The University of Jordan, Comp. Eng. Dept.
Networks Laboratory: Laboratory 1
Network Cabling and Devices and Packet Tracer
(Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Experiment 1: Examining network setting:

Tip: To complete all parts of this experiment, your computer needs to be connected to the Internet.
To do so, perform the following steps:

- Go to network and internet settings, choose change adapter options.
- Double click on Ethernet, then go to properties.
- Select internet protocol version 4(TCP/IPv4), then go to properties.
- Select "Obtain an IP address automatically".

To this extent and based on the network troubleshooting section discussed in the handout of this experiment, perform the following please:

1) Fill the following table with the correct values using the correct commands in the command prompt of your PC.

Field	**Address**
MAC Address	
IPv4 Address	
Subnet Mask	
Default Gateway	
DNS Server	
DHCP Server	

2) Use the appropriate commands to fill the following table with IP address and the status of ICMP messages.

URL	**IP address**	**The status of ICMP messages** **(Succeeded → 4/4, Failed→ 0/4, Partially Succeeded → X/4)**
www.cisco.com		
www.google.com		
www.ju.edu.jo		

3) Display all entries in ARP cache, what is the command used to accomplish this task, and show the results to your lab supervisor. Delete the content of ARP cache. What was the command being used?
4) Ping your partner's PC, check his/her IP address in your ARP cache, also maintain his/her MAC address, and discuss with the lab supervisor the process of ARP mapping.

Field	**address**

IP address	
MAC address	

5) Ping the default gateway of your PC, and fill the IP and MAC addresses of the default gateway.

Field	**address**
IP address	
MAC address	

Experiment 2: Building a network topology using Packet Tracer:

Tip: Before you start working on Packet Tracer, you have to disconnect the Internet on your PC. Follow the same steps mentioned in experiment 1 to obtain an IP address and subnet mask statically rather than automatically. Ask your lab supervisor for the IP address.

In this experiment, you are asked to build the network topology shown in the figure below. The following is the procedure that you must follow:

1) Use the components located in the network component box to select the PCs, router, switches, and the appropriate cables to connect different devices. Note: select router 1941 and switch 2960.
2) Use the addressing table, shown below, to assign the IP addresses, subnet masks of PC A and PC B.

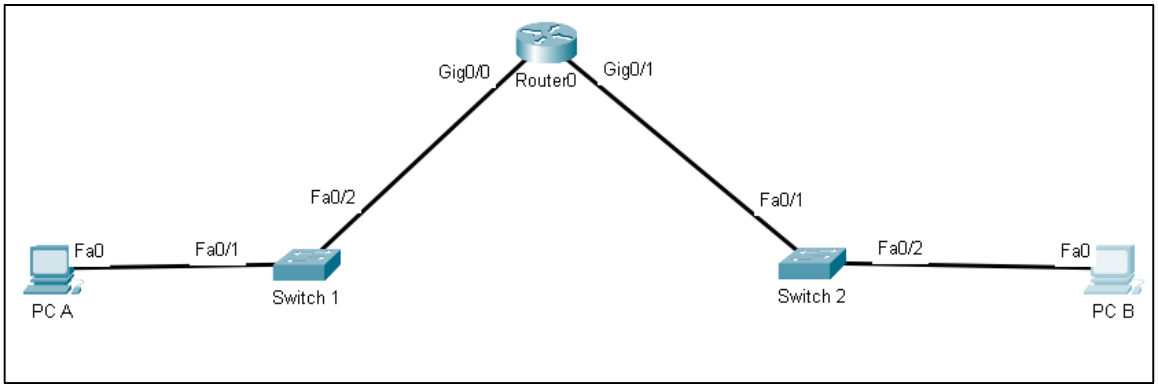


Table 1: Addressing table for the network topology.

Device	Interface	IPv4 address	Subnet Mask	Default Gateway
Router 0	**G0/0**	**172.16.0.1**	**255.255.0.0**	**-**
	G0/1	**172.17.0.1**	**255.255.0.0**	**-**
PC A	**Fa 0**	**172.16.0.2**	**255.255.0.0**	**172.16.0.1**
PC B	**Fa 0**	**172.17.1.2**	**255.255.0.0**	**172.17.0.1**

3) After that, you must verify the connectivity:

3.1. Try to ping the default gateway of PC A (you may ping from command prompt of PC A or using the PDU message).

3.2. Try to ping the default gateway of PC B (you may ping from command prompt of PC A or using the PDU message).

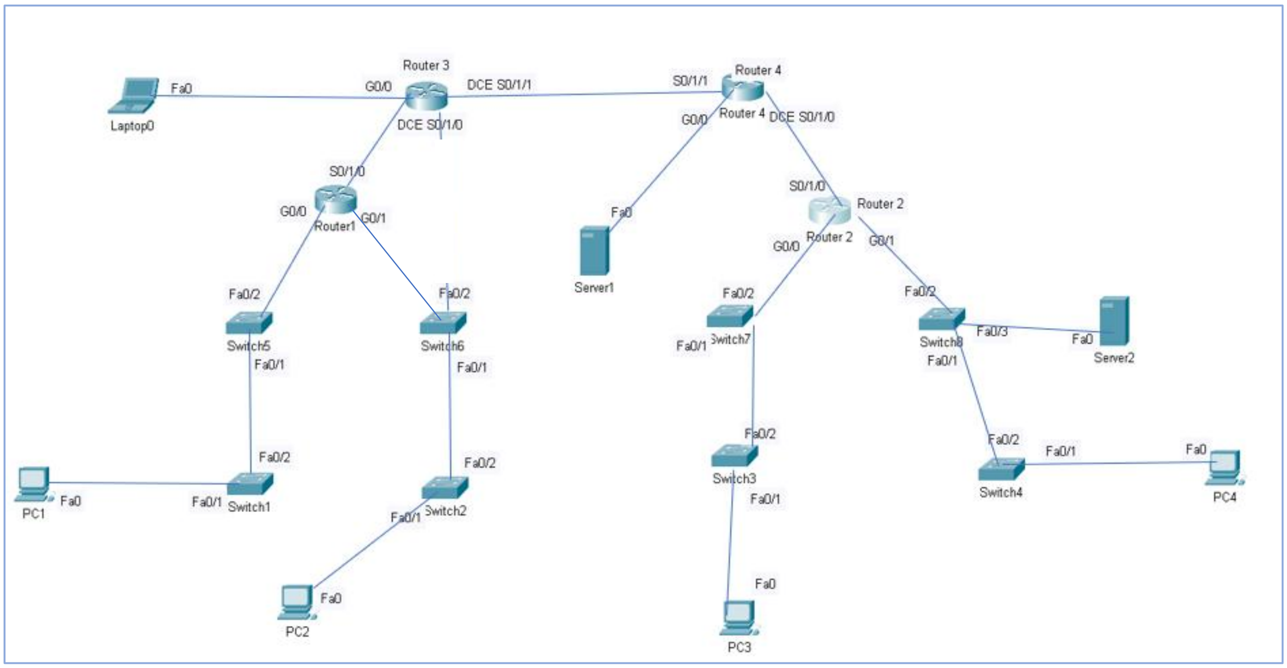
3.3. Try to ping PC A on PC B command prompt. Was the ping successful? If not, why?

