

# Cisco Router Configuration Basics



Scalable Infrastructure  
Workshop  
AfNOG 2010

# Router Components

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## □ RAM

- Holds operating system, data structures, packet buffers, ARP cache, and routing tables
- Router's **running-config is stored in RAM**

## □ Flash memory

- **Holds the IOS**
- Is not erased when the router is reloaded

## □ NVRAM

- Non-Volatile RAM - **stores router startup-config**
- Is not erased when router is reloaded

# Router Components

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## □ Configuration Register

- controls how router boots;
- value can be seen with `show version` command;
- is normally `0x2102`, which tells the router to load the IOS from flash memory and the `startup-config` file from NVRAM
- `0x2142`, tells the router to ignore the NVRAM configuration when rebooting
- Leading `0x` means `hexadecimal`

# Purpose of the Config Register

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- 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

# Configuration Overview

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- 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?

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- 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 configuration
    - 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?

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- Can also be stored in more permanent places:
  - External hosts, using TFTP, FTP, SCP, etc
  - In flash memory in the router
- Copy command is used to move it around

```
copy run start
```

```
copy run tftp
```

```
copy start tftp
```

```
copy tftp start
```

```
copy flash start
```

```
copy start flash
```

# Router Access Modes

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- ❑ User mode – limited access to router – no configuration rights
  - Router>
- ❑ Privileged EXEC mode – detailed access and full configuration of the router, debugging, testing, file manipulation (router prompt changes to an octothorp)
  - Router#
- ❑ ROM Monitor – useful for password recovery (amongst others)
- ❑ Setup Mode – entered when router has no **startup-config** file



# External Configuration Sources

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- 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

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- ❑ 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/ftp/scp
  - `copy tftp start or config net`

# Logging into the Router

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- ❑ 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

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- ❑ Connect your PC to the console port using the serial cable provided
- ❑ 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#
```

# Address Assignments

## SWITCH

**G**  
196.200.220.128/28

**F**  
196.200.220.112/28

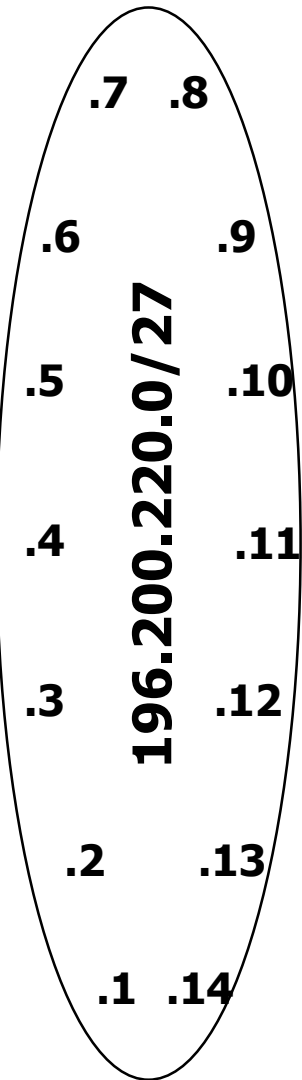
**E**  
196.200.220.96/28

**D**  
196.200.220.80/28

**C**  
196.200.220.64/28

**B**  
196.200.220.48/28

**A**  
196.200.220.32/28



**H**  
196.200.220.144/28

**I**  
196.200.220.160/28

**J**  
196.200.220.176/28

**K**  
196.200.220.192/28

**L**  
196.200.220.208/28

**M**  
196.200.220.224/28

**N**  
196.200.220.240/28

# Configuring your Router (1)

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- ❑ Load configuration parameters into RAM
  - Router#`configure terminal`
  
- ❑ Personalize router identification
  - Router#(config)`hostname RouterA`
  
- ❑ Assign console & vty passwords
  - RouterA#(config)`line console 0`
  - RouterA#(config-line)`password si2010`
  
  - RouterA#(config)`line vty 0 4`
  - RouterA#(config-line)`password si2010`

# Configuring your Router (2)

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- ❑ Set the enable (secret) password:
  - `router(config)# enable secret si@fnog`
    - ❑ 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 (3)

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- ❑ Configure interfaces
  - RouterA# (config) interface fastethernet 0/0
  - RouterA# (config-if) ip address n.n.n.n m.m.m.m
  - RouterA# (config-if) no shutdown
  
- ❑ Configure routing/routed protocols
  - RouterA# (config) router bgp 100
  - RouterA# (config-router)
  
- ❑ Save configuration parameters to NVRAM
  - RouterA# copy running-config startup-config
  - (or write memory)



# Configuring your Router (4)

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## □ IP Specific Configuration

- `no ip source-route` → disable source routing
- `ip domain-name domain-name`
- `ip nameserver n.n.n.n` → set name server

## □ 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

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

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- ❑ You can tell in which area of the router's configuration you are by looking at the router prompts - some examples:

**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

**rommon 1>** → ROM Monitor mode

# The NO Command

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- 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

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- ❑ Interfaces are named by slot/type; e.g.:
  - ethernet0, ethernet5/1, serial0/0/0, serial2
- ❑ And can be abbreviated:
  - ethernet0 or eth0 or e0
  - Serial0/0 or ser0/0 or s0/0
- ❑ Interfaces are shutdown by default
  - `router(config-if)#no shutdown` → wake up interface
- ❑ Description
  - `router(config-if)#description Link to Admin Building router`

# Global Configuration Commands

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- ❑ Cisco **global** config should always include:
  - `ip classless`
  - `ip subnet-zero`
    - (These are default as from IOS 12.2 release)
- ❑ Cisco **interface** config should usually include:
  - `no shutdown`
  - `no ip proxy-arp`
  - `no ip redirects`
  - `no ip directed-broadcast`
- ❑ Industry recommendations are at <http://www.cymru.com/Documents>

# Looking at the Configuration

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- 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
  - (or `show conf`)

# Storing the Configuration on a Remote System

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

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

Writing rtra-config !![OK]
router#
```

