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IOS

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IOS

- Internetwork Operating System
- Software used on the vast majority of Cisco Systems routers and all current Cisco network switches.
- Package of routing, switching, internetworking and telecommunications functions tightly integrated with a multitasking operating system.
- Cisco IOS has a characteristic command line interface (CLI)
  - provides a fixed set of multiple-word commands — the set available is determined by the "mode" and the privilege level of the current user.
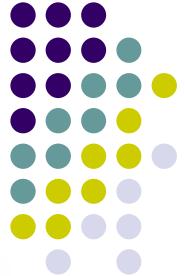
Router Components RAM

RAM

- Temporary storage of config files
- All content is lost on power-down
- May be very large to hold large routing tables
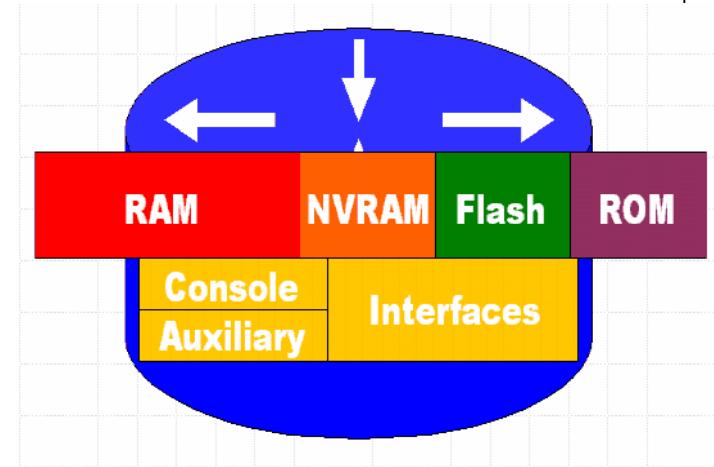

Stores

- *Routing tables (remember: usually built dynamically)*
- *ARP cache (again, built dynamically and ephemeral)*
- *Fast-switching cache*
- *Packet buffers*
- *Packet hold queues*

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Router Components NVRAM

NVRAM

- Non-volatile RAM
- Not especially fast
- Content is NOT LOST on power cycle.
- Usually less than 100 Kbytes
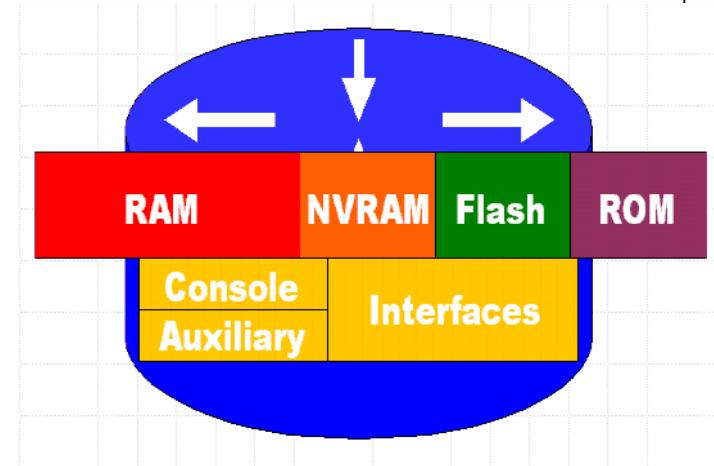
Stores

- *Exclusively used to store configuration scripts that are parsed on power-up (startup-config).*

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Router Components FLASH

FLASH

- EEPROM (Electronically Erasable Programmable Read-Only Memory)
- Retained on power-down.
- May be off-board in the form of flashcards.
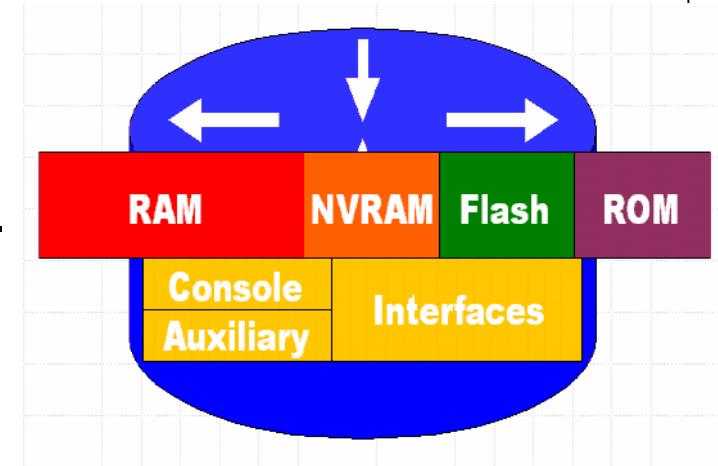

