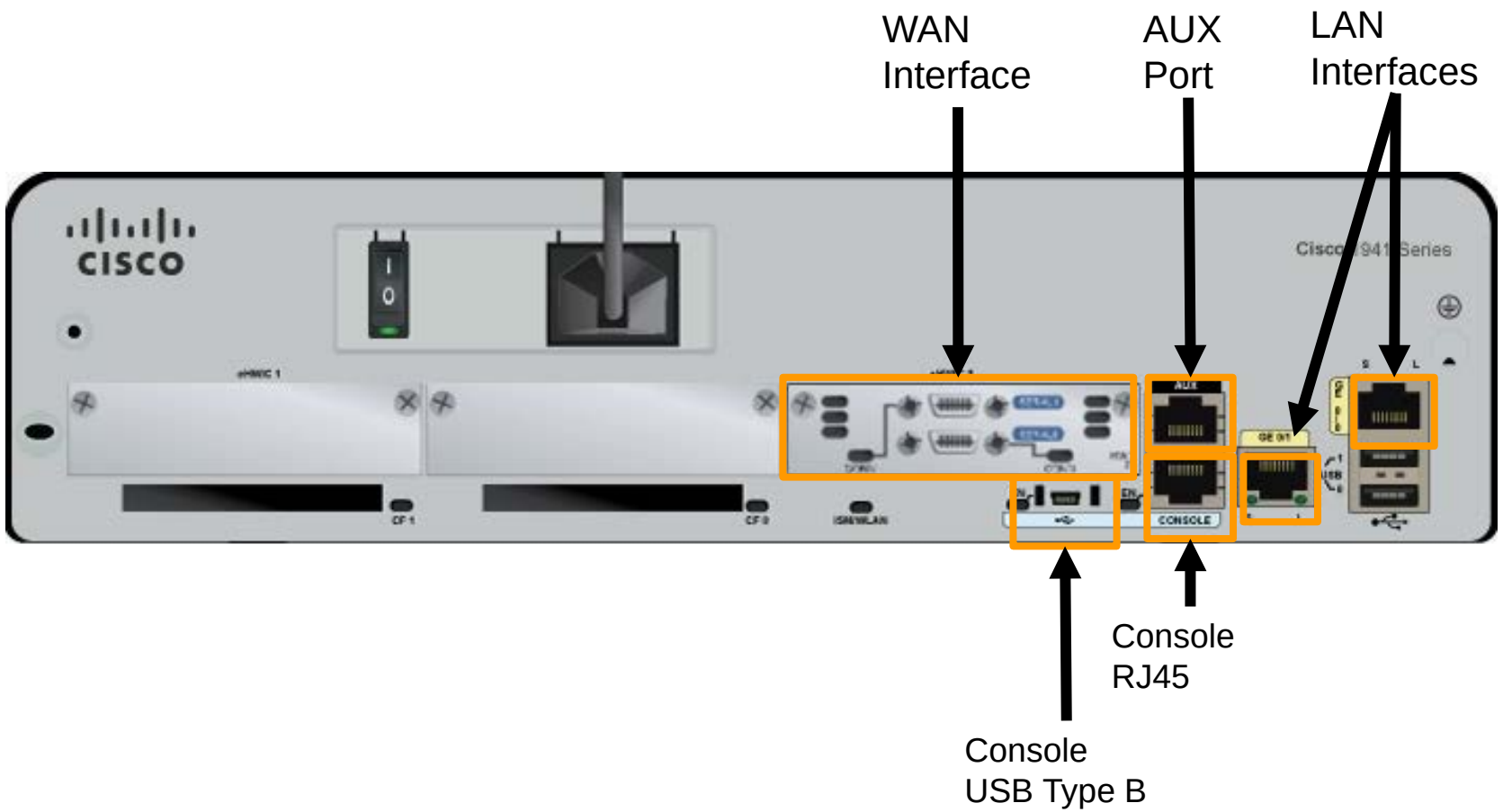
Anatomy of a Router

Router Backplane



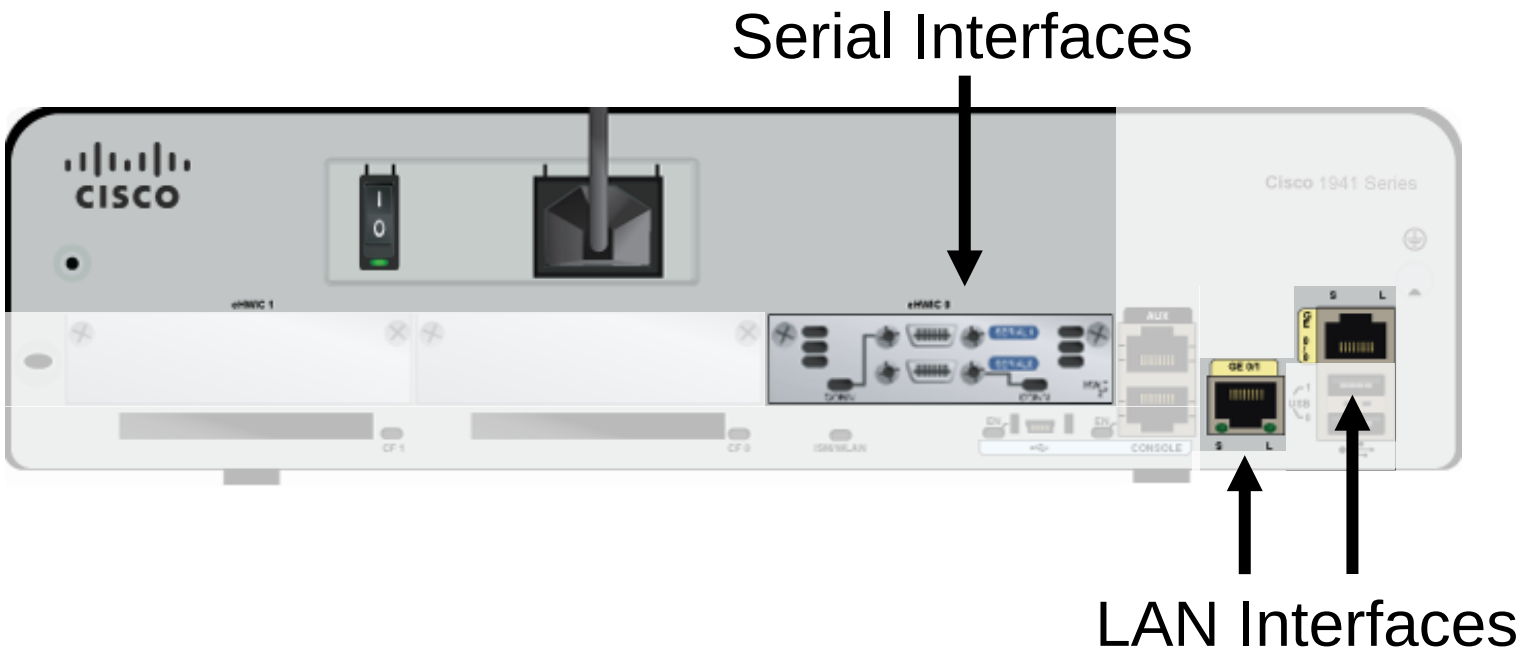
Anatomy of a Router

Connecting to a Router



Anatomy of a Router

LAN and WAN Interfaces



Router Boot-up

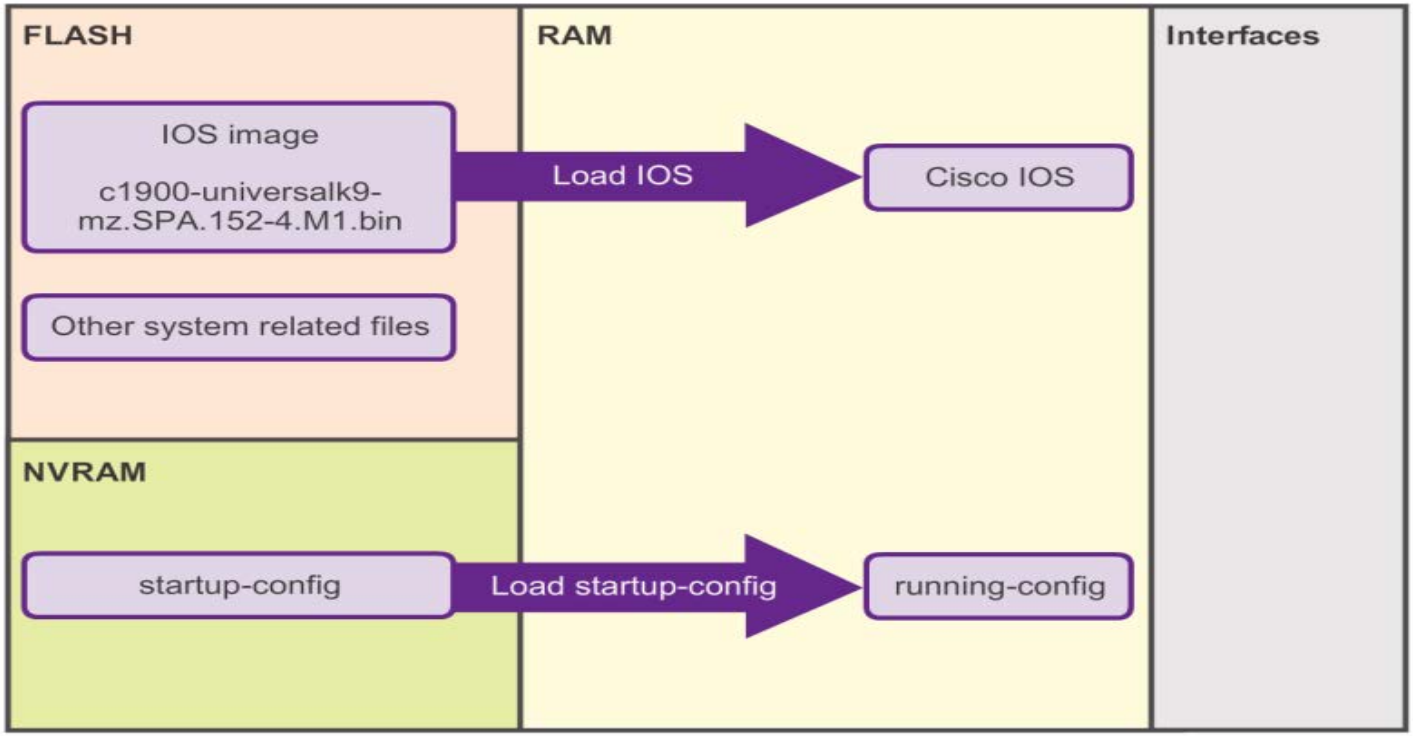
Cisco IOS

The Cisco IOS operational details vary on different internetworking