4) To this extent, configure the default gateways of the PC's and router interfaces.
5) After that, you must verify the connectivity:

5.1. Try to ping the default gateway of PC A (you may ping from command prompt of PC A or using the PDU message).
5.2. Try to ping the default gateway of PC B (you may ping from command prompt of PC A or using the PDU message).
5.3. Try to ping PC A from PC B command prompt. Was the ping successful? If not, why?

Experiment 3: Connecting devices with the appropriate link type:

Open the "Lab_1_Experiment_3.pka" file. In this activity, you are given a network topology with different kinds of devices (PCs, servers, switches, and routers), as shown in the figure below. In this activity, you are requested to connect the devices using the appropriate link types and turn the router interfaces on and other turned-off devices so you can get a 100% completion rate.

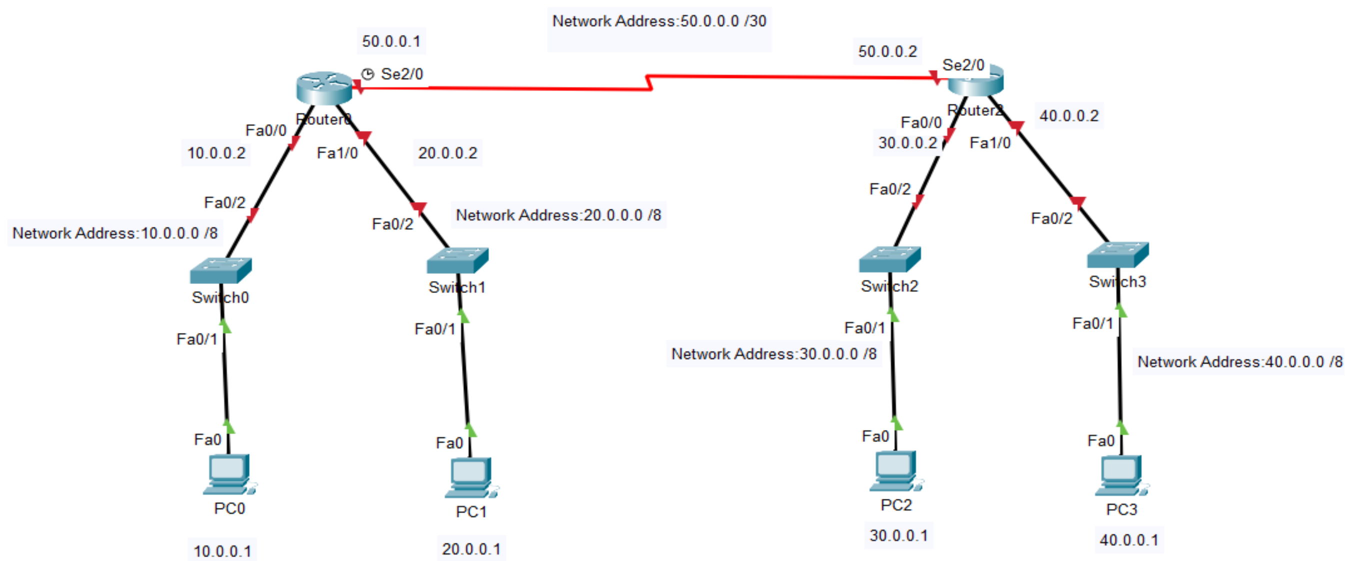


Experiment 4: Connecting devices, configuring IP addresses and routing protocols:

Open "Lab_1_Experiment_4. pka" file using the Packet Tracer, which contains the network topology, shown below. Then, you are required to do the following tasks:

- Check the addressing table below to perform the tasks.

Device	Interface	IP address	Subnet mask	Default gateway
Router 0	Fa0/0	10.0.0.2	255.0.0.0	-
	Fa1/0	20.0.0.2	255.0.0.0	-
	Se2/0	50.0.0.1	255.255.255.252	-
Router 2	Fa0/0	30.0.0.2	255.0.0.0	-
	Fa1/0	40.0.0.2	255.0.0.0	-
	Se2/0	50.0.0.2	255.255.255.252	-
PC0	Fa0	10.0.0.1	255.0.0.0	10.0.0.2
PC1	Fa0	20.0.0.1	255.0.0.0	20.0.0.2
PC2	Fa0	30.0.0.1	255.0.0.0	30.0.0.2
PC3	Fa0	40.0.0.1	255.0.0.0	40.0.0.2



- Configure the IP address, subnet mask, and default gateway settings on PC0, PC1, PC2, and PC3.
- Configure and activate the interfaces on **Router 0 using CLI.**
- Configure the **clock rate with the value 64000** on the DCE serial of Router 0, using the following command:

```
Router0>enable
Router0#
Router0#configure terminal
Enter configuration commands, one per line.  End with
CNTL/Z.
Router0(config)#interface Serial2/0
Router0(config-if)#clock rate 64000
Router0(config-if)#
```

- Configure and activate the RIP on **Router 0 using the CLI,** use the following commands.

```
Router(config)#router rip
```

```
Router(config-router)#network [network address]
Router(config-router)#
```

