

Cisco Router Configuration Basics



Scalable Infrastructure
Workshop

Router vs Switch

- The two pieces of equipment look similar and perform some similar functions, but each has its own distinct function to perform on a network.
- **Switches** create a networks.
- **Routers** connect networks.
 - A router links computers to the Internet, so users can share the connection. A router acts as a dispatcher, choosing the best path for information to travel so it's received quickly.

Router Components

❑ The Chassis



❑ Control Plane

- The map / routing – Static, OSPF, ISIS, BGP,
- Determines how packets should be forwarded

❑ Forwarding Plane

- Line cards
- Packets / Traffic in and out through interfaces

Router Components

- RAM
 - Holds operating system, data structures, packet buffers, ARP cache, and routing tables
 - Reset on reload
 - Router's **running-config is stored in RAM**
- Flash
 - **Holds the IOS**
 - Is not erased when the router is reloaded
- NVRAM
 - Non-Volatile RAM - stores router's **startup-config**
 - Is not erased when router is reloaded

Router Components

- Configuration Register
- It's a **16bit** configuration registers in NVRAM
 - controls how router boots;
 - value can be seen with “`show version`” command;
 - For most Cisco routers the value is **0x2102**, which tells the router to load the IOS from flash memory and the `startup-config` file from NVRAM
 - When the value is set to **0x2142**, that tells the router to ignore the NVRAM configuration when rebooting
 - Leading “**0x**” means “hexadecimal”

Purpose of the Config Register

- Reasons why you would want to modify the config-register:
 - Force the router into ROM Monitor Mode (recovery 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

A Router

- Cisco ISR Modular Routers

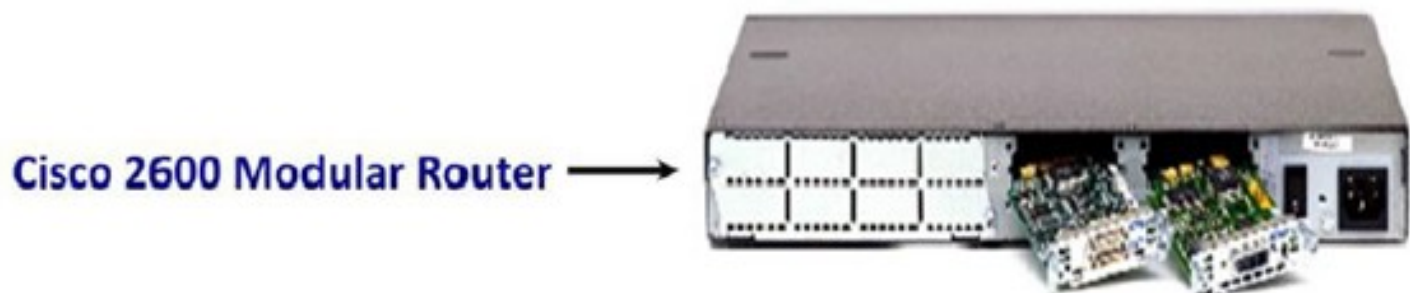
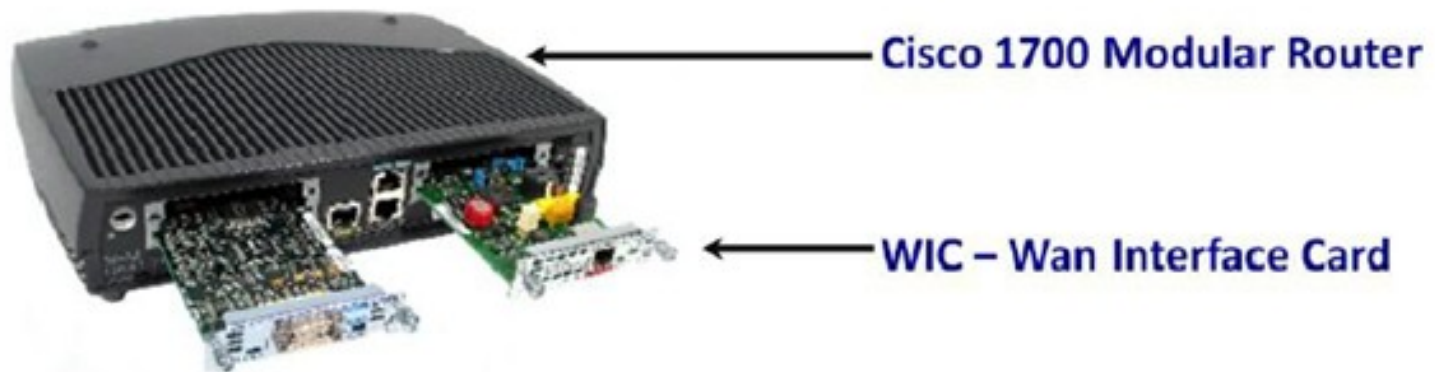


Fig . 1

Configuration 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 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?

