Cisco Router Configuration Basics

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Router Components

- Bootstrap – stored in ROM microcode – brings router up during initialisation, boots router and loads the IOS.
- POST – Power On Self Test - stored in ROM microcode – checks for basic functionality of router hardware and determines which interfaces are present
- ROM Monitor – stored in ROM microcode – used for manufacturing, testing and troubleshooting
- Mini-IOS – a.k.a RXBOOT/boot loader by Cisco – small IOS ROM used to bring up an interface and load a Cisco IOS into flash memory from a TFTP server; can also perform a few other maintenance operations

Router Components

- RAM – holds packet buffers, ARP cache, routing table, software and data structure that allows the router to function; running-config is stored in RAM, as well as the decompressed IOS in later router models
- ROM – starts and maintains the router
- Flash memory – holds the IOS; is not erased when the router is reloaded; is an EEPROM [Electrically Erasable Programmable Read-Only Memory] created by Intel, that can be erased and reprogrammed repeatedly through an application of higher than normal electric voltage
- NVRAM – Non-Volatile RAM - holds router configuration; is not erased when router is reloaded

Router Components

- Config-Register
  - controls how router boots;
  - value can be seen with "`show version`" command;
  - is typically 0x2102, which tells the router to load the IOS from flash memory and the `startup-config` file from NVRAM

Purpose of the Config Register

- Reasons why you would want to modify the config-register:
  - Force the router into ROM Monitor Mode
  - Select a boot source and default boot filename
  - Enable/Disable the Break function
  - Control broadcast addresses
  - Set console terminal baud rate
  - Load operating software from ROM
  - Enable booting from a TFTP server

System Startup

- POST – loaded from ROM and runs diagnostics on all router hardware
- Bootstrap – locates and loads the IOS image; default setting is to load the IOS from flash memory
- IOS – locates and loads a valid configuration from NVRAM; file is called `startup-config`; only exists if you copy the `running-config` to NVRAM
- startup-config – if found, router loads it and runs embedded configuration; if not found, router enters setup mode

Overview

- Router configuration controls the operation of the router's:
  - Interface IP address and netmask
  - Routing information (static, dynamic or default)
  - Boot and startup information
  - Security (passwords and authentication)

Where is the Configuration?

- Router always has two configurations:
- Running configuration
  - In RAM, determines how the router is currently operating
  - Is modified using the `configure` command
  - To see it: `show running-config`
- Startup confguration
  - In NVRAM, determines how the router will operate after next reload
  - Is modified using the `copy` command
  - To see it: `show startup-config`

Where is the Configuration?

- Can also be stored in more permanent places:
  - External hosts, using TFTP (Trivial File Transfer Protocol)
  - In flash memory in the router
- Copy command is used to move it around
  - copy run start
  - copy start tftp
  - copy flash start
  - copy run tftp
  - copy tftp start
  - copy start flash

Router Access Modes

- User EXEC mode – limited examination of router
  - Router>
- Privileged EXEC mode – detailed examination of router, debugging, testing, file manipulation (router prompt changes to an octothorp)
  - Router#
- ROM Monitor – useful for password recovery & new IOS upload session
- Setup Mode – available when router has no `startup-config` file

External Configuration Sources

- Console
  - Direct PC serial access
- Auxiliary port
  - Modem access
- Virtual terminals
  - Telnet/SSH access
- TFTP Server
  - Copy configuration file into router RAM
- Network Management Software
  - e.g. CiscoWorks

Changing the Configuration

- Configuration statements can be entered interactively
  - changes are made (almost) immediately, to the running configuration
- Can use direct serial connection to console port, or
- Telnet/SSH to vty's ("virtual terminals"), or
- Modem connection to aux port, or
- Edited in a text file and uploaded to the router at a later time via tftp; `copy tftp start` or `config net`

Logging into the Router

- Connect router to console port or telnet to router

```
router>
router>enable
password
router#
router#?
```

- Configuring the router
  - Terminal (entering the commands directly)

```
router# configure terminal
router(config)#
```

Connecting your FreeBSD Machine to the Router's Console Port

- Connect your machine to the console port using the rollover serial cable provide
- Go to /etc/remote to see the device configured to be used with "tip". you will see at the end, a line begin with com1

```
bash$ tip com1 <enter>
router>
router>enable
router#
```

New Router Configuration Process

- Load configuration parameters into RAM
  - **`Router#configure terminal`**
- Personalize router identification
  - **`Router#(config)hostname RouterA`**
- Assign access passwords
  - **`RouterA#(config)line console 0`**
  - **`RouterA#(config-line)password cisco`**
  - **`RouterA#(config-line)login`**