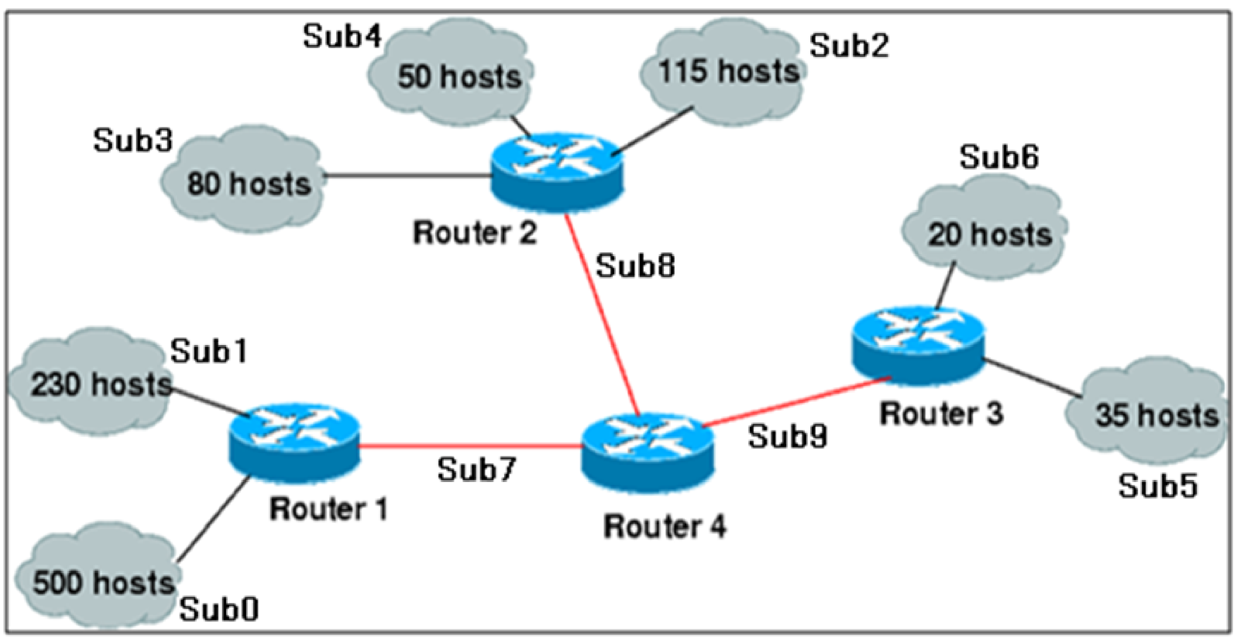
- Configure and activate the interfaces on **Router 2 using the Wizard.**
- Configure and activate the RIP on **Router 2 using the Wizard.**
- Ping PC2 from a command prompt window on PC0. Were the pings successful?
- Ping PC0 from a command prompt window on PC3. Were the pings successful?
- After completing the work, check the completion rate. It should be 100%.

The University of Jordan, Comp. Eng. Dept.
Networks Laboratory: Laboratory 2
IP Addressing: Version 4
(Laboratory Sheet): Two Experiments

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Experiment 1: Subnetting:

In this activity, you are given a network topology with different kinds of devices (PCs and routers), as shown in the figure below. In this activity, you will be asked to implement subnetting for the network topology depicted in the figure below. You must configure the PCs and routers interfaces with the correct IP addresses, which are obtained after applying subnetting for the given network number. After that, you should enable the RIP v2 routing protocol with the correct network address (i.e., subnet network address) to check the connectivity of your network and make sure that each device can reach another without any problems. You can check the correctness of your work by getting a 100% completion rate.



You must follow the following instructions to complete the task:

- You have been given the **182.16.0.0/19** address space to use in your network design. The plan should have equally sized subnets taking into account that the remaining host bits after subnetting can accommodate the subnet that has the largest number of hosts.
- Fill in the table below with addresses based on the subnetting rules addressed in the handout for this experiment.

Table 1. Addressing table for the subnetting problem_1

Subnet #	Network Address	Prefix length	Subnet mask	First assignable address	Last assignable address	Broadcast Address
Subnet 0	182.16.0.0					
Subnet 1						
Subnet 2						
Subnet 3						
Subnet 4						
Subnet 5						
Subnet 6						
Subnet 7						
Subnet 8						
Subnet 9						

- Open the "Lab_2_Experiment_1.pka" file. After you are done with that, complete it with the correct configurations and address assignments to PCs and routers interfaces according to the following specifications.

  1. **For each LAN interface (i.e., Subnet 0, Subnet 1, Subnet 2, Subnet 3, Subnet 4, Subnet 5, and Subnet 6):**
     - ✓ LAN interface is the connection between the PC and the router.
     - ✓ Each LAN is represented by a single PC to simplify the network topology.
     - ✓ Assign the first valid host address in each subnet to the LAN interface of each Router.
     - ✓ Assign the last valid host address in each subnet to the PC in the corresponding subnet.

  2. **For each WAN interface (Subnet 7, Subnet 8, and Subnet 9):**
     - ✓ WAN interface is the connection between two routers.
     - ✓ Assign the first valid host address in each subnet to the DCE WAN interface on the router.
     - ✓ Assign the last valid host address in each subnet to the DTE WAN interface on the router.

- On each router in the topology, **configure the RIP v2 routing protocol** based on the network address of the directly connected networks.
- Test connectivity between all LANs to ensure that the network is operating properly.
  - ✓ Ping 35 Hosts PC from 500 Hosts PC.
  - ✓ Ping 230 Hosts PC from 50 Hosts PC.

- You are required to assign the **clock rate to 64000** to the DCE serial interface.

Experiment 2: CIDR

- You have been given the **200.87.0.0/21** address space to use in your network design. Perform CIDR to minimize the number of routing entries that each router will advertise. Consider that the default gateway IP addresses of the hosts (i.e., the routers' LAN interfaces) are excluded from the hosts' number.
- Fill in the table below with addresses based on the CIDR rules addressed in the handout for this experiment.

Table 2. Addressing table for the CIDR problem_2

Subnet #	Addresses Required	Number of required bits for hosts	2 ^ (Number of required bits for hosts)	CIDR notation	Subnet mask	Network ID	Broadcast ID	Hosts range

- Open the "Lab_2_Experiment_2.pka" file. After you are done with that, complete it with the correct configurations and address assignments to PCs and routers interfaces according to the previous specifications for LAN and WAN interfaces mentioned in the Problem 1.
- On each router in the topology, **configure the RIP v2 routing protocol** based on the network address of the directly connected networks.
- Test connectivity between all LANs to ensure that the network is operating properly.
- You are required to assign the **clock rate to 64000** to the DCE serial interface.

The University of Jordan, Comp. Eng. Dept.
Networks Laboratory: Laboratory 3
IP Addressing: Version 6
(Laboratory Sheet): Two Experiments