devices, depending on the device's purpose and **feature set.** However, Cisco IOS for routers provides the following:

- **Addressing**
- **Interfaces**
- **Routing**
- **Security**
- **QoS**
- **Resources Management**

Router Boot-up

Bootset Files



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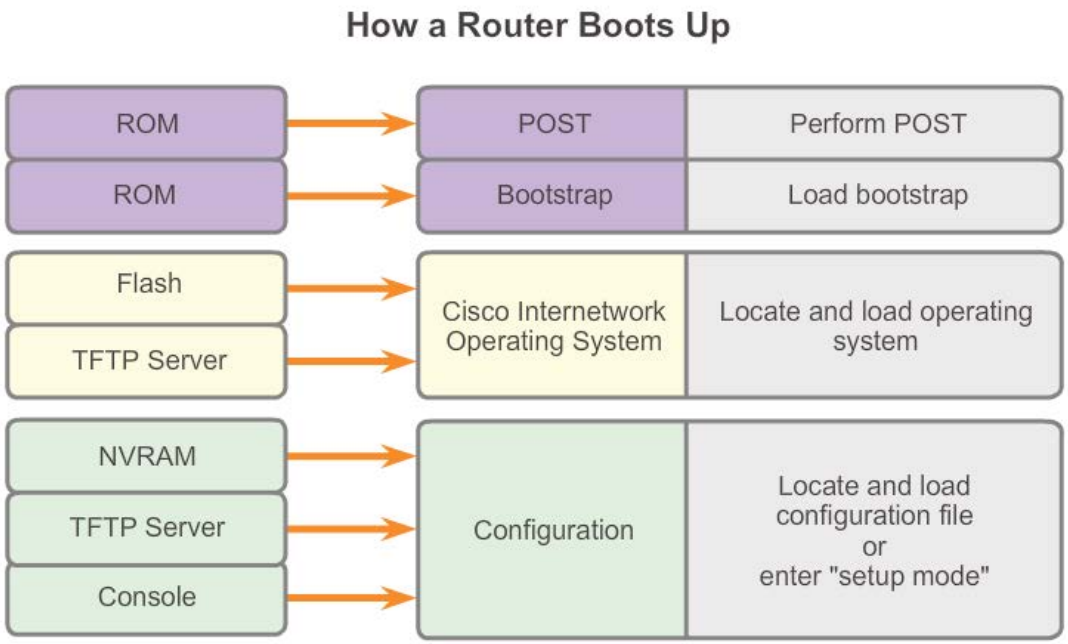
Router Boot-up