- 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 start tftp
```

```
copy flash start
```

```
copy run tftp
```

```
copy tftp start
```

```
copy start flash
```

Router Access Modes

- 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 octothorpe)
 - Router#
- ROM Monitor – useful for password recovery (amongst others)
- Setup Mode – entered 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/ftp/scp
 - `copy tftp start`

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
```

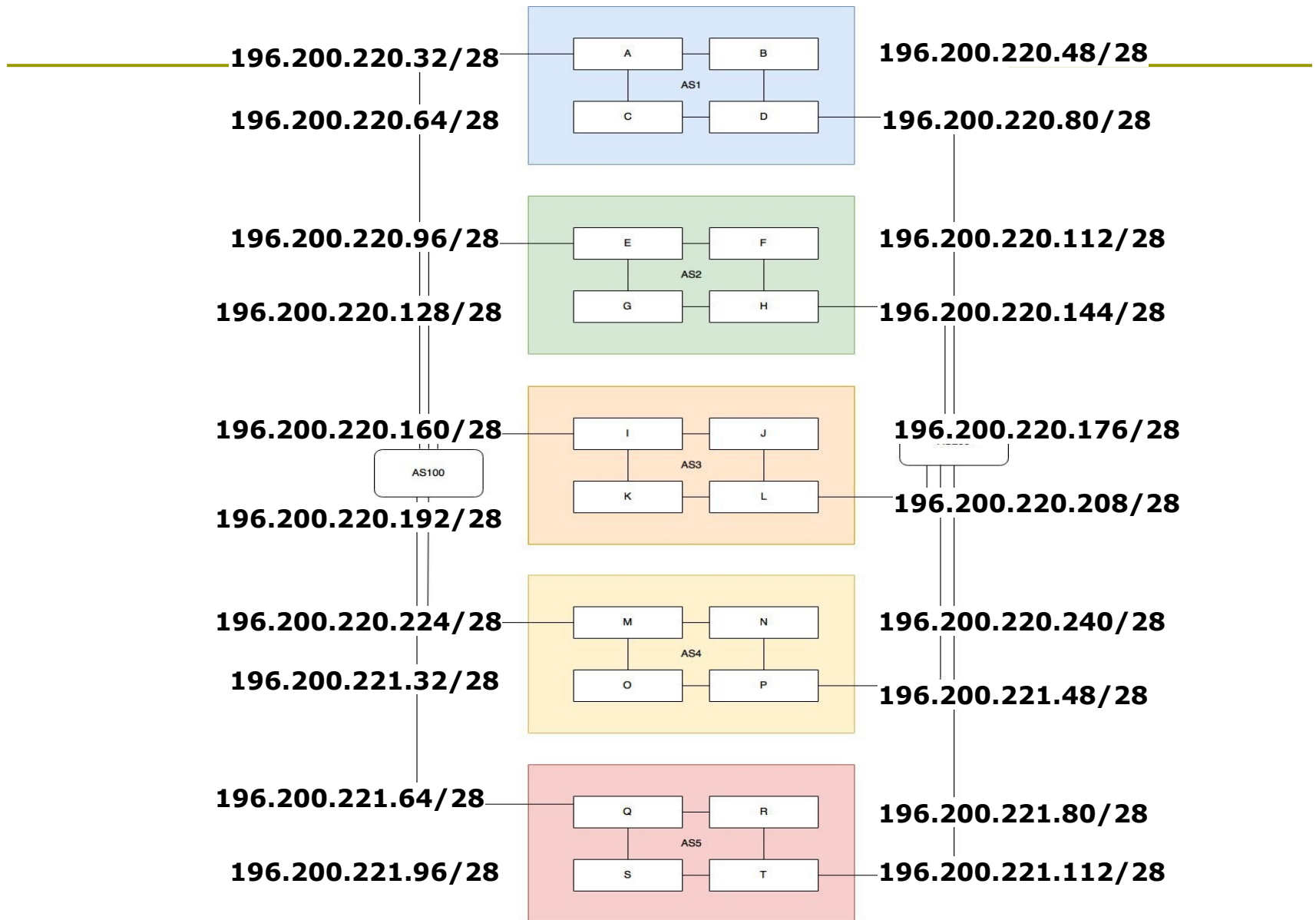
```
router(config)#
```

Connecting your Laptop to the Router's Console Port

- ❑ Open your telnet client program on your laptop
- ❑ Open a telnet session to ts01.sie.ws.afnog.org port 200x

```
bash$ telnet ts01.sie.ws.afnog.org 2004 <enter>
Router>
router>enable
router#
```

Address Assignments



Configuring your Router (1)

- Load configuration parameters into RAM
 - Router#configure terminal

- Personalise router identification
 - Router#(config)hostname RouterA

- Assign console & vty passwords
 - RouterA#(config)line console 0
 - RouterA#(config-line)password *afnog*

 - RouterA#(config)line vty 0 4
 - RouterA#(config-line)password *afnog*

Spaces count, so don't add them at the end !!

Configuring your Router (2)

- Set the enable (secret) password:
 - `router(config)# enable secret afnog`
 - 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)

□ 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)

□ 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

- 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

- 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, 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

- 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 <https://www.cymru.com/Documents/secure-ios-template.html>

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
 - (or `show conf`)

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...

```
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

- 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

- 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
 - Ctrl-u deletes an entire line

Many other 'unix-like' tricks...

Connecting to the Router's Console port

- Look at your running configuration
- Configure an IP address for fastethernet0/1 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 exist

Password Recovery

Working around a forgotten or
lost password

Disaster Recovery – ROM Monitor

- 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

- 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

- 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?