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

<u>Experiment 1:</u> Configuring IPv6 Addressing - Subnetting

- Your ISP has given you the IPv6 prefix 2000:ABDF:9C2:5000/52 to be used in building the network of the University of Jordan. Tip: The subnets' numbers should start from 1.
- Consider the following scenario, as shown in Figure 1 (a) and (b), which helps you practice configuring IPv6 subnetting on routers and PCs, followed by the addressing table for each device interface, as shown in Table 1.
- In this activity, you are required to fill the IPv6 addressing table after performing the subnetting for routers' interfaces and PCs based on what you've learned about IPv6 subnetting and the IPv6 prefix provided.
- You are required to assign the PCs the second valid address of the subnet and the router interface (i.e., default gateway) the first valid address of that subnet.
- You are required to assign the DEC serial interface the first valid address of the subnet and the DTE serial interface the second valid address of that subnet (if any) taking into account that all DTE interfaces, in this experiment, are not required to be assigned any address while all interfaces' statuses are to be configured "ON".
- You are required to assign the **clock rate to 64000** to the DCE serial interface.
- Follow these steps to configure **the routers interfaces**:
    - ✓ Enable the "**ipv6 unicast-routing**" global configuration command on each router (i.e., University of Jordan, School of Science, School of Engineering, School of Business, School of Law, and Computer Department).
    - ✓ On each interface of the routers (i.e., GigabitEthernet0/0 and GigabitEthernet0/1), you must do the following:
        - o Configure the IPv6 address with the correct prefix length based on the address you filled in Table 1.
        - o Configure the IPv6 link-local address as shown in the table below.
        - o Enable the interface.
    - ✓ For University of Jordan router' serial interfaces, activate them, and assign the IPv6 address, prefix length, and IPv6 link-local address for the required interfaces in the activity.
    - ✓ For other routers' serial interfaces, only activate them.
- Configure the PCs with the correct IPv6 addresses, prefix lengths, and IPv6 link-local addresses, as shown in the handout.
- Verify the connectivity between each PC and its corresponding default gateway using the ping command, as shown in the handout.

Table 1. Required IPv6 configuration after performing subnetting.

Device	Interface	IPv6 Address	Link-local	Default Gateway	Connected with
University of Jordan	S0/0/0(DCE)		FE80::1	--	School of Science
	S0/0/1(DCE)		FE80::1	--	School of Engineering
	S0/1/0(DCE)		FE80::1	--	School of Business
	S0/1/1(DCE)		FE80::1	--	School of Law
School of Science	**S0/0/0**		**FE80::2**	**--**	**University of Jordan**
	G0/0		FE80::2	--	PC0
	G0/1		FE80::2	--	PC1
School of Engineering	**S0/0/0**		**FE80::3**	**--**	**University of Jordan**
	S0/0/1		**FE80::3**	**--**	**Computer Department**
	G0/0		FE80::3	--	PC4
	G0/1		FE80::3	--	PC5
School of Business	**S0/0/0**		**FE80::4**	**--**	**University of Jordan**
	G0/0		FE80::4	--	PC6
	G0/1		FE80::4	--	PC7
School of Law	**S0/0/0**		**FE80::5**	**--**	**University of Jordan**
	G0/0		FE80::5	--	PC8
	G0/1		FE80::5	--	PC9
Computer Department	**S0/0/0**		**FE80::6**	**--**	**School of Engineering**
	G0/0		FE80::6	--	PC2
	G0/1		FE80::6	--	PC3
PC0	Fa0		--	FE80::2	Science G0/0
PC1	Fa0		--	FE80::2	Science G0/1
PC2	Fa0		--	FE80::6	Computer G0/0
PC3	Fa0		--	FE80::6	Computer G0/1
PC4	Fa0		--	FE80::3	Engineering G0/0
PC5	Fa0		--	FE80::3	Engineering G0/1
PC6	Fa0		--	FE80::4	Business G0/0
PC7	Fa0		--	FE80::4	Business G0/1
PC8	Fa0		--	FE80::5	Law G0/0
PC9	Fa0		--	FE80::5	Law G0/1

Tip: The highlighted black cells are neither required to be filled out nor to be included in Packet Tracer configurations.