Router Bootup Process




```
System Bootstrap, Version 15.0(1r)M15, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport

<output omitted>
```

Router Boot-up

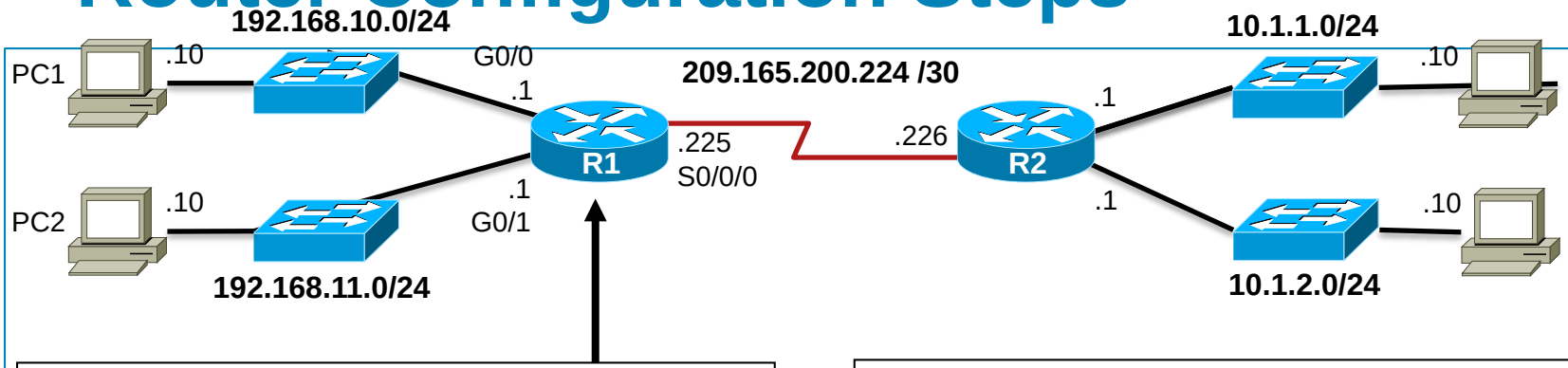
Show Versions Output

```
Router# show version
Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version 15.2(4)M1, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thu 26-Jul-12 19:34 by prod_rel_team

ROM: System Bootstrap, Version 15.0(1r)M15, RELEASE SOFTWARE (fc1)

Router uptime is 10 hours, 9 minutes
System returned to ROM by power-on
System image file is "flash0:c1900-universalk9-mz.SPA.152-4.M1.bin"
Last reload type: Normal Reload
Last reload reason: power-on

<Output omitted>

Cisco CISCO1941/K9 (revision 1.0) with 446464K/77824K bytes of memory.
Processor board ID FTX1636848Z
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
1 terminal line
DRAM configuration is 64 bits wide with parity disabled.
255K bytes of non-volatile configuration memory.
250880K bytes of ATA System CompactFlash 0 (Read/Write)

<Output omitted>

Technology Package License Information for Module:'c1900'

-----------------------------------------------------------------
Technology    Technology-package          Technology-package
              Current       Type          Next reboot
-----------------------------------------------------------------
ipbase        ipbasek9      Permanent     ipbasek9
security      None          None          None
data          None          None          None

Configuration register is 0x2142 (will be 0x2102 at next reload)

Router#
```

Configuring a Cisco Router

Configure Initial Settings

Router Configuration Steps




```
Router> enable
Router# configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Router(config)# hostname R1
R1(config)#
```

OR

```
Router> en
Router# conf t
Enter configuration commands, one per line.
End with CNTL/Z.
Router(config)# ho R1
R2(config)#
```

```
R1(config)# enable secret class
R1(config)#
R1(config)# line console 0
R1(config-line)# password cisco
R1(config-line)# login
R1(config-line)# exit
R1(config)#
R1(config)# line vty 0 4
R1(config-line)# password cisco
R1(config-line)# login
R1(config-line)# exit
R1(config)#
R1(config)# service password-encryption
R1(config)#
```

```
R1(config)# banner motd #
Enter TEXT message.  End with the character '#'.
    **********************************************
      WARNING: Unauthorized access is prohibited!
    **********************************************
#

R1(config)#
```

```
R1# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
R1#
```

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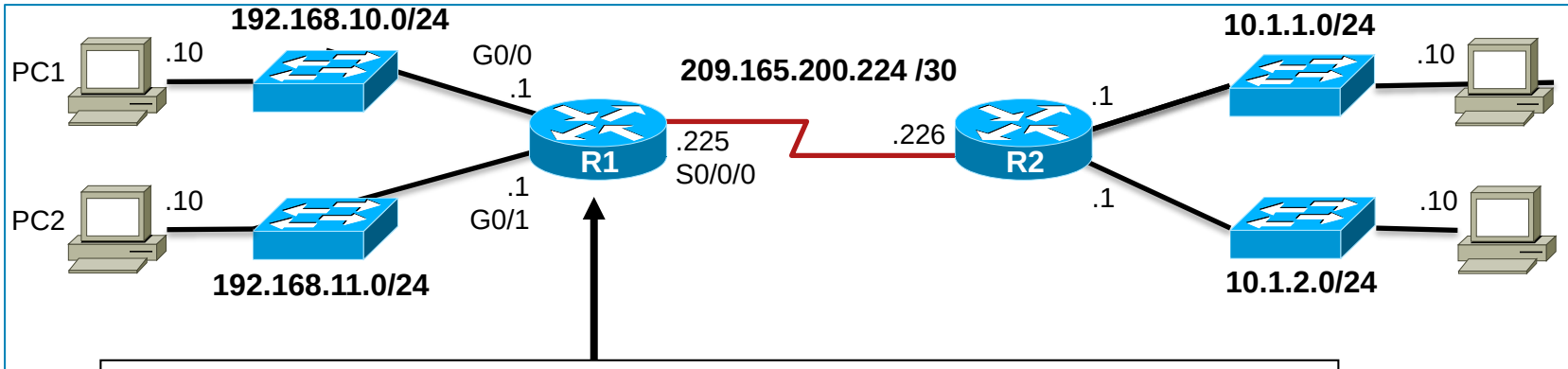
Configure Interfaces