# Restoring the Configuration from a Remote System

---

- Use 'tftp' to pull file from UNIX host, copying to running-config (added to existing running configuration) or startup-config (stored in configuration NVRAM and used on next reboot)

```
rtra#copy tftp start
```

```
Address of remote host [255.255.255.255]? n.n.n.n
```

```
Name of configuration file [rtra-config]?
```

```
Configure using rtra-config from n.n.n.n? [confirm]
```

```
Loading rtra-config from n.n.n.n (via Ethernet0/0):
```

```
!
```

```
[OK - 1005/128975 bytes]
```

```
rtra# reload
```



# Getting Command Help

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- IOS has a command help facility;
  - use "?" to get a list of possible configuration options
- "?" after the prompt lists all possible commands:  
`router#?`
- "<command> ?" lists all possible subcommands  
`router#show ?`  
`router#show ip ?`
- "<partial command>?" lists all possible command completions:  
`router#con?`  
`configure connect`

# Getting Lazy Command Help

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- 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 to complete command keywords; partial commands can be used:

```
router#conf t
```

```
router(config)#int e0/0
```

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

# Editing

---

- ❑ Command history
  - IOS maintains a 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 fastethernet0/0 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

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- 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 exist

# Password Recovery



Working around a forgotten or  
lost password

# Disaster Recovery – ROM Monitor

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- ROM Monitor is very helpful in recovering from emergency failures such as:
  - Password recovery
  - Upload new IOS into router with NO IOS installed
  - Selecting a boot source and default boot filename
  - Set console terminal baud rate to upload new IOS quicker
  - Load operating software from ROM
  - Enable booting from a TFTP server

# Getting to the ROM Monitor

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- ❑ 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
  
- ❑ MacOS using Zterm for the console session
  - Apple B



# 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#copy start run (only!!!)
```

```
Router#show running
```

```
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
```

```
Router#reload
```

# Basic IPv6 Configuration



# IPv6 Configuration

---

- ❑ IPv6 is not enabled by default in IOS
- ❑ Enabling IPv6:  
Router(config)# ipv6 unicast-routing
- ❑ Disable Source Routing  
Router(config)# no ipv6 source route
- ❑ Activating IPv6 CEF  
Router(config)# ipv6 cef

# IPv6 Configuration - Interfaces

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- ❑ Configuring a global or unique local IPv6 address:
  - Router(config-if)# ipv6 address X:X..X:X/prefix
  
- ❑ Configuring an EUI-64 based IPv6 address (not such a good idea on a router):
  - Router(config-if)# ipv6 address X:X::/prefix  
eui-64

# IPv6 Configuration

---

- ❑ Note that by configuring any IPv6 address on an interface, you will see a global or unique-local IPv6 address and a link-local IPv6 address on the interface
  - Link-local IPv6 address format is *FE80::interface-id*
  
- ❑ The local-link IPv6 address is constructed automatically by concatenating FE80 with Interface ID as soon as IPv6 is enabled on the interface:
  - Router(config-if)# `ipv6 enable`

# IOS IPv6 Interface Status – Link Local

---

```
br01#sh ipv6 interface fast 0/1.220
```

```
FastEthernet0/1.220 is up, line protocol is up
```

```
IPv6 is enabled, link-local address is FE80::225:45FF:FE6A:5B39
```

```
No global unicast address is configured
```

```
Joined group address(es):
```

```
FF02::1
```

```
FF02::2
```

```
FF02::1:FF6A:5B39
```

```
MTU is 1500 bytes
```

```
ICMP error messages limited to one every 100 milliseconds
```

```
ICMP redirects are enabled
```



# IOS IPv6 Interface Status

---

```
br01#sh ipv6 interface fast 0/1.223
```

```
FastEthernet0/1.223 is up, line protocol is up
```

```
IPv6 is enabled, link-local address is FE80::225:45FF:FE6A:5B39
```

```
Description: backbone
```

```
Global unicast address(es):
```

```
2001:4348:0:223:196:200:223:254, subnet is 2001:4348:0:223::/64
```

```
Joined group address(es):
```

```
FF02::1
```

```
FF02::2
```

```
FF02::1:FF23:254
```

```
FF02::1:FF6A:5B39
```

```
MTU is 1500 bytes
```

```
ICMP error messages limited to one every 100 milliseconds
```

```
ICMP redirects are enabled
```

# IPv6 Configuration – Miscellaneous

---

- ❑ Disable IPv6 redirects on interfaces

```
interface fastethernet 0/0  
  no ipv6 redirects
```

- ❑ Nameserver, syslog etc can be IPv6 accessible

```
ip nameserver 2001:db8:2:1::2  
ip nameserver 10.1.40.40
```

# Static Routing – IOS

---

## □ Syntax is:

```
ipv6 route ipv6-prefix/prefix-length {ipv6-  
address | interface-type interface-number}  
[admin-distance]
```

## □ Static Route

```
ipv6 route 2001:db8::/64 2001:db8:0:CC00::1
```

- Routes packets for network 2001:db8::/64 to a networking device at 2001:db8:0:CC00::1

# Cisco Router Configuration Basics



Questions?