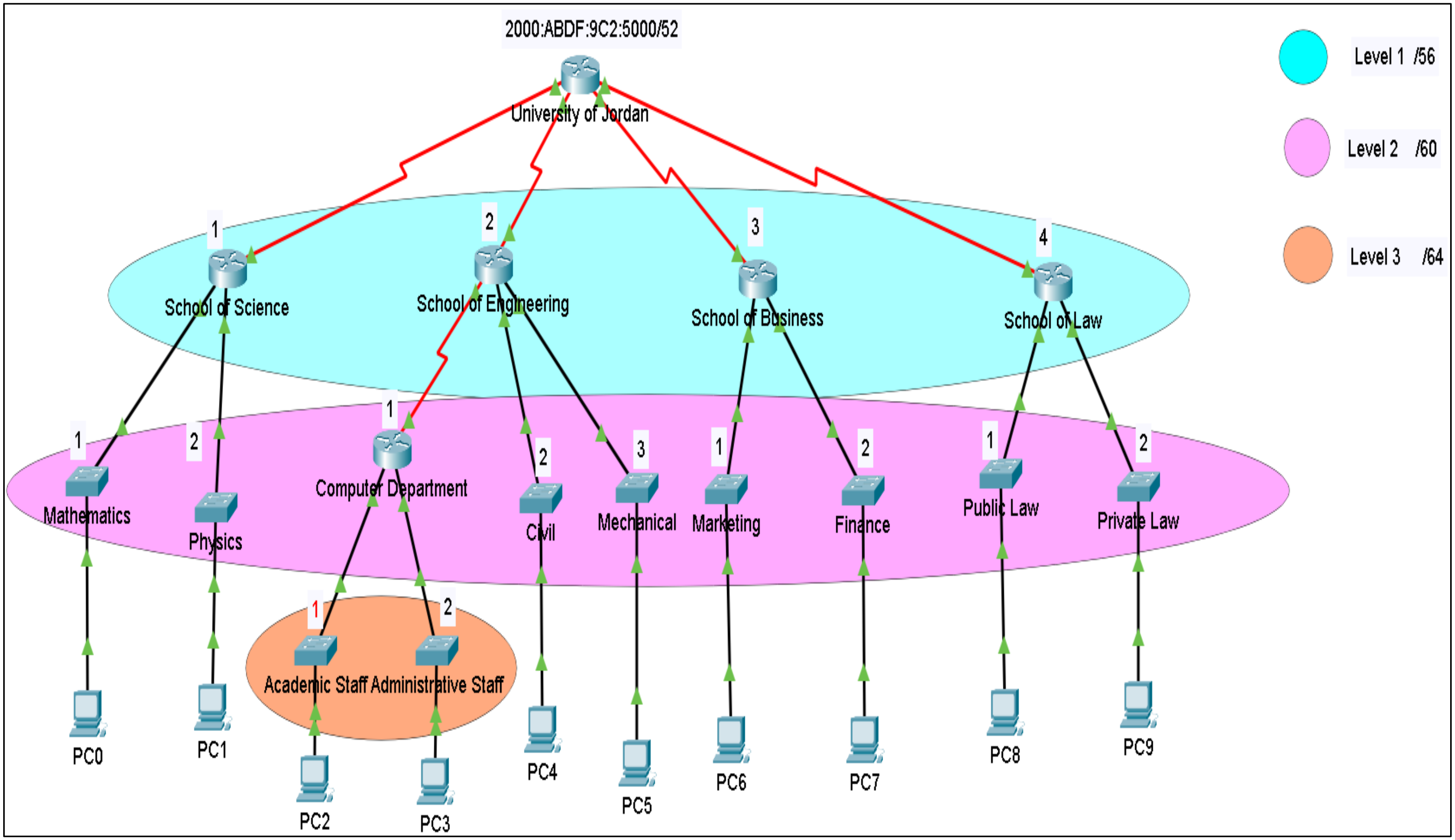


Figure 1 (a). The network topology for IPv6

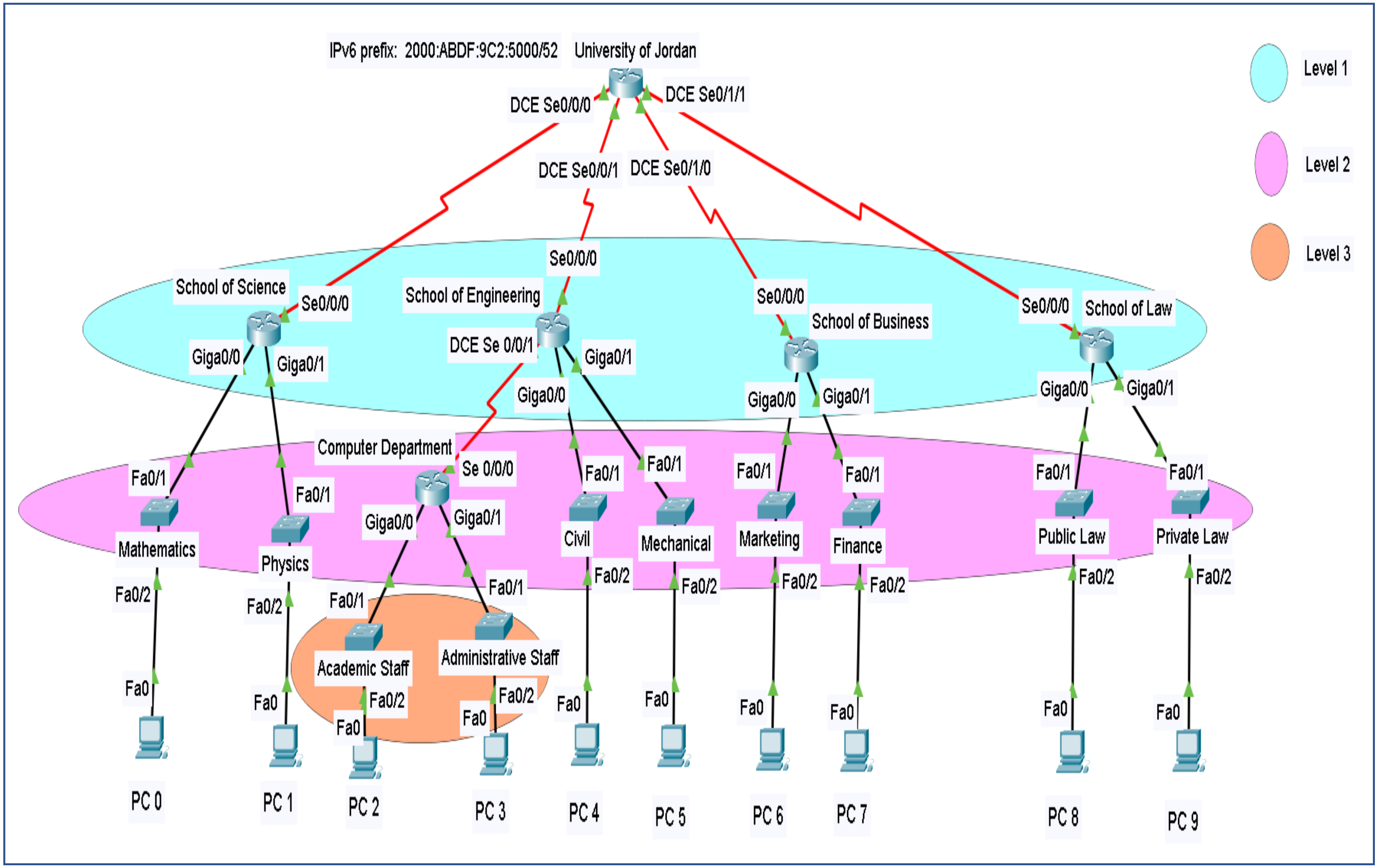


Figure 1 (b). The network topology for IPv6

<u>Experiment 2:</u> Configuring IPv6 Addressing Using EUI-64 format.

In this activity (Lab_3_Experiment_2_IPv6.pka), you will configure the IPv6 addressing for routers' interfaces, PCs, and laptops. Figure 2 represents the network topology that requires configuration. On the other hand, Table 2 shows the prefix addresses for the routers' interfaces, that should be used to complete the configuration.

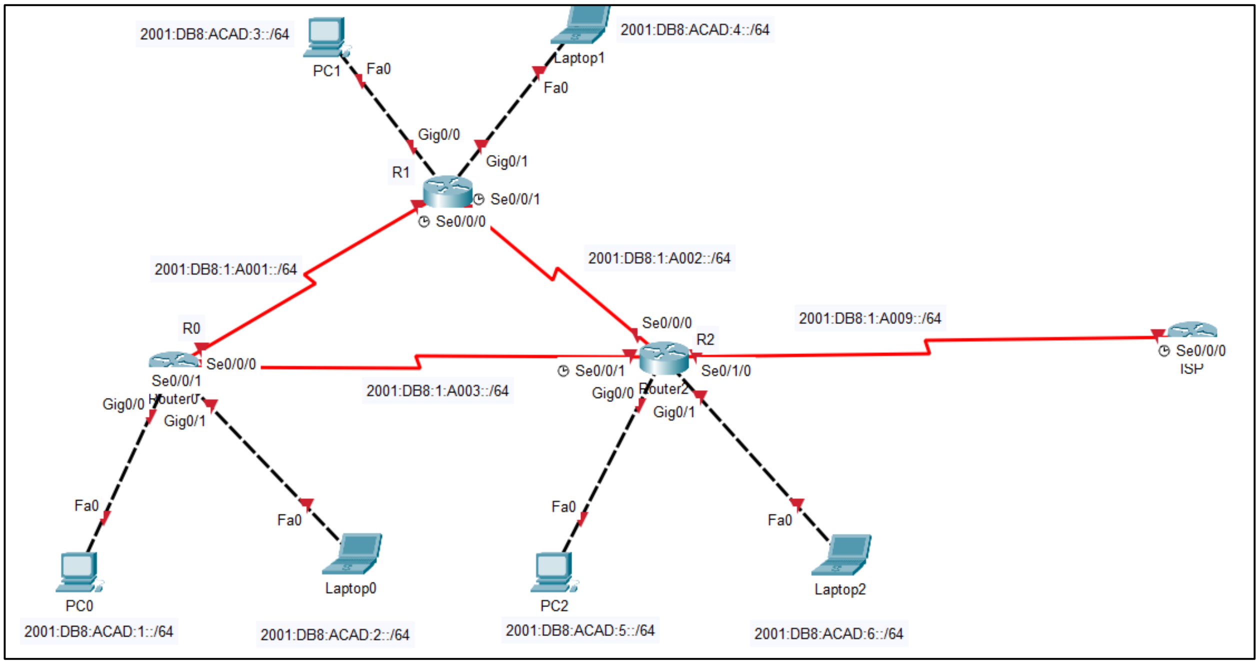


Figure 2. Network topology for Experiment 2.