Stores

- *IOS versions. Allows for upgrading Operating System without replacing chip.*
- *Multiple versions of IOS may be stored at once (GREAT for testing install of a new version!)*
- *Off-board configuration allows you to "put OS in your pocket".*

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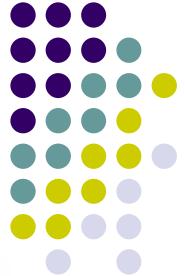
Router Components ROM

ROM

- Read-Only Memory.
- Generally installed in factory and never touched again!
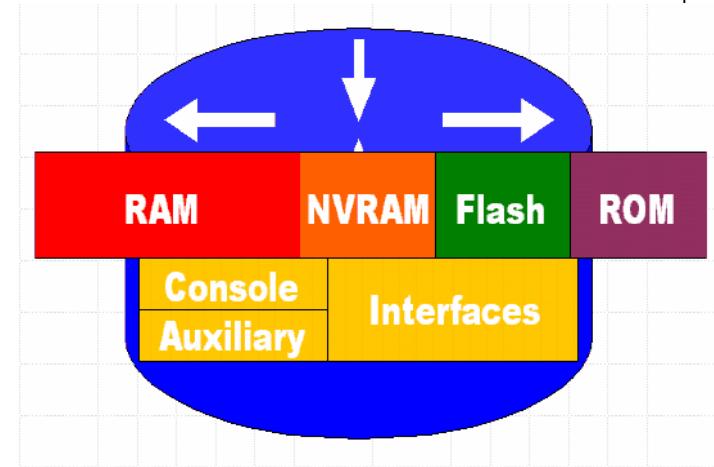
Stores

- *POST (power-on self test)*
- *Bootstrap program that calls IOS.*
- *Bare-bones version of an IOS. If IOS load routine fails, it defaults back to this version, giving limited functionality.*
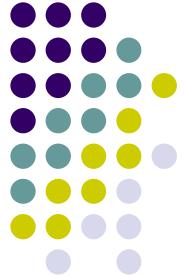
Router modes (1)
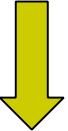
password   ↓   **New session**

User
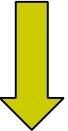
password   ↓   `enable`

Privileged
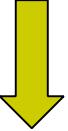
↓   `config term`

Configuration
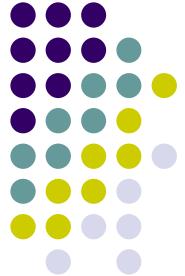
Logging In to the Router: Cisco IOS


```
Router con0 is now available

Press RETURN to get started.


User Access Verification
Password:
Router>
Router> enable
Password:
Router#
Router# disable
Router>
Router> exit
```