Configure LAN Interfaces




```
R1# conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)# interface gigabitethernet 0/0
R1(config-if)# ip address 192.168.10.1 255.255.255.0
R1(config-if)# description Link to LAN-10
R1(config-if)# no shutdown
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0,
changed state to up
R1(config-if)# exit
R1(config)#
R1(config)# int g0/1
R1(config-if)# ip add 192.168.11.1 255.255.255.0
R1(config-if)# des Link to LAN-11
R1(config-if)# no shut
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1,
changed state to up
R1(config-if)# exit
R1(config)#
```

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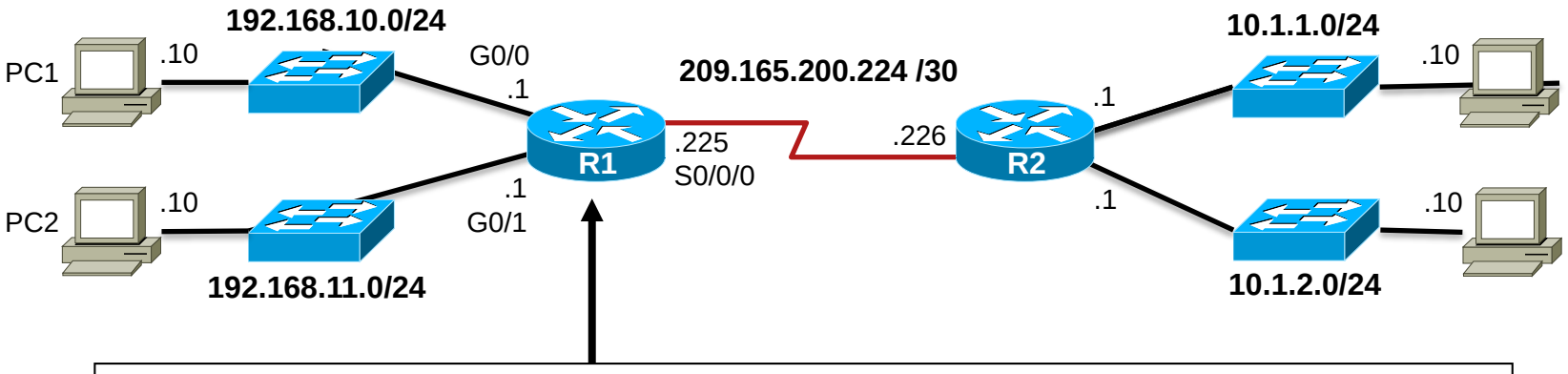
Configure Interfaces

Verify Interface Configuration




```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol

GigabitEthernet0/0     192.168.10.1    YES manual up                    up
GigabitEthernet0/1     192.168.11.1    YES manual up                    up
Serial0/0/0            209.165.200.225 YES manual up                    up
Serial0/0/1            unassigned      YES NVRAM  administratively down down
Vlan1                  unassigned      YES NVRAM  administratively down down
R1#
R1# ping 209.165.200.226

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.200.226, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/9 ms

R1#
```

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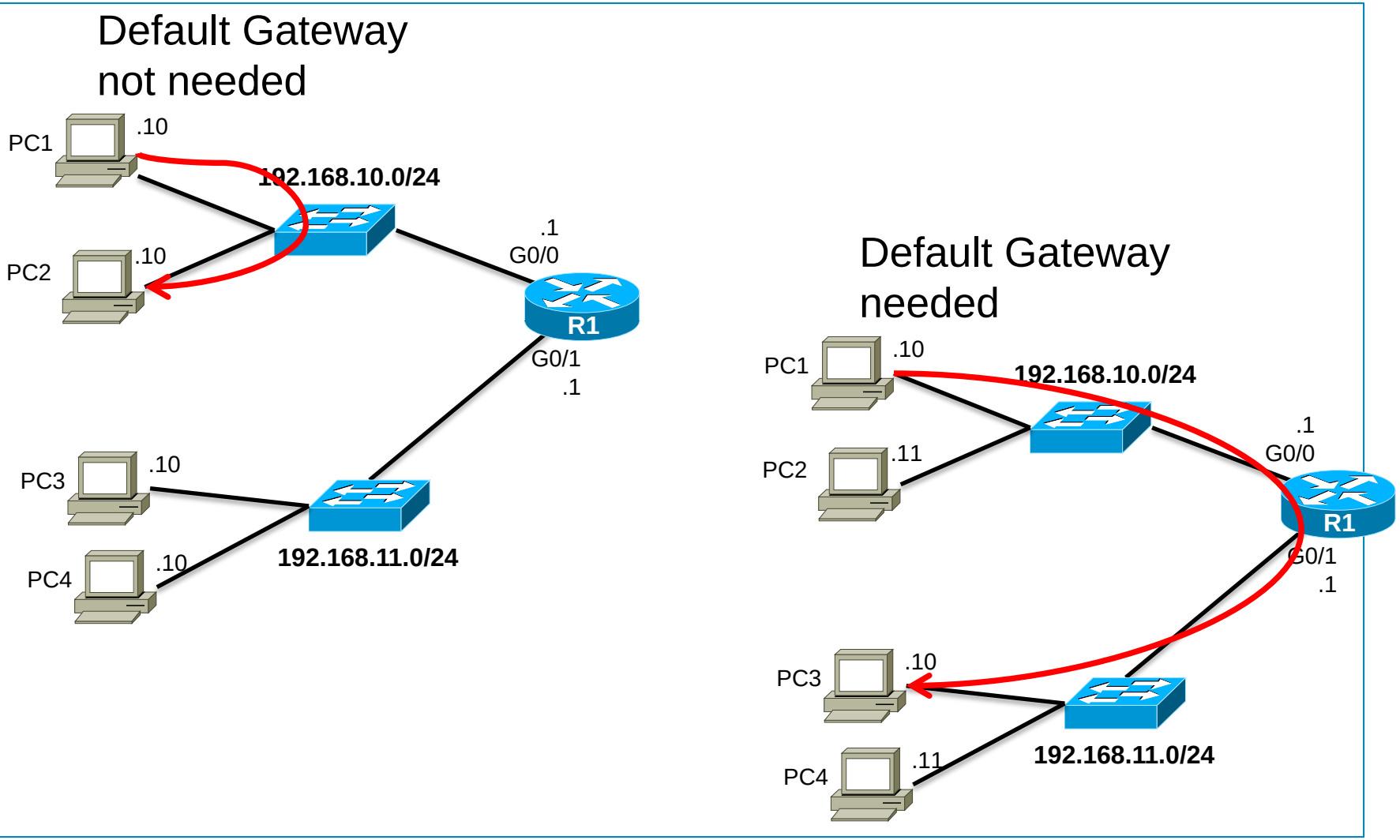
Configuring the Default Gateway