Use the following instructions:

1. Enable IPv6 routing on all routers (`Router(config)#ipv6 unicast-routing`).
2. Configure the routers' interfaces with the IPv6 addresses you specified in the Addressing Table (i.e., Table 2). Tip: Use **eui-64 format global unicast address**. Follow these steps to do that:

   - ✓ You should enable IPv6 for the interfaces utilizing "`ipv6 enable`" command.
   - ✓ To configure an interface with EUI-64 format, we need firstly to reach that interface, then we will use "**ipv6 address {ipv6-address/prefix-length} eui-64**" command. For example, suppose that the IPv6 prefix and prefix-length of an interface is **2001:AAAA:BBBB:CCCC::/64**. Then, the EUI-64 interface ID is created utilizing the MAC address of that interface through having the following necessary configurations, without forgetting the activation of that interface:

```
Router(config)# interface GigabitEthernet0/0
Router(config-if)# ipv6 enable
Router(config-if)# ipv6 address 2001:AAAA:BBBB:CCCC::/64 eui-64
Router(config-if)# no shutdown
```

   - ✓ To check the IPv6 address that is created with EUI-64 format with "`show ipv6 interface brief`" command.

```
R1# show ipv6 interface brief
GigabitEthernet0/0          [up/up]
FE80::2E0:B0FF:FE0E:7701
2001:AAAA:BBBB:CCCC:2E0:B0FF:FE0E:7701
```

3. Configure the PCs for auto-configuration. Each should then automatically receive full IPv6 addresses from the routers as shown in Figure 3. To check the IPv6 of PCs, double click on the PC, go to the desktop tab and enter the command prompt. Then, print `ipv6config` to recognize the given IPv6 address to be then used for pinging purposes.

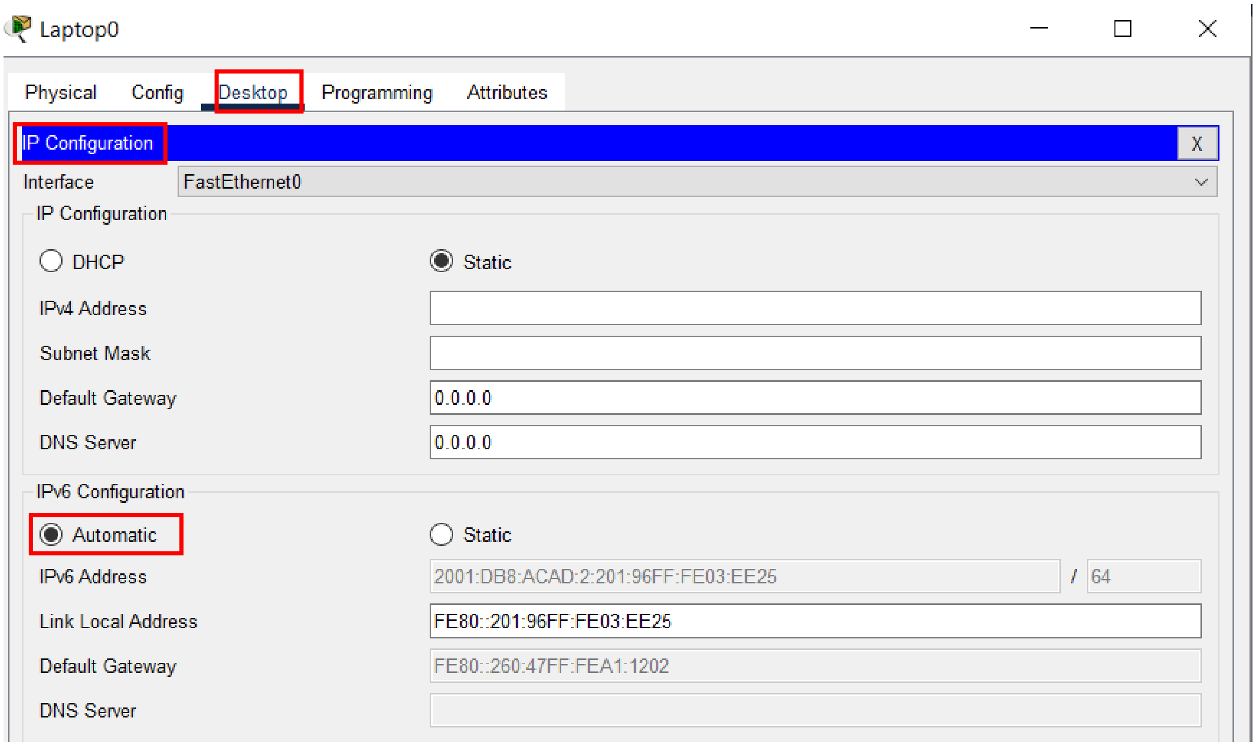


Figure 3. IPv6 configuration for the PCs and Laptops.

Table 2: Addressing table for IPv6 configuration

Device	Interface	IPv6 prefix and the prefix length	Connected with
Router 0	GigabitEthernet0/0	2001:DB8:ACAD:1::/64	PC0
	GigabitEthernet0/1	2001:DB8:ACAD:2::/64	Laptop0
	Serial0/0/0	2001:DB8:1:A001::/64	Router 1
	Serial0/0/1	2001:DB8:1:A003::/64	Router 2
Router 1	GigabitEthernet0/0	2001:DB8:ACAD:3::/64	PC1
	GigabitEthernet0/1	2001:DB8:ACAD:4::/64	Laptop1
	Serial0/0/0	2001:DB8:1:A001::/64	Router 0
	Serial0/0/1	2001:DB8:1:A002::/64	Router 2
Router 2	GigabitEthernet0/0	2001:DB8:ACAD:5::/64	PC2
	GigabitEthernet0/1	2001:DB8:ACAD:6::/64	Laptop2
	Serial0/0/0	2001:DB8:1:A002::/64	Router 1
	Serial0/0/1	2001:DB8:1:A003::/64	Router 0
	Serial0/1/0	2001:DB8:1:A009::/64	ISP
ISP	Serial0/0/0	2001:DB8:1:A009::/64	Router 2
PC0	Fa0	Auto Config	Router 0
Laptop0	Fa0	Auto Config	Router 0
PC1	Fa0	Auto Config	Router 1
Laptop1	Fa0	Auto Config	Router 1
PC2	Fa0	Auto Config	Router 2
Laptop2	Fa0	Auto Config	Router 2

The University of Jordan, Comp. Eng. Dept.
Networks laboratory: Laboratory 4
Static Routing (Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Experiment 1: Configuring IPv4 static routing

In this activity, you will configure static, summarized, and default routes for IPv4. A static route is a route that is entered manually by the network administrator to create a reliable and safe route. There are four different static routes that are used in this activity: a recursive static route, a directly attached static route, a floating route, and a default route. Figure 1 shows the topology that you need to configure.