User-mode prompt

Privileged-mode prompt
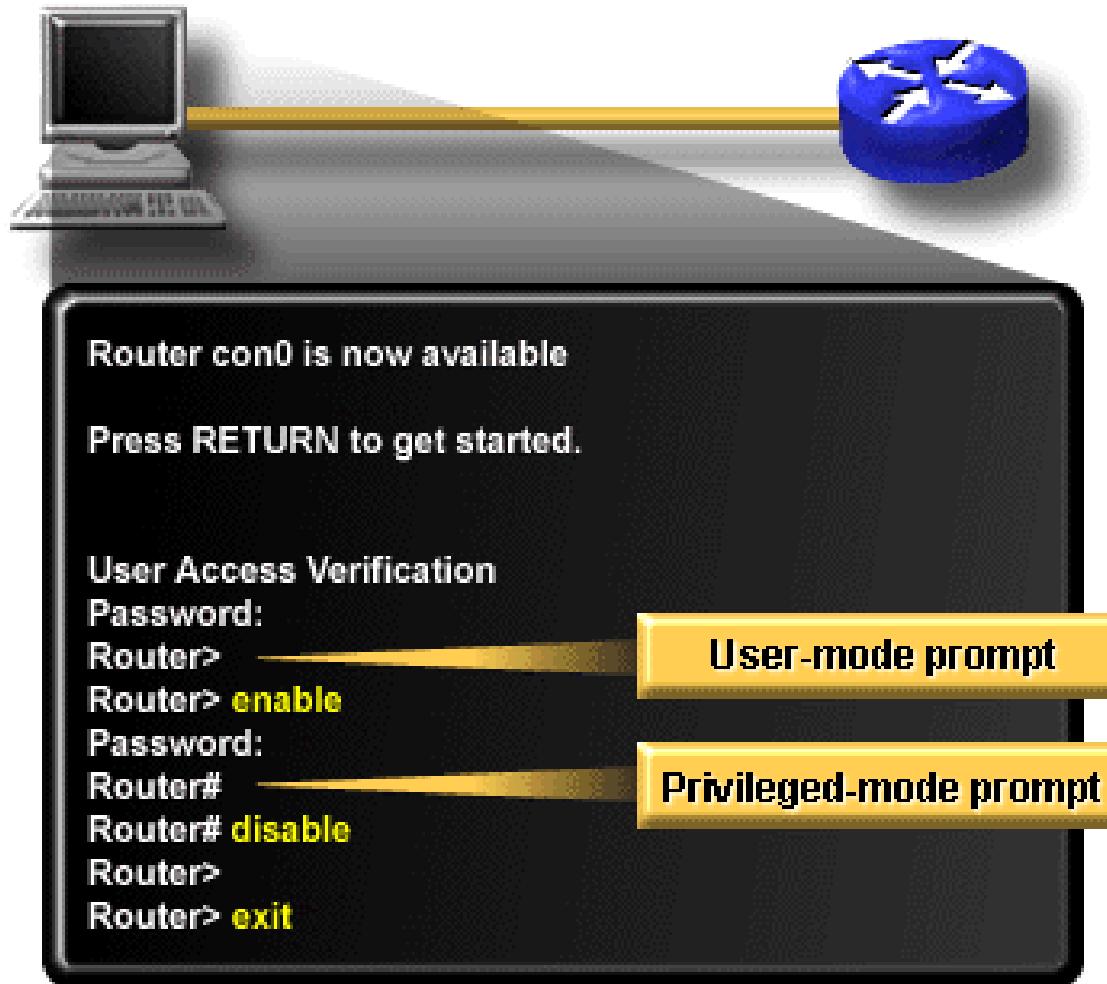
Router modes (2)

User mode

- user can examine router status and operation.
- configuration cannot be viewed or altered from user mode
- prompt `router>`

Privileged mode ("root")

- complete control over the router (anything can be set or reset)
- configuration cannot be altered
- prompt `router#`
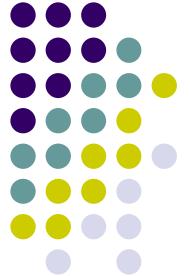
Router modes (3)

Configuration mode

- used only for change of configuration

- not password protected from privileged mode

- privileged mode commands don't have meaning in configuration mode

- most statements can be removed from the configuration with the prefix `no` (ex. `no shutdown`)

- prompt `router(config)#`
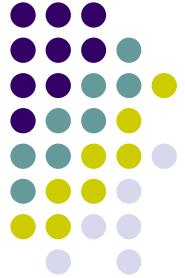
Router configurations

Two configurations:

- the active configuration (`show running-config`)(RAM)

- the startup configuration (`show startup-config`)(NVRAM)

