

## LAN-to-LAN Connections



### I. Objectives:

- Learn how to create two LANs with Cisco switches and connect them with Cisco routers
- Upon completing the Lab, students should know how to create a small office wide network
- Cisco devices Router 1801 (included Router and 8-port Switch) will be given at Lab time

### II. Introduction to LAN-to-LAN Connection

#### 1. Creation of a Switched LAN Basics

##### Configuring a LAN with DHCP server on router

You can connect 8 workstations auto-configured with the Dynamic Host Configuration Protocol (DHCP) to the 8 high-speed Ethernet ports on the Cisco 1800 (fixed) integrated router.

You can configure your Cisco 1800 integrated services fixed-configuration router to act as a DHCP server, providing IP address assignment and other TCP/IP-oriented configuration information to your workstations. DHCP frees you from having to manually assign an IP address to each client. When you configure a DHCP server, you must configure the server properties, policies, and DHCP options.

Perform these steps to configure your router for DHCP operation, beginning in global configuration mode:

	Command	Purpose
Step 1	<b>ip domain name</b> <i>name</i> <b>Example:</b> CEx (config) # <b>ip domain name</b> netlab-bk.org  CEx (config) #	Identifies the default domain that the router uses to complete unqualified hostnames (names without a dotted-decimal domain name).
Step 2	<b>ip name-server</b> <i>server-address1</i> [ <i>server-address2</i> ... <i>server-</i>	Specifies the address of one or more Domain Name System

	<code>address6]</code> <b>Example:</b> <code>CEx (config)# ip name-server 172.28.2.4</code>  <code>CEx (config)#</code>	(DNS) servers to use for name and address resolution.
<b>Step 3</b>	<b><code>ip dhcp excluded-address</code></b> <i>low-address [high-address]</i> <b>Example:</b> <code>CEx (config)# ip dhcp excluded-address 10.10.1x.1</code> (Note: x will be 1 or 2)  <code>CEx (config-dhcp)#</code>	Specifies IP addresses that the DHCP server should not assign to DHCP clients. In this example, we are excluding the router address.
<b>Step 4</b>	<b><code>ip dhcp pool</code></b> <i>name</i> <b>Example:</b> <code>CEx (config)# ip dhcp pool lab4</code>  <code>CEx (config-dhcp)#</code>	Creates a DHCP address pool on the router and enters DHCP pool configuration mode. The <i>name</i> argument can be a string or an integer.
<b>Step 5</b>	<b><code>Network</code></b> <i>network-number [mask   prefix-length]</i> <b>Example:</b> <code>CEx (config-dhcp)# network 10.10.1x.0 255.255.255.0</code>  <code>CEx (config-dhcp)#</code>	Defines subnet number (IP) address for the DHCP address pool, optionally including the mask.
<b>Step 6</b>	<b><code>import all</code></b> <b>Example:</b> <code>CEx (config-dhcp)# import all</code>  <code>CEx (config-dhcp)#</code>	Imports DHCP option parameters into the DHCP portion of the router database.
<b>Step 7</b>	<b><code>default-router</code></b> <i>address [address2...address8]</i> <b>Example:</b> <code>CEx (config-dhcp)# default-router 10.10.1x.1</code>  <code>CEx (config-dhcp)#</code>	Specifies up to 8 default routers for a DHCP client.
<b>Step 8</b>	<b><code>dns-server</code></b> <i>address [address2...address8]</i> <b>Example:</b> <code>CEx (config-dhcp)# dns-server 172.28.2.4</code>  <code>CEx (config-dhcp)# dns-server 172.28.10.20</code>	Specifies up to 8 DNS servers available to a DHCP client.
<b>Step 9</b>	<b><code>domain-name</code></b> <i>domain</i>	Specifies the domain name for a DHCP client.

	<b>Example:</b> CEx (config-dhcp) # <b>domain-name netlab-bk.org</b>  CEx (config-dhcp) #	
<b>Step 10</b>	<b>exit</b> <b>Example:</b> CEx (config-dhcp) # <b>exit</b>  CE0 (config) #	Exits DHCP configuration mode, and enters global configuration mode.

### Verify Your DHCP Configuration

Use the following commands to view your DHCP configuration.

- **show ip dhcp import**—Displays the optional parameters imported into the DHCP server database.
- **show ip dhcp pool**—Displays information about the DHCP address pools.
- **show ip dhcp server statistics**—Displays the DHCP server statistics, such as the number of address pools, bindings, and so forth.