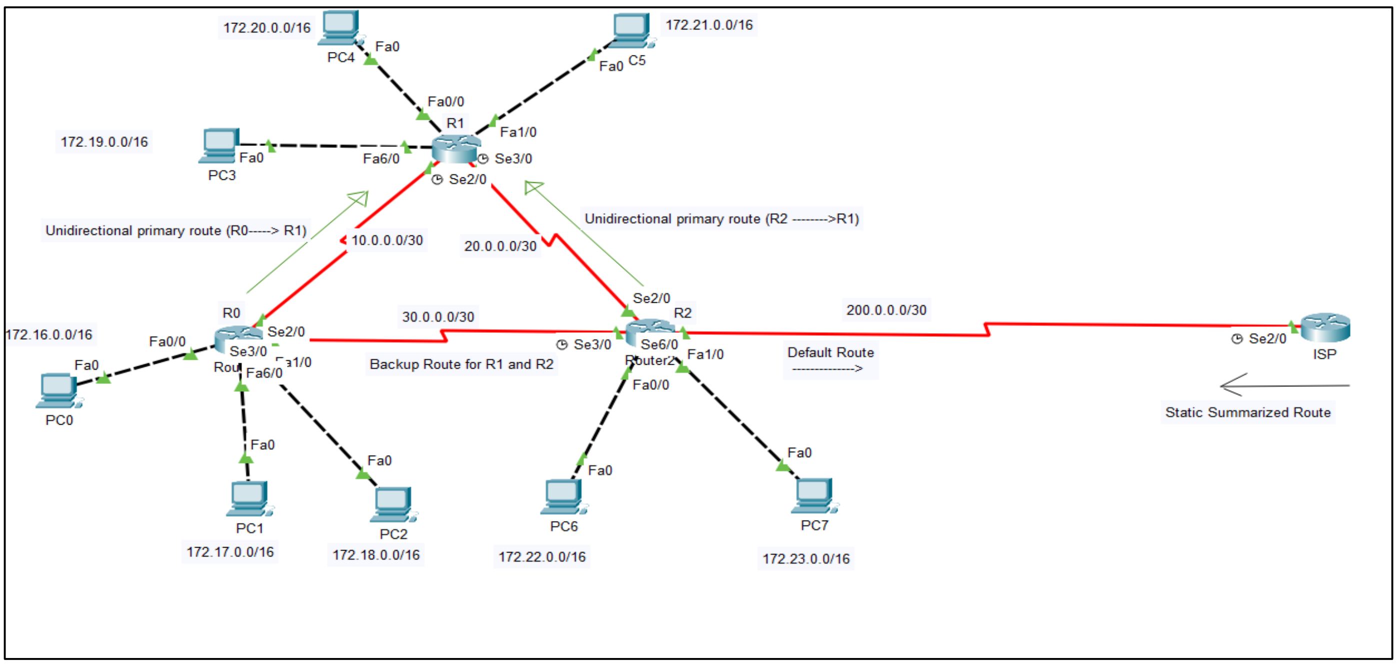


Figure 1. Network topology for experiment 1.

In this activity (Lab_4_Experiment_1_IPv4.pka), the routers' interfaces and PCs are configured for you with the addresses displayed in the addressing table (i.e., Table 1). You should use static routes to ensure full connectivity between all devices in the network. It is worth mentioning that Router 0 has a primary serial route to Router 1 whereas Router 2 has a primary serial route to Router 1. These are not bidirectional but unidirectional instead as stated in the figure above. The backup (floating) serial route will be used in case any of the primary serial routes got failed. In other words, this is only a floating route for the two unidirectional primary routes (R0→R1 and R2→R1). The Router R1 has two active serial routes (R1→R0 and R1→R2). **Please keep in mind triggering the equal load balancing mechanism to reach the network, 30.0.0.0/30, from R1 (i.e., you should configure two routes in R1 to reach that network).**

Use the following instructions:

1. Configure Routers 0 and 1 with standard static routes utilizing the directly attached static routes next-hop option (i.e., that uses only the exit interfaces).

2. Configure Router 2 with static routes using recursive static routes next-hop option (i.e., that uses only the next hop IP address).
3. As far as the ISP router is concerned, please configure static routes based on the next hop IP address bearing in mind that is a route which should be certainly summarized while the other remote networks have to be configured as the way we used to do.
4. Configure ***the default routes*** on the routers as follows: Router 0 using the exit interface (i.e., serial 2/0), Router 1 using the next hop IP address (i.e., 20.0.0.2), and Router 2 using the next hop IP address (i.e., 200.0.0.1).
5. Verify static route configurations.
6. Verify network connectivity by pinging all remote networks; every device should now be able to ping every other device. If not, review your static and default route configurations.
7. Suppose that the primary link between Router 0 and Router 1 (R0→R1) and the primary link between Router 2 and Router 1 (R2→R1) got failed for any reason. Consequently, please configure all remote networks on Router 0 and Router 2 utilizing the floating route with an administrative distance of 100 taking into account the exact use of the same procedure mentioned in the steps 1, 2, and 4.
   - ✓ Use the following command to check your configuration of the primary and floating routes (`Router#show running-config`).
   - ✓ Verify the routing table after configuration (`Router#sh ip route`).
   - ✓ Shut down the interface serial 2/0 of Router 1 and verify the routing table after doing the previous step. What do you observe?
   - ✓ Re-enable the serial 2/0 interface and recheck the routing table. What do you observe?
8. **Clue: the total number of static routes which should be configured on Routers 0, 1, 2, and ISP are 16, 9, 15, and 4, respectively.**