Terminal → RAM Active config

NVRAM → RAM Active config

Flash → RAM Active config

Network → RAM Active config

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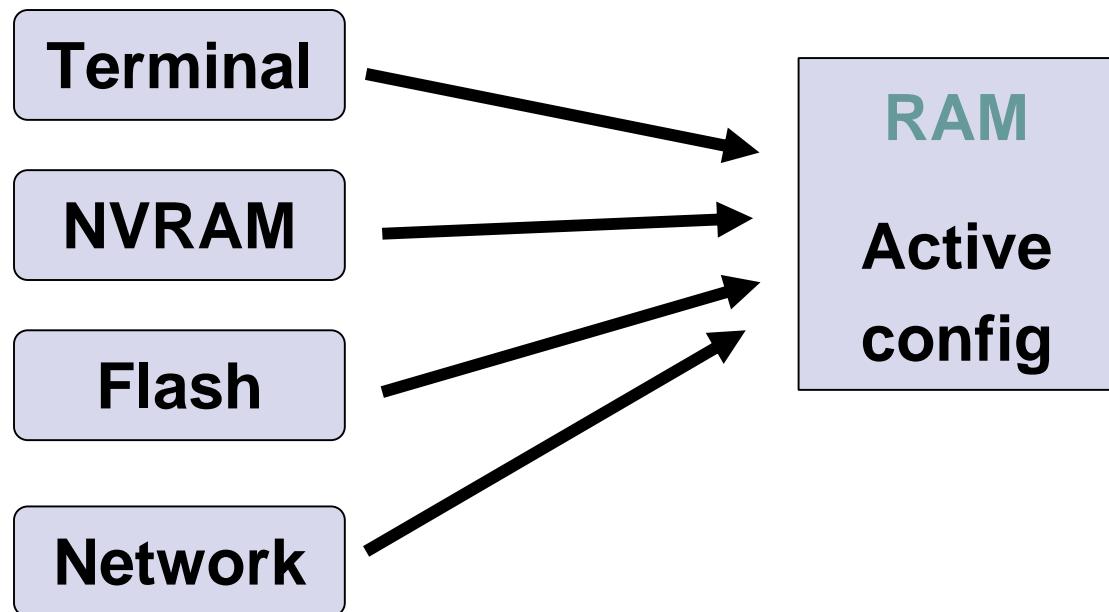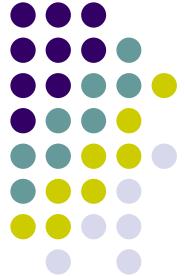
The show running-config and show startup-config Commands

```
Router#  show running-config
Building configuration...

Current configuration:
!
version 11.2
!
       -- More --
```

```
Router# show startup-config
Using 1108 out of 130048 bytes
!
version 11.2
!
hostname router

       -- More --
```

- Use *write terminal* with Release 10.3 and earlier

- Use *show config* with Release 10.3 and earlier

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Router Modes

User EXEC Mode

Limited examination of router. Remote access.

Router>

Global Configuration Mode

Simple configuration commands.

Router (config) #

Privileged EXEC Mode

Detailed examination of router. Debugging and testing. File manipulation. Remote access.

Router#

Other Configuration Modes

Complex and multiline configurations.

Router (config - mode) #

SETUP Mode

Prompted dialog used to establish an initial configuration.

RXBOOT Mode

Recovery from a catastrophe in the case of a lost password or the operating system being accidentally erased from Flash.

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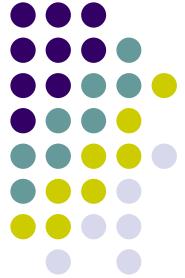
Help Functions

- IOS have built-in help

- at any point user may type ? and receive a list of what the executive expect to see next

- when used after character, help displays all command with the same prefix

  Router# co?

  configure connect copy

- at the beginning of command line ? will give a list of all commands available in the current mode

  Router>?

Help Functions

```
Router# clok
Translating "CLOK"
% Unknown command or computer name, or unable to find computer address

Router# c1?
clear     clock

Router# clock
% Incomplete command.

Router# clock ?
set       Set the time and date

Router# clock set
% Incomplete command

Router# clock set ?
Current Time ( hh : mm : ss )
```

```
Router# clock set 19:56:00
% Incomplete command.

Router# clock set 19:56:00 ?
<1-31>        Day of the month
MONTH         Month of the year

Router# clock set 19:56:00 04 8
.                                            ^
% Invalid input detected at the '^' marker

Router# clock set 19:56:00 04 August
% Incomplete command.

Router# clock set 19:56:00 04 August ?
<1993-2035>    Year
```

- Symbolic translation
- Keyword completion
- Last command recall <Ctrl P>

- Command prompting
- Syntax checking

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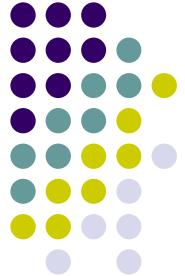
IOS Version