## 2. Connecting LANs to outside solution

Most commonly, a router will have both LAN and WAN interfaces and it is the device that connects the two. Alternately, a device called a gateway can connect a LAN to a WAN, essentially adding on to the LAN by making the WAN an extension of it.

## 3. Introduction to Cisco router 1801

List of the interfaces supported for each router and their associated port labels on the equipment:

Router	Interface	Port Label
Cisco 1801	Fast Ethernet LANs	SWITCH and FE8–FE5 (top), FE x and FE4–FE1 (bottom)
	Fast Ethernet WANs	FE0
	ATM WAN	ADSLoPOTS
	Wireless LAN	LEFT, RIGHT/PRIMARY
	BRI	ISDN S/T

## Configuring Basic Parameters

Perform these steps to configure selected global parameters for your router:

	Command	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> CEx>enable  CEx#configure terminal  CEx(config)#	Enters global configuration mode, when using the console port.  If you are connecting to the router using a remote terminal, use the following: telnet <i>router name or address</i>  Login: <i>login id</i>  Password: *****  CEx> enable
<b>Step 2</b>	<b>hostname name</b> <b>Example:</b> CEx(config)#hostname CEx  CEx(config)#	Specifies the name for the router.
<b>Step 3</b>	(ignore this step) <b>enable secret password</b> <b>Example:</b> CEx(config)#enable secret NetLab@routerx  CEx(config)#	Specifies an encrypted password to prevent unauthorized access to the router.
<b>Step 4</b>	<b>no ip domain-lookup</b> <b>Example:</b> CEx(config)#no ip domain-lookup  CEx(config)#	Disables the router from translating unfamiliar words (typos) into IP addresses.

## Configure Fast Ethernet LAN Interfaces (no ip address setting on these interfaces)

The 8 Fast Ethernet LAN interfaces on your router are automatically configured as part of the default VLAN and as such, they are not configured with individual addresses. Access is afforded through the VLAN. You may assign the interfaces to other VLANs if desired. The 8 high speed Ethernet ports on the Cisco 1800 (fixed) integrated router supports 8 VLANs per port.

1. Create a new VLAN
  - a. Router# conf t
  - b. Router(config)# vlan 1x name LANx
  - c. Router(config-vlan)#ip address 10.10.1x.1 255.255.255.0
  - d. Router(config-vlan)#no shut

2. Add ports on Switch to VLAN
  - a. Router# conf t
  - b. Router(config)# int fast 1 (or 2,3,4,5,6,7,8)
  - c. Router(config-if)#switchport mode access
  - d. Router(config-if)#switchport access vlan 1x
  - e. Router(config-if)#no shut
3. Renew network configuration on Workstation
  - a. C:\ipconfig /renew

## Configure WAN Interfaces (fastethernet 0)

### ◦ Configure the Fast Ethernet WAN Interface

Perform these steps to configure the Fast Ethernet interfaces, beginning in global configuration mode.

	Command	Purpose
<b>Step 1</b>	<p><i>interface type number</i></p> <p><b>Example:</b></p> <p>CEx (config)# <b>interface fastethernet 0</b></p> <p>CEx (config-int)#</p>	<p>Enters the configuration mode for a Fast Ethernet WAN interface on the router.</p> <p><b>Note</b> Fast Ethernet WAN ports are numbered 0-1 on the Cisco 1800 series routers.</p>
<b>Step 2</b>	<p><b>ip address ip-address mask</b></p> <p><b>Example:</b></p> <p>CEx (config-int)# <b>ip address 192.168.1.1x 255.255.255.0</b></p> <p>CEx (config-int)#</p>	<p>Sets the IP address and subnet mask for the specified Fast Ethernet interface.</p>
<b>Step 3</b>	<p><b>no shutdown</b></p> <p><b>Example:</b></p> <p>CEx (config-int)# <b>no shutdown</b></p> <p>CEx (config-int)#</p>	<p>Enables the Ethernet interface, changing its state from administratively down to administratively up.</p>
<b>Step 4</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <p>CEx (config-int)# <b>exit</b></p> <p>CEx (config)#</p>	<p>Exits interface configuration mode and returns to global configuration mode.</p>

◦ **Configure the ATM WAN Interface (optionally, no connection testing)**

The Cisco 1801 routers each have one ATM interface for WAN connection.

