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

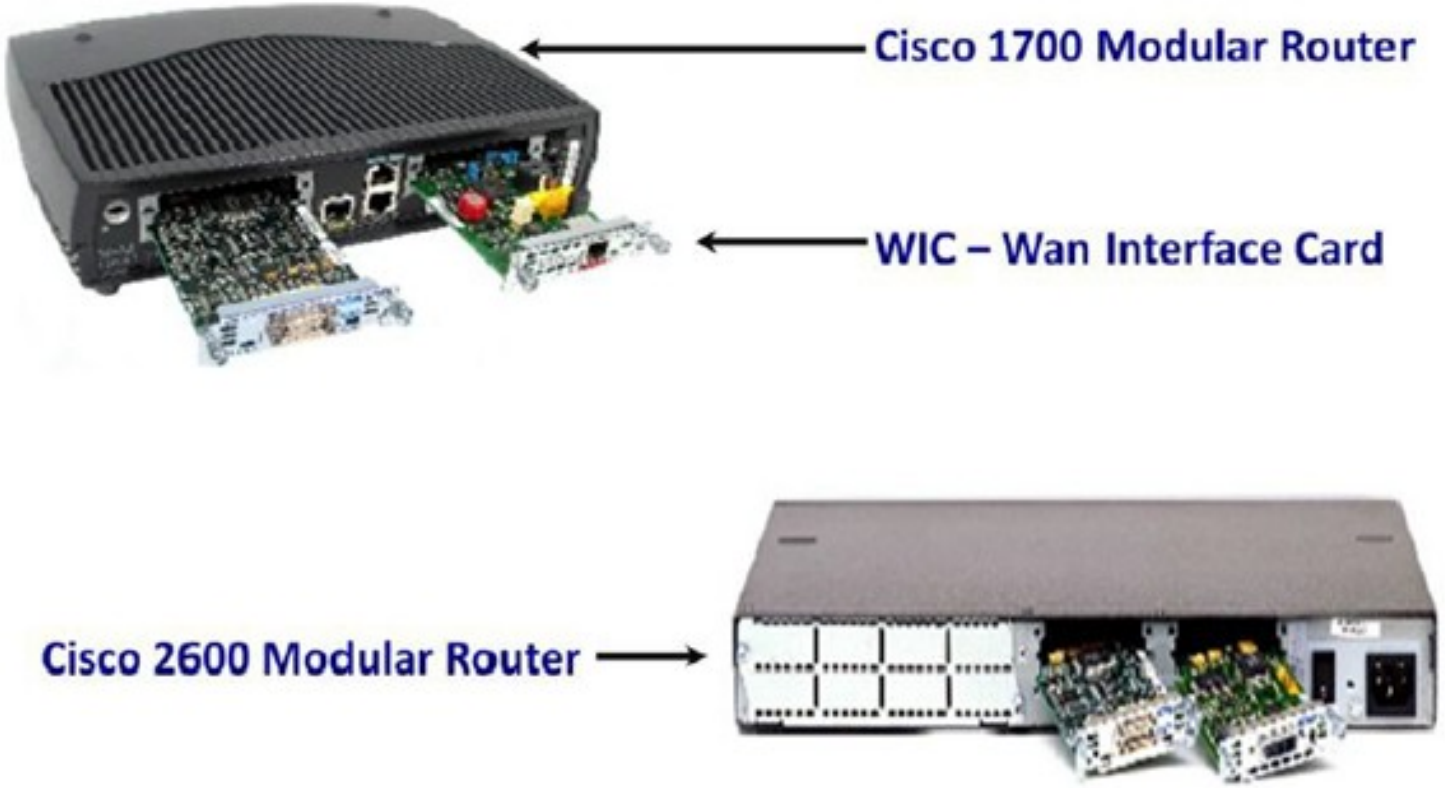


Fig . 1

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 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, 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

- 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)