New Router Configuration Process

- Configure interfaces
  - **`RouterA#(config)interface ethernet 0/0`**
  - **`RouterA#(config-if)ip address n.n.n.n m.m.m.m`**
  - **`RouterA#(config-if)no shutdown`**
- Configure routing/routed protocols
- Save configuration parameters to NVRAM
  - **`RouterA#copy running-config startup-config`**
  - (or **`write memory`**)

Router Prompts – How to tell where you are on the router

- You can tell in which area of the router's configuration you are by looking at the router prompts:
  - **`Router>`** – USER prompt mode
  - **`Router#`** – PRIVILEGED EXEC prompt mode
  - **`Router(config)`** – terminal configuration prompt
  - **`Router(config-if)`** – interface configuration prompt
  - **`Router(config-subif)`** – sub-interface configuration prompt

Router Prompts – How to tell where you are on the router

- You can tell in which area of the router's configuration you are by looking at the router prompts:
  - **`Router(config-route-map)#`** – route-map configuration prompt
  - **`Router(config-router)#`** – router configuration prompt
  - **`Router(config-line)#`** – line configuration prompt
  - `rommon 1>` - ROM Monitor mode

Configuring your Router

- Set the enable (secret) password:
  - **`router(config)# enable secret`** "your pswd"
    - This MD5 encrypts the password
  - The old method was to use the **`enable password`** command. But this is not secure (weak encryption) and is ABSOLUTELY NOT RECOMMENDED. DO NOT USE!
- Ensure that all passwords stored on router are (weakly) encrypted rather than clear text:
  - **`router(config)# service password-encryption`**

Configuring Your Router

- To configure interface you should go to interface configuration prompt

  `router(config)# interface ethernet0` (or 0/x)

  `router(config-if)#`

- Save your configuration
  - **`router#copy running-config startup-config`**
  - (or **`write memory`**)

Configuring Your Router

- Global:

```
enable secret e2@fnog
```

- Interface:

```
interface ethernet 0/0
 ip address n.n.n.n m.m.m.m
```

- Router:

```
router ospf 1
 network n.n.n.n w.w.w.w area 0
```

- Line:

```
line vty 0 4
```

Global Configuration

- Global configuration statements are independent of any particular interface or routing protocol, *e.g.*:
  - **`hostname` *`e2-@fnog`***
  - **`enable secret` *`tracke2`***
  - **`service password-encryption`**
  - **`logging facility` *`local0`***
  - **`logging` *`n.n.n.n`***

Global Configuration

- IP specific global configuration statements:

  `ip classless`

  `ip name-server` ***`n.n.n.n`***

- Static Route Creation

  `ip route` ***`n.n.n.n m.m.m.m g.g.g.g`***

  `n.n.n.n` = network block

  `m.m.m.m` = network mask denoting block size

  `g.g.g.g` = next hop gateway destination packets are sent to

The NO Command

- Used to reverse or disable commands e.g

```
ip domain-lookup
no ip domain-lookup

router ospf 1
no router ospf 1

ip address 1.1.1.1 255.255.255.0
no ip address
```

Interface Configuration

- Interfaces are named by slot/type; *e.g.*:
  - ethernet0, ethernet1,... Ethernet5/1
  - Serial0/0, serial1 ... serial3
- And can be abbreviated:
  - ethernet0 or eth0 or e0
  - Serial0/0 or ser0/0 or s0/0

Interface Configuration

- Administratively enable/disable the interface

```
router(config-if)#no shutdown
router(config-if)#shutdown
```

- Description

```
router(config-if)#description ethernet
  link to admin building router
```

Looking at the Configuration

- Use "**`show running-configuration`**" to see the current configuration

- Use "**`show startup-configuration`**" to see the configuration in NVRAM, that will be loaded the next time the router is rebooted or reloaded

Storing the Configuration on a Remote System

- Requires: '**tftpd**' on a unix host; destination file must exist before the file is written and must be world writable...

```
router#copy run tftp
Remote host []? n.n.n.n
Name of configuration file to write [hoste2-rtr-
  confg]? hoste2-rtr-confg
Write file hoste2-rtr-confg on Host n.n.n.n?
  [confirm]
Building configuration...

Writing hoste2-rtr-confg !![OK]
router#
```