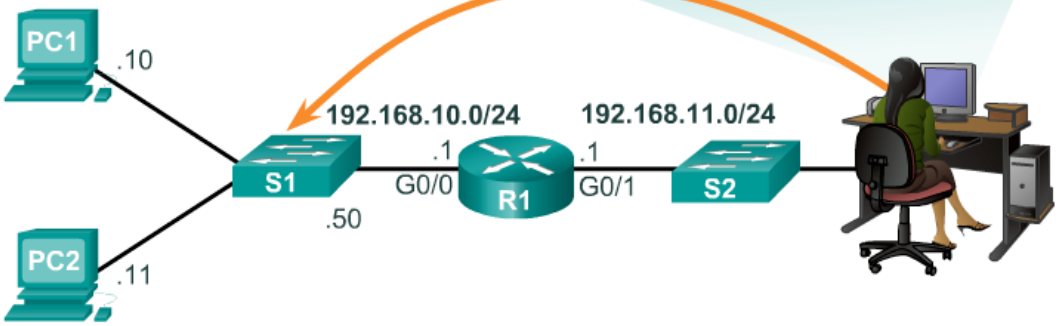
Default Gateway on a Host



Configuring the Default Gateway

Default Gateway on a Switch

```
S1# show running-config
Building configuration...
!
<output omitted>
service password-encryption
!
hostname S1
!
Interface Vlan1
ip address 192.168.10.50
!
ip default-gateway 192.168.10.1
<output omitted>
```



If the default gateway was not configured on S1, response packets from S1 would not be able to reach the administrator at 192.168.11.10. The administrator would not be able to manage the device remotely.

Router cable connector

Routers have physical conne

Router IOS

Cisco IOS

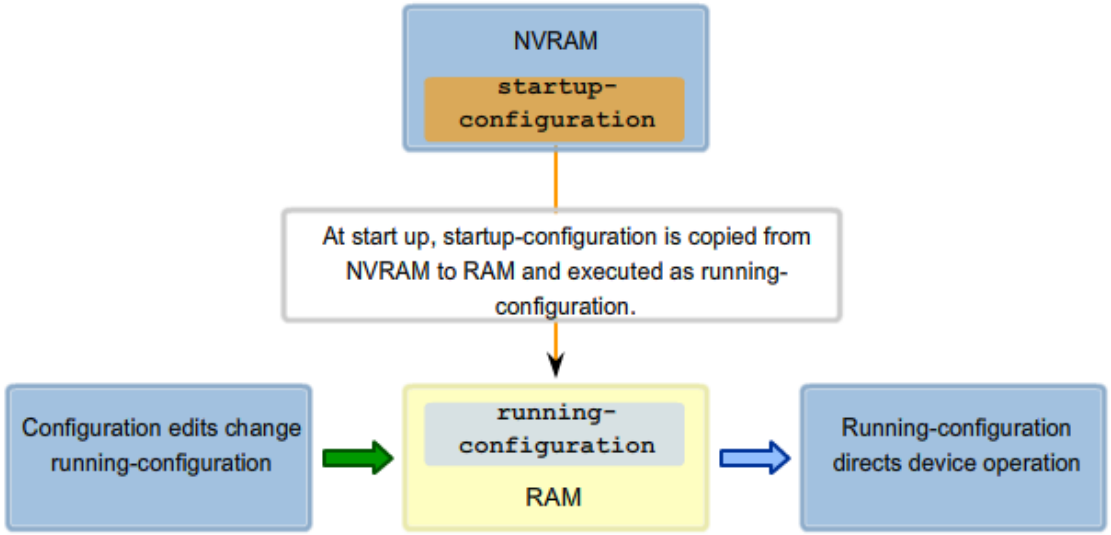
IOS Naming Conventions

- This line shows how much main and **shared memory** is installed in the router
- Both numbers [illegible] amount of DR

```
Cisco#show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-JK8S-M), Version
12.2(12c), RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2003 by cisco Systems, Inc.
Compiled Wed 05-Feb-03 16:36 by kellythw
Image text-base: 0x8000808C, data-base: 0x8156F2AC

ROM: System Bootstrap, Version 11.3(2)XA4, RELEASE
SOFTWARE (fc1)
R2 uptime is 4 weeks, 2 days, 17 hours, 9 minutes
System returned to ROM by reload
System image file is "flash:c2600-jk8s-mz.122-12c.bin"

cisco 2620 (MPC860) processor (revision 0x102) with
59392K/6144K bytes of memory
```

Types of Configuration Files

- A Cisco network device contains two configuration files:
  - **The running configuration file** - used during the current operation of the device
  - **The startup configuration file** - used as the backup configuration and is loaded when the device is started



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Basic tasks

- The CLI (**command-line interface**) environment can be accessed several ways:
- Typically, the CLI is accessed through a **console session**
- A console uses a **low speed serial connection** directly from a computer or terminal to the console connection on the router
- A CLI session can also be accessed **remotely** through a dialup connection using a **modem connected** to the router **AUX port**

Starting a Router

- The CLI (**command-line interface**) environment

A user interface to a router or switch requires an ASCII terminal or a PC running a terminal-emulation program such as Windows HyperTerminal.