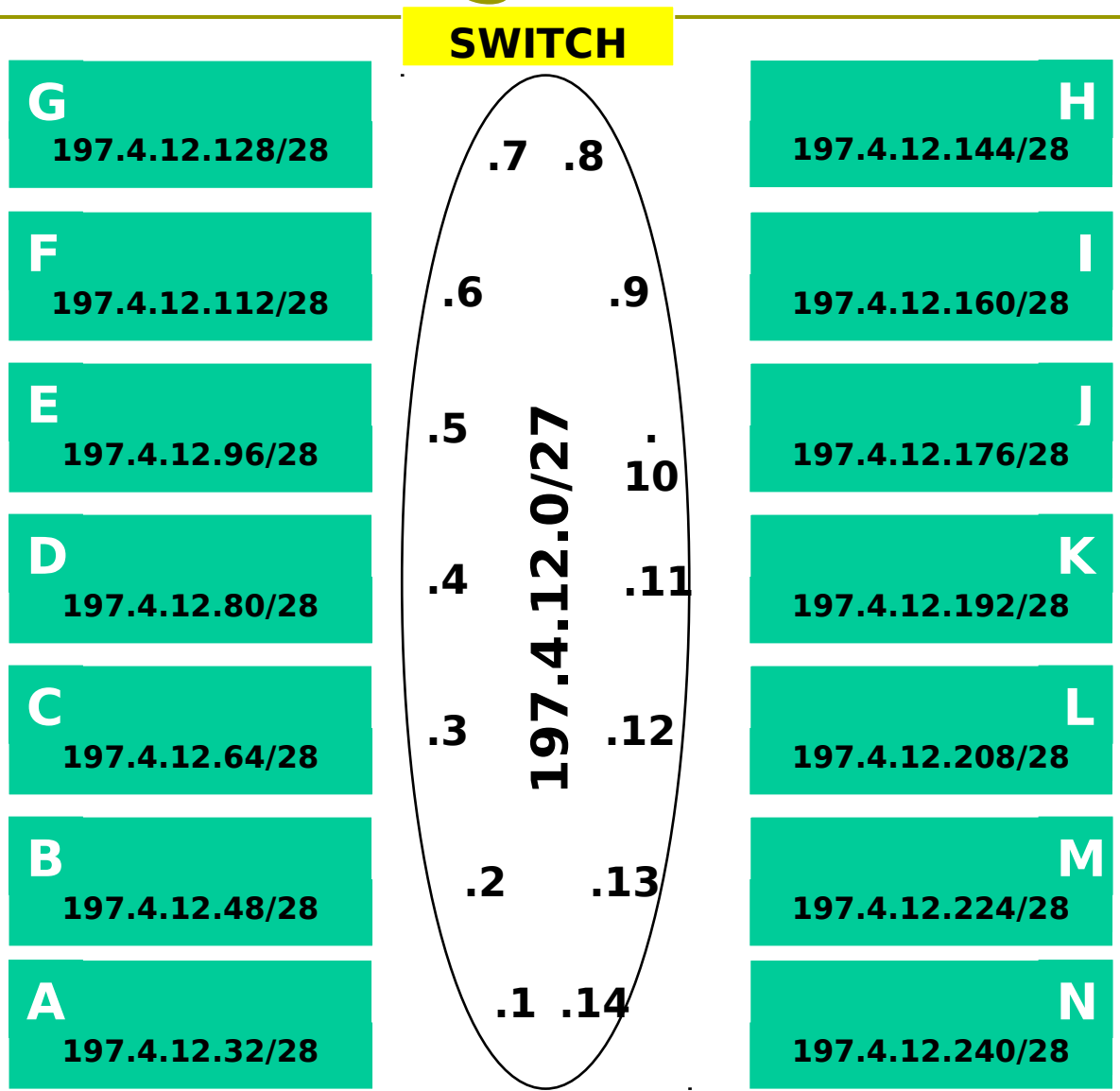
```
router# configure terminal
router(config)#
```

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 http://www.cymru.com/Documents

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-confg]?
Write file rtra-confg on Host n.n.n.n? [confirm]
Building configuration...

Writing rtra-confg !![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-confg]?
Configure using rtra-confg from n.n.n.n? [confirm]
Loading rtra-confg 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 exists

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?