Perform these steps to configure the ATM interface, beginning in global configuration mode:

	Command	Purpose
<b>Step 1</b>	<p>interface <i>type number</i></p> <p><b>Example:</b></p> <p>CEx (config)# <b>interface atm0</b></p> <p>CEx (config-int)#</p>	Enters interface configuration mode.
<b>Step 2</b>	<p>ip address <i>ip-address mask</i></p> <p><b>Example:</b></p> <p>CEx (config-int)# <b>ip address 200.200.100.1 255.255.255.0</b></p> <p>CEx (config-int)#</p>	Sets the IP address and subnet mask for the ATM interface.
<b>Step 3</b>	<p>no shutdown</p> <p><b>Example:</b></p> <p>CEx (config-int)# <b>no shutdown</b></p> <p>CEx (config-int)#</p>	Enables the ATM 0 interface.
<b>Step 4</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <p>CEx (config-int)# <b>exit</b></p> <p>CEx (config)#</p>	Exits interface configuration mode and returns to global configuration mode.

#### 4. Connecting two Cisco router back-to-back for lab experiences

There are many ways to connect two Cisco 1801 routers back-to-back:

- **Connect through Ethernet ports:** use a crossover cable to directly connect the routers together through two Ethernet ports (Connecting from Fastethernet0/0 to Fastethernet0/1 on routers).
- **Connect through serial ports:** use a DCE/DTE cable to connect the serial ports.
- **Connect through auxiliary user interface (AUI) ports:** connect two routers through AUX (AUI speed up to **115.2 k bps**).
- **Connect through Network Modules:** e.g. using network module NM-1HSSI High-Speed Serial Interface (HSSI) card (speed is up to 44.736M bps).

- **Connect through WICs (WAN Interface Cards):** e.g. connect two routers using two WAN Interface cards (WIC-1T). WIC-1T is a fast serial interface card, and the speed is up to 1.544 M. Configuration commands are the same as the serial connection.

### III. Routers are connected through serial ports

#### 1. Objective:

In this lab you will configure a simple network to allow two routers to route packets between to remote networks. The text that is in bold is the text you need to type during the lab.

Requirements:

- Two Cisco routers 2600 series with one Ethernet port and one serial port.
- Cisco IOS 10.0 or higher
- One PC for consoling into routers with terminal emulation software (Putty)
- One serial cable
- One Cisco rollover cable

#### 2. Setup:

**Step 1: Physical Connections Connect the following interfaces:**

- Console: Connect your PC/terminal to the console port using a rollover cable and Putty (9600-8-N-1-no flow)
- Ethernet: Connect Ethernet ports to a Cisco switch 2960 using a straight-through cable. Use a cross-over cable if going directly from the PC's NIC to the Ethernet (AUI) port on the router using a transceiver.
- Serial: If going directly between two routers, don't forget to connect one port via the DTE cable and the other via the DCE cable.

**Step 2: Boot up the routers**

Just say "no" to use the setup mode (setup dialogue). The setup mode will only allow you to configure the router with the basic features and not with any advanced features. If asked if you would like to terminate the auto configuration; say "yes". Let the routers finish booting.

**Step 3: Route basic configuration**

Begin your configuration with the host name and passwords. This is to remind you of what router you are configuring and now's the time to start thinking about router security.

- **Router CE0**

```
router>en
```

```
router#config t (Enter configuration commands, one per line. End with CNTL/Z)
```

```
router(config)#hostname CE0 (Sets the router's name)
```

```
CE0(config)#enable secret NetLab@routerx (Sets the secret password for the router)
```



CE0(config)#line vty 0 4 (There are five concurrent connections for the telnet ports coming into a Cisco 2600 router. We are setting the login password on all five of them)

CE0(config-line)#login (This enables the router to require a login password for a telnet session to the router)

CE0(config-line)#password **NetLab@routerx** (This sets the login password for all 5 telnet sessions coming into the router as *NetLab@routerx*)

CE0(config-line)#exit

CE0(config)#^Z (This is the key combination of control+z which takes you back to the privileged executive mode)

CE0#copy running-config startup-config or CE0# copy run start or CE0#wr me (short for write memory)

CE0#

- **Router CE6**

router>en

router#config t (Enter configuration commands, one per line. End with CNTL/Z)

router(config)#hostname CE6 (sets the router's name)

CE6(config)#enable secret **NetLab@routerx** (Sets the secret password for the router)