Starting a Router

- Cables and adapters are needed to **connect a console terminal** to the console port.
- A console terminal is an ASCII terminal or PC that runs terminal-emulation software such as **HyperTerminal**.
- Use an RJ-45 to **RJ-45 rollover cable** with a female RJ-45 to DB-9 adapter to connect this type of a PC to the console port

Starting a Router

The default parameters for the console port are:

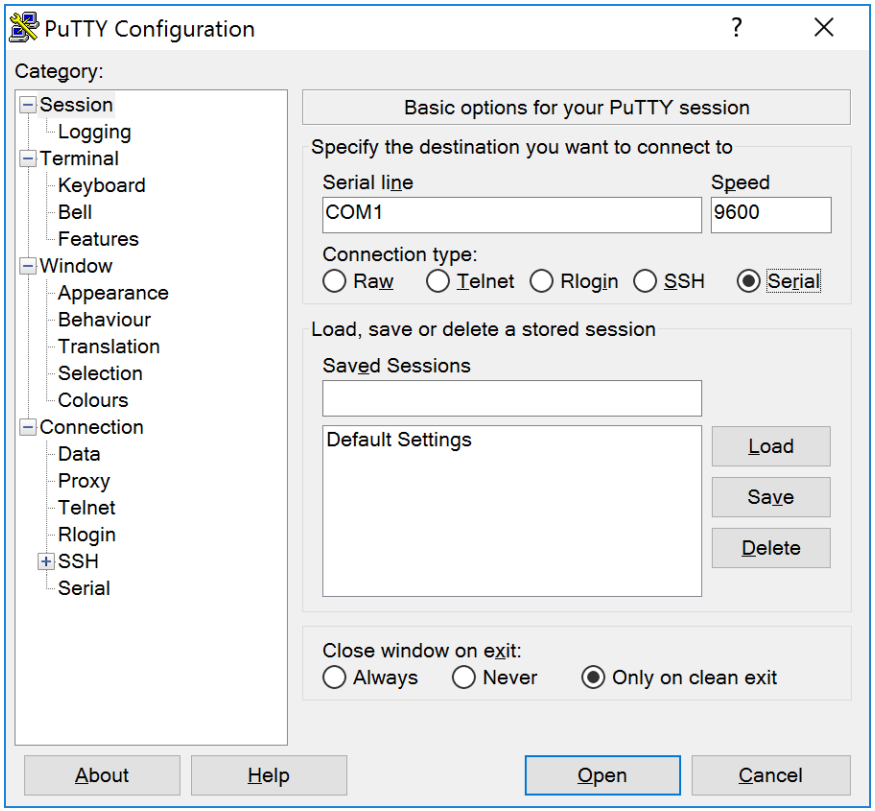
9600 baud,

8 data bits,

no parity,

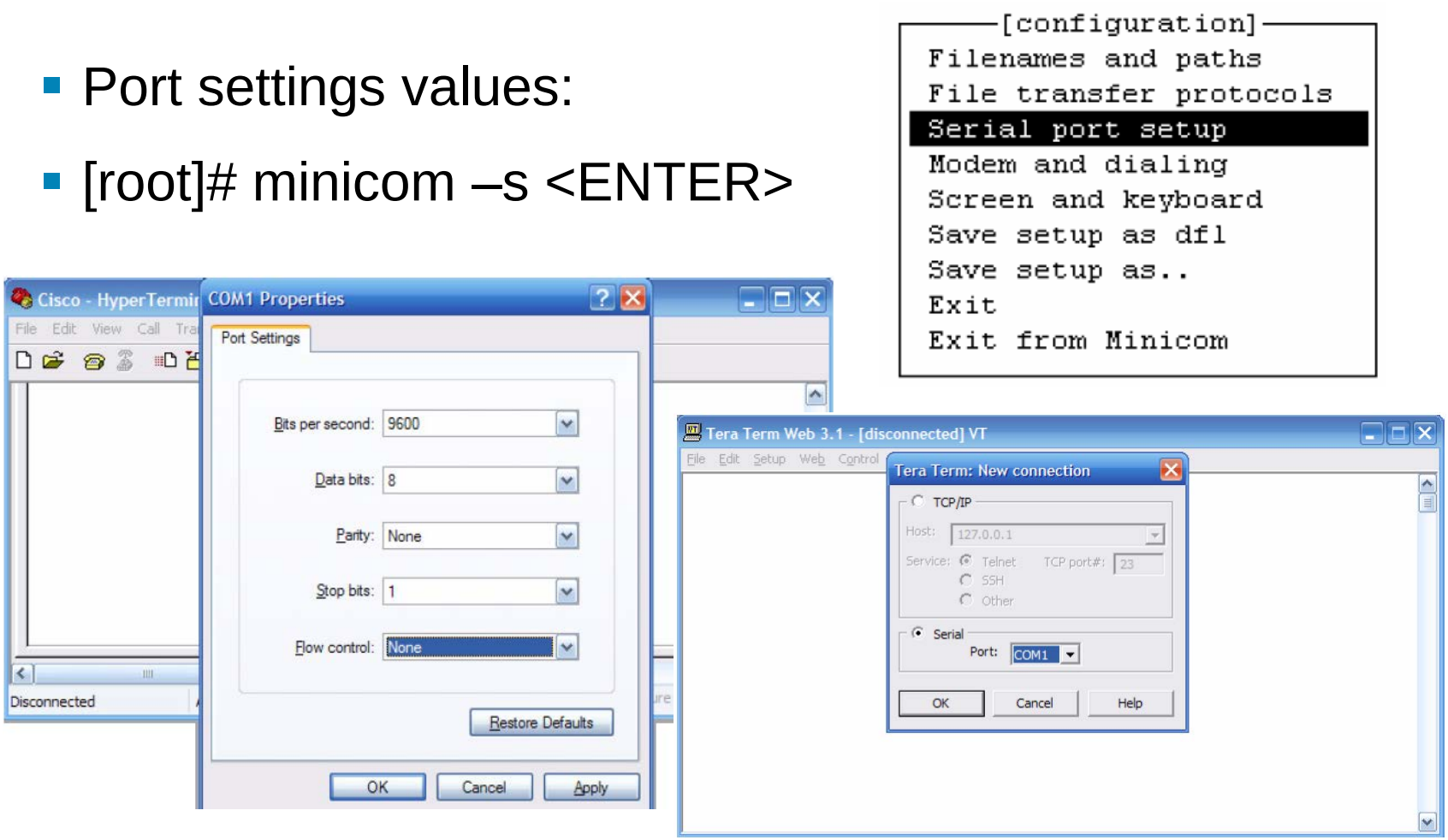
1 stop bit,

no flow control.



