

ROUTER BASICS

Cisco routers are designed to address the needs of:

Branch	<ul style="list-style-type: none">– Teleworkers/small business/medium-sized branch sites– Cisco 800, 1900, 2900, 3900 ISR (Integrated Series Router) G2 (2nd Generation)
WAN	<ul style="list-style-type: none">– Large businesses/organizations/enterprises– Cisco Catalyst 6500 Series switches and Cisco Aggregation Service Router 1000 (ASR)
Service Provider	<ul style="list-style-type: none">– Large service providers– Cisco ASR 1000, ASR 9000, Cisco XR 12000, Cisco CRS-3 Carrier Routing System and 7600 Series

All routers are essentially computers and require:

OS	CPU	RAM	ROM	NVRAM
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NVRAM: Routers also have a special memory that includes flash and nonvolatile random-access memory

Router Memory:

Routers have access to 4 types of memory: RAM/ROM/NVRAM/Flash

RAM

Used to store various applications/processes including:

Cisco IOS: IOS is copied into RAM during boot up

Running configuration file: the configuration file that stores configuration commands that the router IOS is using

IP routing table: Stores information about directly connected/remote networks

– Used to determine the best path to use to forward packets

ARP cache: Contains the IPv4 address-to-MAC address mappings, similar to ARP cache on a PC

– ARP cache is used on routers that have LAN interfaces such as Ethernet interfaces

Packet buffer: Packets are temporarily stored in a buffer when received on an interface or before they exit one

Cisco routers use DRAM (dynamic): Stores the instructions/data needed to be executed by the CPU

Unlike ROM, RAM is volatile memory and requires continual power to maintain its information

– It loses all its content when the router is powered down/restarted

ROM

Cisco routers use ROM to store:

Boot up instructions

Basic diagnostic software: Performs the POST of all components

Limited IOS: A limited backup version of the OS, in case the router can't load the full-featured IOS

ROM is firmware embedded on an integrated circuit inside the router

– It doesn't lose its contents when the router loses power/is restarted

NVRAM

Used by Cisco IOS as permanent storage for the startup configuration file

– Like ROM, NVRAM doesn't lose its contents when powered/turned off

Flash Memory

– Nonvolatile computer memory used as permanent storage for the IOS/other system-related files

– IOS is copied from flash into RAM during the boot up process

Memory	Volatile/Nonvolatile	Stores
RAM	V	<ul style="list-style-type: none">– Running IOS– Running configuration– IP routing/ARP tables– Packet buffer
ROM	NV	<ul style="list-style-type: none">– Boot up instructions– Basic diagnostic software– Limited IOS

NVRAM	NV	– Startup configuration file
Flash	NV	– IOS – Other system files

Internal components of a Cisco 1841 Router



Internal Router Components

Power supply	Provides various voltages to internal router components
WIC slot	Supports HWICs (high-speed WAN interface cards)
RAM	Holds running configuration/running IOS/routing tables/buffers: AKA SRAM (synchronous)
ROM	Nonvolatile
NVRAM	Startup Configuration file
Flash	Basic diagnostic/IOS file/ROMMON
CPU	Microprocessor supporting router operations
AIC	Advanced Integration Module option that offloads from the CPU processor-intensive functions such as encryption

Router Backplane:

Console ports	– 2 console ports for the initial configuration and CLI management access – takes a regular RJ-45 port and a new USB Type-B (mini-B USB connector)
AUX port	– An RJ-45 port for remote management access – Similar to the console port
Two LAN interfaces	– 2 Gigabit Ethernet interfaces for LAN access
EHWIC slots	– Enhanced high-speed WAN interface card – 2 slots provide modularity/flexibility by enabling router to support different interface modules: Including: Serial, DSL, switch port, and wireless

Connecting to a Router:

Cisco router connections can be grouped into 2 categories:

- Cisco devices use LED indicators to provide status information

Management ports	<ul style="list-style-type: none"> – The console/auxiliary ports used to configure/manage/troubleshoot the router – Unlike LAN/WAN interfaces, management ports are not used for packet forwarding
In-band router interfaces	<ul style="list-style-type: none"> – These are the LAN/WAN interfaces configured with IP addressing to carry user traffic – Ethernet interfaces are the most common LAN connections – Common WAN connections include serial/DSL interfaces

LAN/WAN Interfaces:

Console	– Uses low-speed serial/USB connection to provide direct connect out-of-band management access
Telnet/SSH	– 2 methods for remotely accessing a CLI session
AUX port	– Used for more remote management of the router using a dialup telephone line/modem

Router interfaces can usually be grouped into 2 broad categories:

Ethernet LAN interfaces	<ul style="list-style-type: none"> – Used for connecting cables that terminate with LAN devices (computers/switches) – Interface can also be used to connect routers to each other – Ethernet/Fast Ethernet/Gigabit Ethernet
Serial WAN interfaces	<ul style="list-style-type: none"> – Used for connecting routers to external networks, usually over a geographical distance – Similar to LAN interfaces, each serial WAN interface has its own IP address/subnet mask – It identifies it as a specific member of a specific network

Cisco IOS for routers provide the following:

Addressing	Interfaces	Routing	Security	QoS	Resources Management
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The IOS file is 7MB's in size and is stored in flash memory

– Flash allows IOS to be upgraded to newer versions/have new features added

During Boot up: IOS is copied from flash memory into RAM:

– DRAM is much faster, therefore copying the IOS into RAM increases performance of the device

Bootset Files:

Routers load the following 2 files into RAM when it's booted:

IOS image file	<ul style="list-style-type: none"> – Cisco IOS facilitates the basic operation of the device's hardware components – The image file is stored in flash memory – This image is loaded into the device's RAM to provide the OS for the router
Startup configuration file	<ul style="list-style-type: none"> – Contains commands that are used to initially configure a router – Creates the running configuration file stored in RAM – The startup configuration file is stored in NVRAM and is copied to RAM – This provides the "program" to the device that tells it how to operate – All configuration changes are stored in running config files – Implemented by the IOS

Router Bootstrap Process:

1. Perform the POST and load the bootstrap program
2. Locate and load the Cisco IOS software
3. Locate and load the startup configuration file or enter setup mode

Show Version Output

show version: You can use the command to verify/troubleshoot basic hardware/software components of the router

Output from show version command includes:

IOS version	– Version of Cisco IOS software in RAM and that is being used by router Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version 15.1(4) M4, RELEASE SOFTWARE (fc2)
ROM bootstrap program	– Displays version of system bootstrap software stored in ROM that was initially used to boot up the router ROM: System Bootstrap, Version 15.1(4)M4, RELEASE SOFTWARE (fc1)
Location of IOS	– Displays where bootstrap is located/loaded in Cisco IOS System image file is "flash0:c1900-universalk9-mz.SPA.151-1.M4.bin"
CPU/Amt of RAM	Cisco CISCO1941/K9 (revision 1.0) with 491529K/32768K bytes of memory
Interfaces	– Displays physical interfaces on the router

	2 Gigabit Ethernet interfaces 4 Low-speed serial (sync/async) network interfaces(s)
NVRAM/FLASH	Self-explanatory
	<ul style="list-style-type: none"> – Displays current configured value of the software configuration register in hex. – If a second value is displayed in parenthesis, it denotes the config register value that is used during the next reload