CE6(config)#line vty 0 4 (There are five concurrent connections for the telnet ports coming into a Cisco 2600 router. We are setting the login password on all five of them)

CE6(config-line)#login (This enables the router to require a login password for a telnet session to the router)

CE6(config-line)#password NetLab@routerx (This sets the login password for all 5 telnet sessions coming into the router as *NetLab@routerx*)

CE6(config-line)#exit

CE6(config)#^Z (This is the key combination of control+z which takes you back to the privileged executive mode)

CE6#copy running-config startup-config or CE6# copy run start or CE6#wr me (short for write memory)

#### **Step 4: Adding IP addresses**

Adding IP addresses is a basic function of configuring routers. Below is an example of configuring both an Ethernet and serial interface. For serial interface with the DCE cable you will need to also add the clocking with the clockrate command. Get the IP addresses from the network diagram.

- **Router CE0**

CE0#config t (Enter configuration commands, one per line. End with CNTL/Z)

CE0(config)#int e0

CE0(config-if)#ip address 10.10.11.1 255.255.255.0

```
CE0(config-if)# description LAN Network for Router CE0
CE0(config-if)# no shutdown
CE0(config-if)#int s0
CE0(config-if)#ip address 192.168.10.1 255.255.255.0 (CE0 will have the serial 0 with the DCE
end of the serial cable. The other partner will have serial1 with the DTE end of the serial cable.
Check the network diagram to confirm to see who has what interface)
CE0(config-if)#clockrate 250000 (DCE interface only which is the s0 on CE0)
CE0(config-if)#no shutdown
CE0(config-if)#description Network connection to CE6
```

- **Router CE6**

```
CE6#config t (Enter configuration commands, one per line. End with CNTL/Z)
CE6(config)#int e0
CE6(config-if)#ip address 10.10.12.1 255.255.255.0
CE6(config-if)# description LAN Network for Router CE6
CE6(config-if)# no shutdown
CE6(config-if)#int s1
CE6(config-if)#ip address 192.168.10.2 255.255.255.0
CE6(config-if)#no shutdown
CE6(config-if)#description Network connection to Router CE0
```

Once both routers are configured properly, you should be able to use the ping command and ping the interface e0 on each of the routers from the neighboring router. If you do a ***show ip route*** on both routers and do not see the directly connected interfaces in the routing table, they are either not configured or they never came up. Confirm that the IP addressing took and the interfaces came up by using the ***show ip int*** and looking at the interfaces' status and ip address configuration.

Ex: CE0# show ip route or CE0# show ip int

Do this on both routers.

### **Step 5: Adding Dynamic Routing: RIP**

For this router to participate in a dynamic routing using a dynamic routing protocol like RIP or IGRP, you'll need to enable a routing protocol and advertise the directly connected networks that want advertised. We only advertise the classful network address, not the subnet mask of the network.

- **Router CE0**

```
CE0>en
CE0#config t (Enter configuration commands, one per line. End with CNTL/Z)
CE0(config)#router rip
```

```
CE0(config-router)#network 192.168.10.0
```

- **Router CE6**

```
CE6>en
```

```
CE6#config t (Enter configuration commands, one per line. End with CNTL/Z)
```

```
CE6(config)#router rip
```

```
CE6(config-router)#network 192.168.10.0
```

Note: We need to advertise the network, not any particular host. An example of that would be enabling RIP on CE6. We want the other router (CE0) to know that any packet destined for the network 10.10.12.0 can be sent to CE6 which has a directly connected in it's routing table showing what interface to send the packet to; in this case its fe0. Test your configuration to ensure that it is configured properly by pinging from router to router. Check your routing table for entries that are preceded by a capital letter "R" to ensure that you are receiving routing updates using RIP. Ensure that your partner has finished configuring his router so that you can receive his updates. No updates, no ping. Do a ***show ip protocols*** to see what routing protocol is configured on the routers.

### Step 6: Adding Default Routes

Good candidates for default routes are routers which are known as the boundary router. This is a router which is normally part of a stub network. Inside the stub network, the routers may be participating in a dynamic routing using a protocol like RIP, but only a static default route is needed to connect the stub network to the Internet.

- **Router CE0**

```
CE0>en
```

```
CE0#config t
```

```
CE0(config)#ip route 0.0.0.0 0.0.0.0 192.168.10.2
```

- **Router CE6**

```
CE6>en
```

```
CE6#config t
```

```
CE6(config)#ip route 0.0.0.0 0.0.0.0 192.168.10.1
```

### Step 7: Adding Static Routes

A static route can be used for different reasons. One reason may be for a router to connect to another router in a lab. You'll need to turn off all routing protocols before you configure the router for static routing.