Port settings

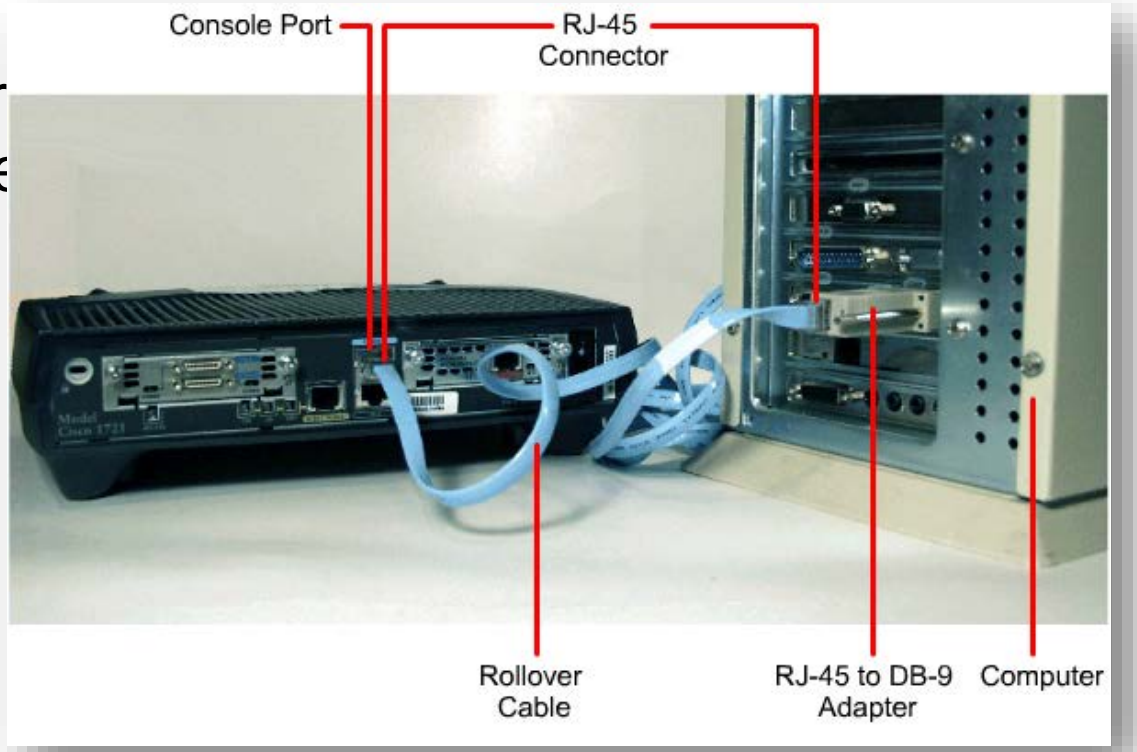
- Port settings values:
- [root]# minicom –s <ENTER>



Starting a Router

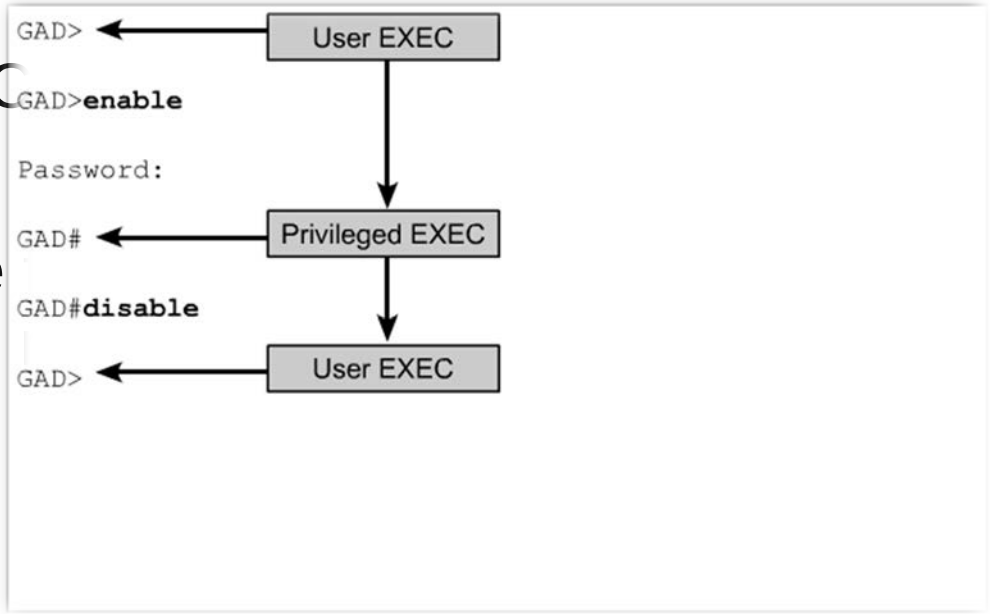
Take the following steps to connect a **terminal to the console** port on a router:

- ✓ Connect the ter
- ✓ Configure the te parameters



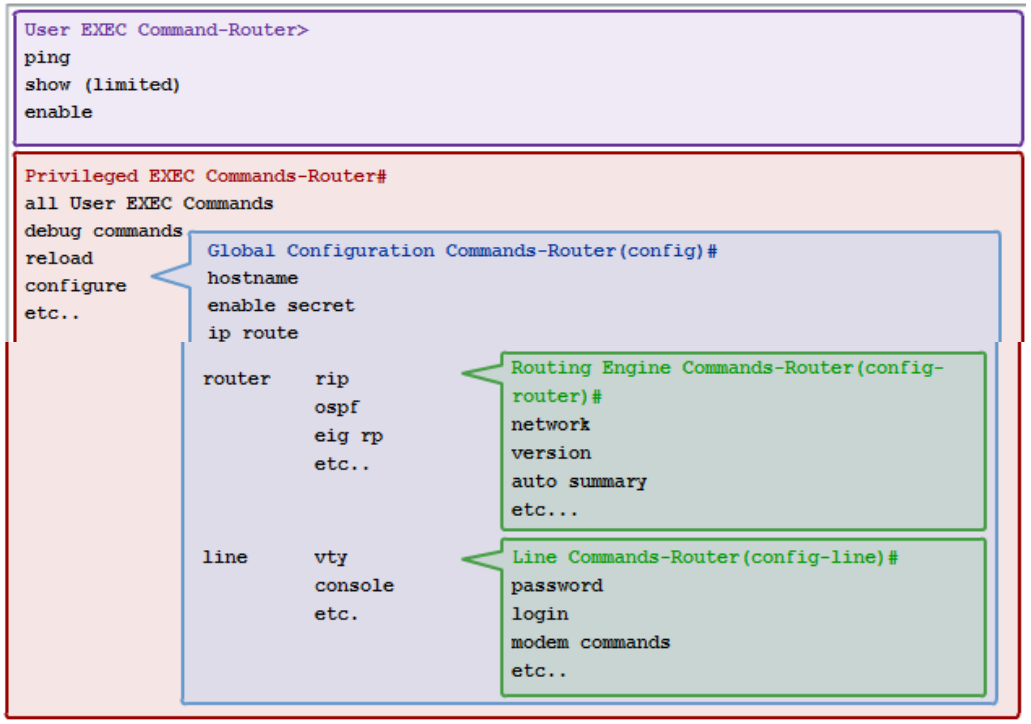
Two user interface modes

- As a security feature the Cisco IOS software separates the EXEC sessions into **two access levels.**
- These levels are **user** EXEC mode and privileged EXEC mode.
- The **privileged** EXEC mode.
- The following are the and privileged EXEC