Router# show version

- Command show version will provide
  - basic configuration for the system hardware
  - basic configuration for the system software version
  - names and sources of
    - configuration files
    - boot images

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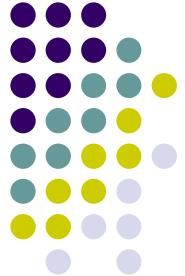
Network interfaces

Router# show interfaces

- each network interface is identified by type and number or by type and slot/number
- types can be abbreviated, numbers start at 0
  - ethernet0   e0   or   ethernet 0/1   e0/1
  - serial2   s2   or   serial0/2   s0/2
  - tokenring1   to1

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Configuration Mode

- Enter configuration mode

Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#

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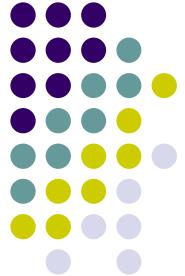
Setting Passwords (1)

- Privileged level Password

  - Router(config)# enable secret mypass

- Console level Password

  - Router(config)# line console 0

  - Router(config-line)# login

  - Router(config-line)# password mypass1

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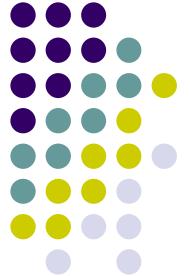
Setting Passwords (2)

- Telnet level Password

  - Router(config)# line vty 0 ?

  - <1-15>Last Line Number

  - Router(config-line)# line vty 0 15

  - Router(config-line)# login

  - Router(config-line)# password mypass2

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Hostname - Banner

- Command hostname set the hostname of the router
  - Router(config)# hostname Zeus
- Command banner set a banner on a Cisco router
  - Show information to users logs into the router
  - Show security notice to users dialing into your internetwork
    - Router(config)# banner motd #
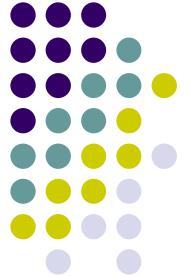
Interfaces (1)

- Access an interface
  - Router(config)# interface ethernet 0/0
  - Router(config-if)#
- Setting descriptions on an interface
  - Router(config-if)# description Uop to Ntua LAN
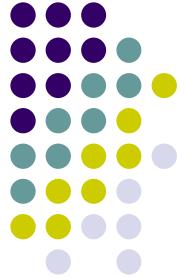
Interfaces (2)

- Configuring an IP Address on an interface
  - Router(config-if)# ip address 147.107.5.1 255.255.255.0
  - Router(config-if)# no shutdown
    - Turn an interface off with the interface command shutdown or turn it on with the no shutdown command.
    - If an interface is shut down, it will display administratively down when using the show interface command or show running-config command

Work with configuration files

- configure terminal – modify the running configuration manually from the terminal.
- show running-config – display the running configuration.
- show startup-config – display the startup configuration.
- copy running-config startup-config – copy the running configuration to the startup configuration.
- copy startup-config running-config – copy the startup configuration to the running configuration.
- erase startup-config – erase the startup-configuration in NVRAM.
- copy tftp running-config – load a configuration file stored on a Trivial File Transfer Protocol (TFTP) server into the running configuration.
- copy running-config tftp – store the running configuration on a TFTP server.

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Command line editing

- all commands and strings can be abbreviated to their shortest unique prefix (ex. `sh run`)

- arrow keys will move the cursor to the left and right on the command line

- command history is accessed via up and down arrows

- previous commands can be edited and re-entered

Command Line Editing

Advanced features:

- ^A   Move to left of line
- ^B   Move to right of line
- ^D   Delete character under cursor
- ^K   Delete to end of line
- ^F   Move forward
- ^B   Move backward
- ^P   Move to previous line
- ^N   Move to next line

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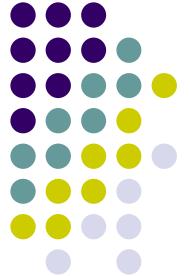
Example

```
router> enable
router# conf t
router(config)# int e0
router(config-if)# ip addr
   10.0.0.10 255.255.255.0
router(config-if)# no shut
router(config-if)# ^z
router# sho ip int e0
```

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