- **Router CE0**

```
CE0>en
```

```
CE0#config t
CE0(config)#no router rip
CE0(config)#ip route 10.10.12.0 255.255.255.0 192.168.10.2
```

What we are saying here is: For CE0 to route to the network 10.10.12.0/24, go to the next hop interface which is the serial1 (192.168.10.2) attached to CE6. Since CE6 knows about the directed connected Ethernet network of 10.10.12.0, it will have route for it in its routing table proceeded by the letter "C". (See next example)

```
CE6#sh ip route
(Output omitted)
10.10.12.0/24 is subnetted, 1 subnets
C 10.10.12.0 is directly connected, Ethernet0
```

- **Router CE6**

```
CE6>en
CE6#
CE6#config t
CE6(config)#no router rip
CE6(config)#ip route 10.10.11.0 255.255.255.0 192.168.10.1
```

### **Step 8: Testing and Monitoring**

At this point, it is a good idea to start testing your network using various commands. Perform the following on both routers.

```
CE0# show ip route
CE0# show ip interface brief (This command shows the IP and status of all interface)
CE0# show controller s0 (Shows whether or not the serial cable is DCE or DTE.)
CE0# ping ip-address
CE0# trace ip-address
CE0# debug ip rip (Remember to turn debug off when done, use undebug all, no debug all or unall)
CE0# terminal monitor (for using debug from a telnet session, otherwise debug output will go to the console. Caution: This will cause the debug output to go to all telnet sessions on the router.)
```

### **Show commands**

```
CE0#terminal no monitor(To turn off monitoring during a telnet session.)
CE0#show cdp neighbors
CE0#show ip protocols
CE0#show version
CE0#show flash
```

CE0# show ip route (shows the routing table)

CE0# show memory

CE0# show stacks

CE0# show buffers

CE0# show arp

CE0# show processes

CE0# show processes cpu

CE0# show tech-support

### **Step 9: Finishing up**

Once you have your routers up and working you may wish to run some commands to make working on Cisco routers easier and to stop some of the default annoying behavior of Cisco routers.

CE0(config)# no service-config

(When you reboot a Cisco router, the default behavior is to try and find a configuration file on the network using a number of methods over a broadcast address of 255.255.255.255. To stop this annoying behavior, Use this command)

CE0(config)#no logging console

(Each time you leave one level of the router and return to the previous level or bring an interface up, you get a read out on the console screen. If you get busy typing and configuring the router this can be distracting and annoying. Use this command to stop the logging of messages to the console screen)

And don't forget to...