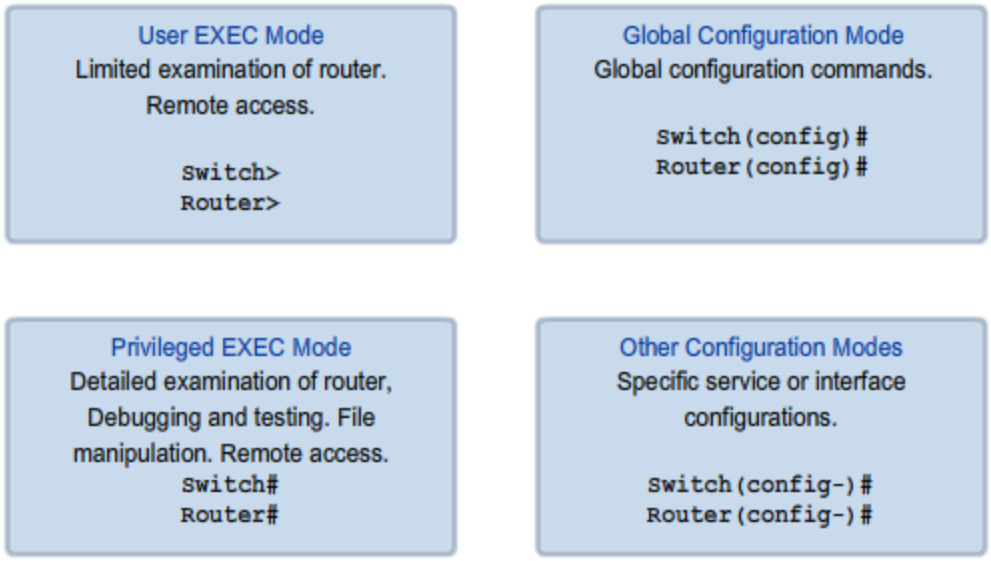
Cisco IOS

- Cisco IOS is designed as a modal operating system



Command Prompts

- Command Prompts



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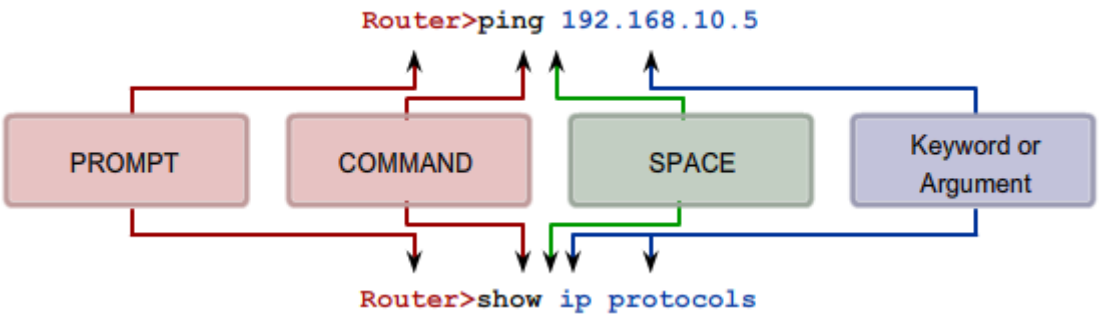
Each IOS command

- The commands are **not case-sensitive**



Basic Router Configuration

Show command

Information from the **show interface**

```
R1#show interfaces fastethernet 0/0
FastEthernet0/0 is up, line protocol is up
  Hardware is AmdFE, address is 000c.3010.9260 (bia 000c.3010.9260)
  Internet address is 172.16.3.1/24
  <output omitted>
R1#
```

```
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        172.16.3.1      YES manual up                    up
Serial0/0/0            unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
Serial0/0/1            unassigned      YES unset  administratively down down
R1#
```

How to locate and fix command line errors?

- If a command keyword is incorrectly typed, the user interface uses the **caret symbol (^)** to identify and isolate the error.
- The **^ appears** at the point in the command string where an incorrect command, keyword, or argument was entered.

```
Router#comfigure terminal
          ^
% Invalid input detected at '^' marker.
Router#configure terminal
```

Basic tasks

- Router > **enable**

  Password:

- Router# **configure terminal**
- Router(config)#
- Type **exit** from one of the specific modes to return a router to global configuration mode
- Router(config)#**exit**
- Router#

Basic tasks

- **Naming** the router
- Setting **passwords (password cisco)**
- Configuring **interfaces**
- Configuring a **banner**
- **Saving changes** on a router
- Verifying **basic configuration** and router operations

Basic tasks

- Connect a router and workstation using a **console cable**.
- Configure **Putty** to establish a console session with the router
- Log into the router (If prompted for a password, enter **cisco**)
- Check show commands on the router
- (**show version, falsh, ip interface, … etc**)
- Use the HELP feature (**by typing the ?)**
- Enter **privileged** EXEC mode
- Examine the **running configuration**
- Check, how much main, shared , DRAM **memory** is installed in the router?
- Configure an **enable password** of „cisco”

Basic tasks

- Configure a hostname „**Perth**”
- Configure an **IP address** for Ethernet 0/0 interface
- Configure an **IP address** for Serial 0/0 interface
- Active the interface
- Display the active **configuration** in DRAM, NVRAM,
- Check, **IOS release** running on router
- Try to **ping router’s** interface from PC and vice versa.
- **Logoff and turn the router off**

QA


Sister Cities
OF LOS ANGELES
Eilat
Jakarta
St. Pete
Giza
Athens 6925 mi
Berlin 5759 mi
Lusaka
Bordeaux
Split 6386 mi
7406 mi Makati

Lab