Restoring the Configuration from a Remote System

- Use 'tftp' to pull file from UNIX host, copying to running config or startup

```
router#copy tftp start
Address of remote host [255.255.255.255]? n.n.n.n
Name of configuration file [hoste2-rtr-confg]?
Configure using hostel-rtr-confg from n.n.n.n?
  [confirm]
Loading hoste2-rtr-confg from n.n.n.n (via
  Ethernet0/0): !
[OK - 1005/128975 bytes]
[OK]
hoste2-rtr# reload
```

Getting Online Help

- IOS has a built-in help facility;
  - use "?" to get a list of possible configuration statements
- "?" after the prompt lists all possible commands:
  - **`router#?`**
- "<partial command> ?" lists all possible subcommands, e.g.:
  - **`router#show ?`**
  - **`router#show ip ?`**

Getting Online Help

- "<partial command>?" shows all possible command completions

```
router#con?

  configure  connect
```

- This is different:

```
hostel-rtr#conf ?
  memory                Configure from NVRAM
  network               Configure from a TFTP network host
  overwrite-network     Overwrite NV memory from TFTP...
                                          network host
  terminal              Configure from the terminal
  <cr>
```

Getting Online Help

- This also works in configuration mode:

```
router(config)#ip a?
  accounting-list  accounting-threshold
  accounting-transits  address-pool
  alias as-path

router(config)#int e0/0
router(config-if)#ip a?
  access-group  accounting  address
```

Getting Online Help

- Can "explore" a command to figure out the syntax:

```
router(config-if)#ip addr ?
  A.B.C.D  IP address

router(config-if)#ip addr n.n.n.n ?
  A.B.C.D  IP subnet mask

router(config-if)#ip addr n.n.n.n m.m.m.m ?
  secondary  Make this IP address a secondary address
  <cr>

router(config-if)#ip addr n.n.n.n m.m.m.m
router(config-if)#
```

Getting Lazy Online Help

- TAB character will complete a partial word

```
hostel-rtr(config)#int<TAB>
hostel-rtr(config)#interface et<TAB>
hostel-rtr(config)#interface ethernet 0
hostel-rtr(config-if)#ip add<TAB>
hostel-rtr(config-if)#ip address n.n.n.n m.m.m.m
```

- Not really necessary; partial commands can be used:

```
router#conf t
router(config)#int e0/0
router(config-if)#ip addr n.n.n.n
```

Getting Lazy Online Help

- Command history
  - IOS maintains short list of previously typed commands
  - up-arrow or '^p' recalls previous command
  - down-arrow or '^n' recalls next command
- Line editing
  - left-arrow, right-arrow moves cursor inside command
  - '^d' or backspace will delete character in front of cursor
  - Ctrl-a takes you to start of line
  - Ctrl-e takes you to end of line

Connecting your FreeBSD machine to the Router's Console port

- Look at your running configuration
- Configure an IP address for e0/0 depending on your table
  - use n.n.n.n for table A etc
- Look at your running configuration and your startup configuration
- Check what difference there is, if any

Deleting your Router's Configuration

- To delete your router's configuration

```
Router#erase startup-config
```

OR

```
Router#write erase
Router#reload
```

  - Router will start up again, but in setup mode, since startup-config file does not exists

Getting to the ROM Monitor

- Windows using HyperTerminal for the console session
  - Ctrl-Break
- FreeBSD/UNIX using Tip for the console session
  - <Enter>, then ~# OR
  - Ctrl-], then Break or Ctrl-C
- Linux using Minicom for the console session
  - Ctrl-A F

Disaster Recovery: How to Recover a Lost Password

- Connect your PC's serial port to the router's console port
- Configure your PC's serial port:
  - 9600 baud rate
  - No parity
  - 8 data bits
  - 1 stop bit
  - No flow control

Disaster Recovery: How to Recover a Lost Password

- Your configuration register should be 0x2102; use "**`show version`**" command to check
- Reboot the router and apply the Break-sequence within 60 seconds of powering the router, to put it into ROMMON mode

```
Rommon 1>confreg 0x2142
Rommon 2>reset
```

  - Router reboots, bypassing startup-config file

Disaster Recovery: How to Recover a Lost Password

```
Type Ctrl-C to exit Setup mode

Router>enable
Router#conf m OR copy start run (only!!!)
Router#show running OR write terminal
Router#conf t
Router(config)enable secret forgotten
Router(config)int e0/0…
Router(config-if)no shut
Router(config)config-register 0x2102
Router(config)Ctrl-Z or end
Router#copy run start OR write memory
Router#reload
```

Cisco Router Configuration Basics