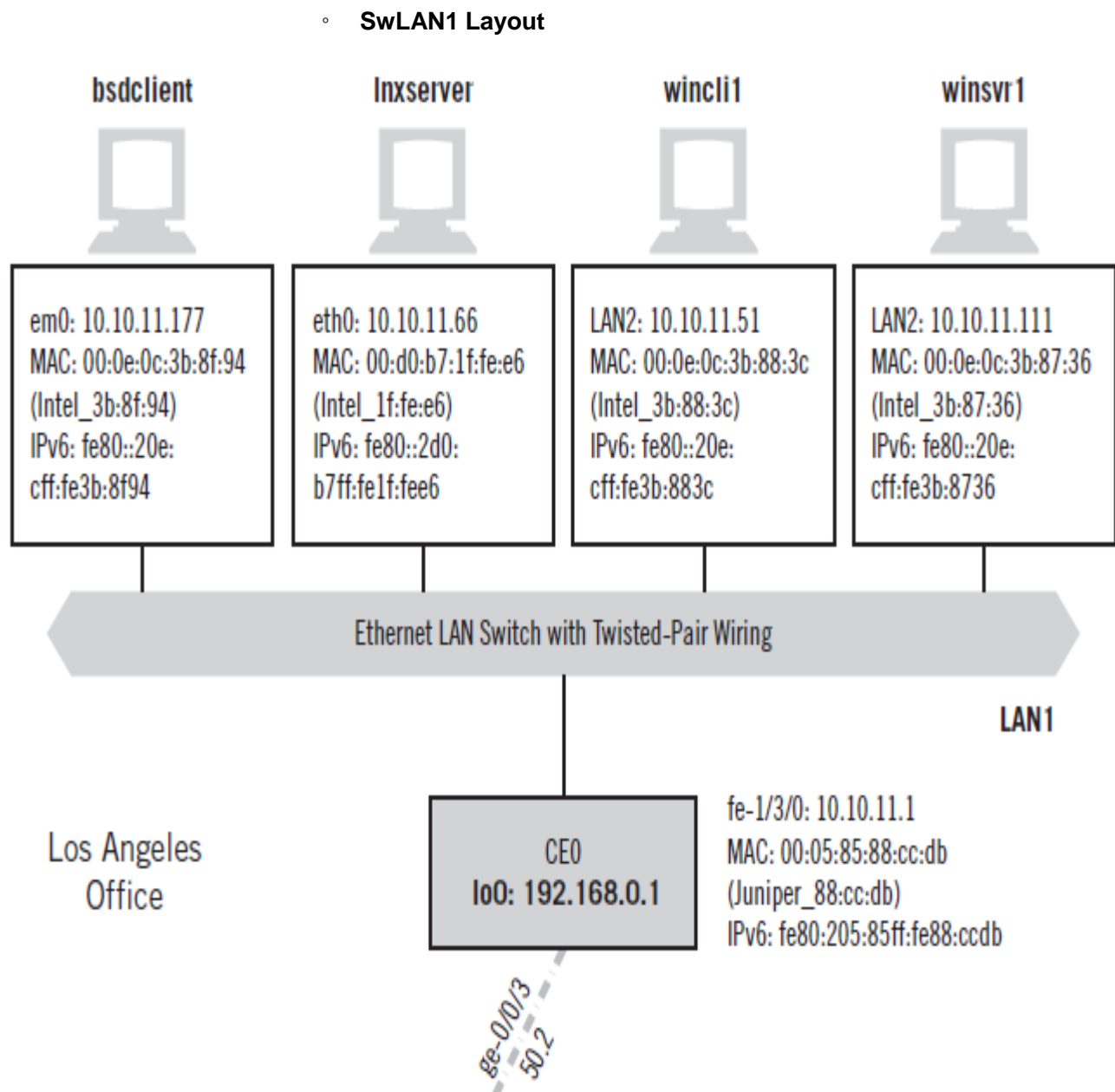
CE0# show running-config

CE0# copy running-config startup-config

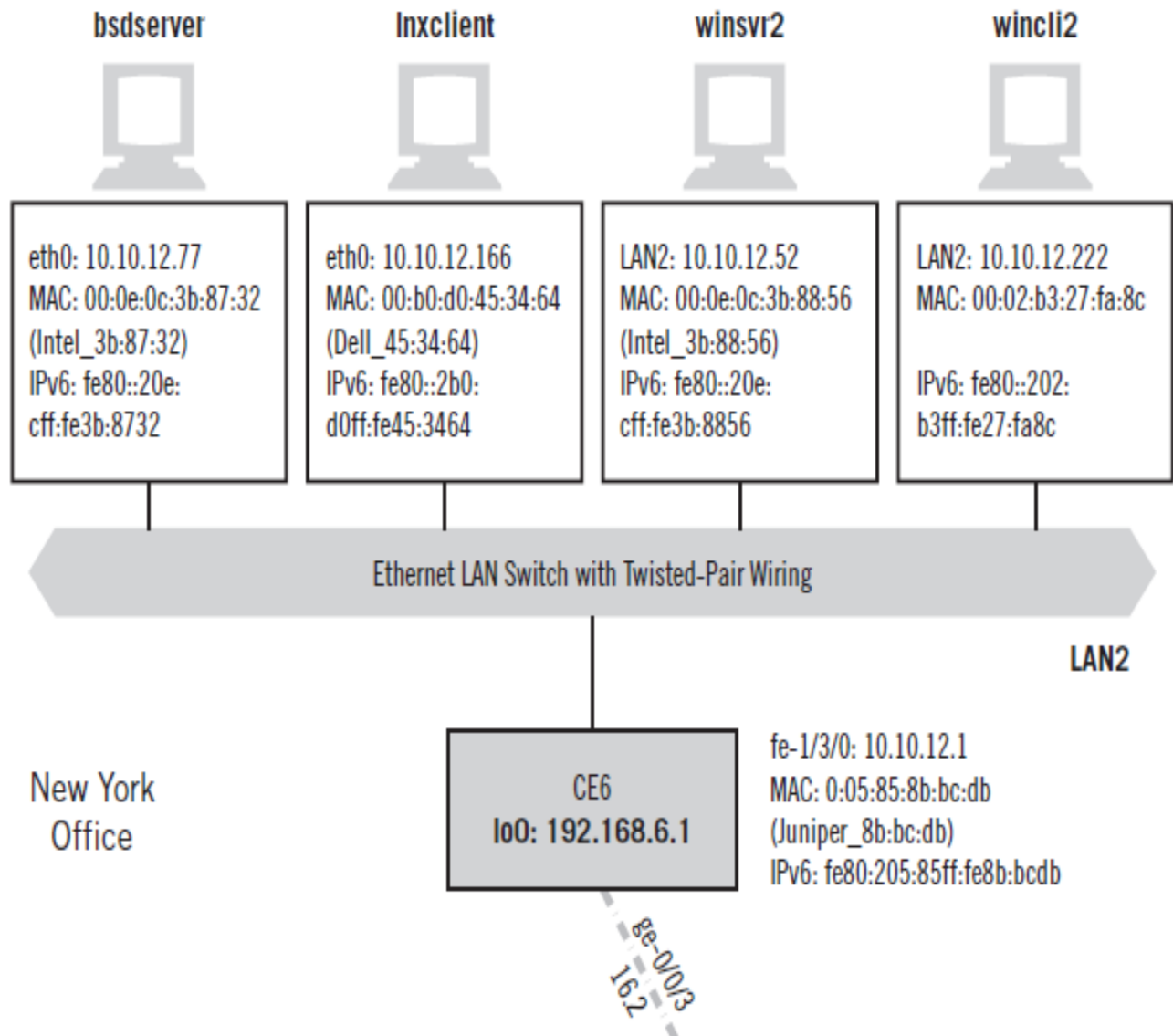
## IV. Lab Practice

**Note:** Each step, you have to type: `device#copy running-config startup-config` for saving the running configuration to NVRAM

### 1. Network Layout



◦ **SwLAN2 Layout**



## 2. Lab steps

### (a) Reset all devices to factory default if it's not

[Switch 2960]

Through either a physical console or a Telnet connection

```
Switch# write erase
Switch# reload
```

[Router 1801]

1. Check the configuration register on the router by issuing the **show version** command.

The configuration register setting is displayed in the last line of the show version command output and should be set to 0x2102. If this is not the case, enter the config-register 0x2102 command once in global configuration mode.

```
router#configure terminal

router(config)#config-register 0x2102

router(config)#end

router#
```

2. Erase the current start-up configuration on the router with the **write erase** command.
3. Reload the router with the **reload** command. When prompted to save the configuration, **DO NOT** save.

```
router#reload
```

System configuration has been modified. Save? [yes/no]: **n**

Proceed with reload? [confirm]

4. Once the router reloads, the System Configuration Dialog appears.

```
--- System Configuration Dialog ---
```

Would you like to enter the initial configuration dialog? [yes/no]: **n**

5. The router is now reset to the original factory defaults.

### (b) Creating two LANs on each Cisco Router 1801

- Based on the Network Layout, one group sets up SwLAN1 Layout and another of the same column the SwLAN2 Layout by using 4 PCs connected to Cisco Router 1801.
- All Fast Ethernet LAN Interfaces on your router are automatically configured as part of the default VLAN 1. You have to configure these ports belong to new VLAN 1x and set up new VLAN address as 10.10.1x.1 (x = 1 or 2).
- Configure the Cisco router 1801 acting as a DHCP server, whose pool will be on 10.10.11.0/24 or 10.10.12.0/24 subnet.



- Renew DHCP configuration on each PC or restart the computer.

**(c) Setting up a router-to-router connection back-to-back**

- Through the asynchronous AUX ports with the help of a null modem cable (rollover cable) (not available, actually).
- Through the serial port with DCE/DTE cables (not available, actually).
- Cascading two routers by a straight cable on Ethernet ports. (Static Routing method is using).
  - Router(config)#ip route 192.168.1.11 255.255.255.0 192.168.1.12

Choose what that match your networking configuration kit?

**(d) Test connectivity (*pinging*) from a host on SwLAN1 to a host SwLAN2, CE6 and CE0.**

**(e) *Traceroute* from a host on SwLAN1 (wincli1) to a host on SwLAN2 (winsvr2).**

**(f) Finish your work by reporting your network status and explaining your solution on place.**