Table 1: Addressing table for IPv4 configuration

Device	Interface	IPv4 Address	Subnet mask	Default Gateway	Connected with
Router 0	FastEthernet0/0	172.16.0.1	255.255.0.0	--	PC0
	FastEthernet1/0	172.18.0.1	255.255.0.0	--	PC2
	FastEthernet6/0	172.17.0.1	255.255.0.0	--	PC1
	Serial2/0	10.0.0.2	255.255.255.252	--	Router 1
	Serial3/0	30.0.0.2	255.255.255.252	--	Router 2
Router 1	FastEthernet0/0	172.20.0.1	255.255.0.0	--	PC4
	FastEthernet1/0	172.21.0.1	255.255.0.0	--	PC5
	FastEthernet6/0	172.19.0.1	255.255.0.0	--	PC3
	Serial2/0	10.0.0.1	255.255.255.252	--	Router 0
	Serial 3/0	20.0.0.1	255.255.255.252	--	Router 1
Router 2	FastEthernet0/0	172.22.0.1	255.255.0.0	--	PC6
	FastEthernet1/0	172.23.0.1	255.255.0.0	--	PC7
	Serial2/0	20.0.0.2	255.255.255.252	--	Router 1
	Serial3/0	30.0.0.1	255.255.255.252	--	Router 0
	Serial6/0	200.0.0.2	255.255.255.252	--	ISP
ISP	Serial2/0	200.0.0.1	255.255.255.252	--	Router 2
PC0	Fa0	172.16.0.2	255.255.0.0	172.16.0.1	Router 0
PC1	Fa0	172.17.0.2	255.255.0.0	172.17.0.1	Router 0
PC2	Fa0	172.18.0.2	255.255.0.0	172.18.0.1	Router 0
PC3	Fa0	172.19.0.2	255.255.0.0	172.19.0.1	Router 1
PC4	Fa0	172.20.0.2	255.255.0.0	172.20.0.1	Router 1
PC5	Fa0	172.21.0.2	255.255.0.0	172.21.0.1	Router 1
PC6	Fa0	172.22.0.2	255.255.0.0	172.22.0.1	Router 2
PC7	Fa0	172.23.0.2	255.255.0.0	172.23.0.1	Router 2

Experiment 2: Configuring IPv6 static routing

In this activity, you will configure static and default routes for IPv6. A static route is a route that is entered manually by the network administrator to create a reliable and safe route. There are four different static routes that are used in this activity: a recursive static route, a directly attached static route, a floating route, and a default route. Figure 2 shows the topology that you need to configure. However, Table 2 shows the addressing table for the routes' interfaces.

In this activity (Lab_4_Experiment_2_IPv6.pka), you should use IPv6 static routes to ensure full connectivity between all devices in the network. It is worth mentioning that Router 0 has a primary serial route to Router 1 whereas Router 2 has a primary serial route to Router 1. These are not bidirectional but unidirectional instead as stated in the figure above. The backup (floating) serial route will be used in case any of the primary serial routes got failed. In other words, this is only a floating route for the two unidirectional primary routes (R0→R1 and R2→R1). The Router R1 has two active serial routes (i.e., R1→R0 and R1→R2).

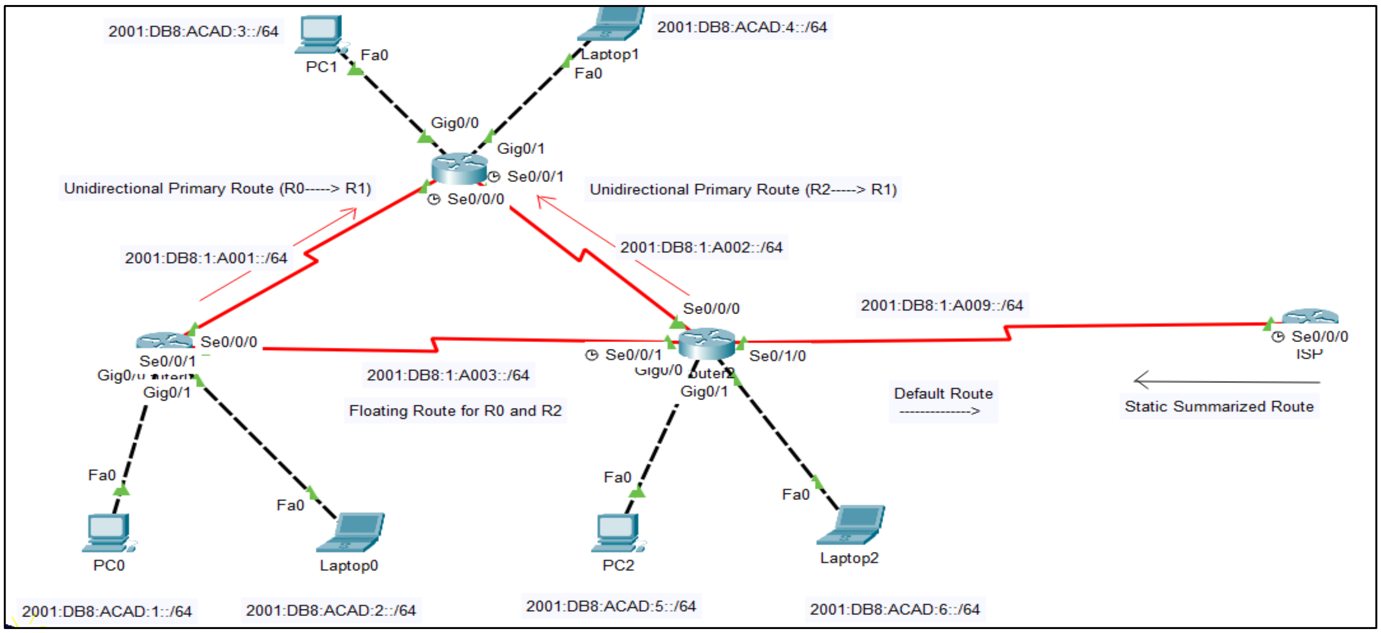


Figure 2. Network topology for experiment 2.

Use the following instructions:

1. Enable IPv6 routing on all routers (`Router(config)#ipv6 unicast-routing`).
2. Configure Routers 0, 1, and 2 with standard static routes utilizing the directly attached static routes next-hop option (i.e., that uses only the exit interfaces).
3. As far as the ISP router is concerned, please configure static routes based on the next hop IP address bearing in mind that is a route which should be certainly summarized while the other remote networks have to be configured as the way we used to do. Interestingly, to check the next hop IP address of the ISP, which is the Serial0/1/0 interface of router 2, go to the router 2, then use the following command "`show ipv6 interface brief`" command.
4. Configure a default route on Router 0 using the exit interface (i.e., serial 0/0/0), on Router 1 using the exit interface (i.e., serial 0/0/1), and on Router 2 using the next-hop IP address (i.e., 2001:DB8:1:A009:260:5CFF:FED0:709A).
5. Verify static route configurations.

6. Verify network connectivity by pinging all remote networks; every device should now be able to ping every other device. If not, review your static and default route configurations.
7. Configure the network 2001:DB8:1:A003::/64 as a remote network for Router 1 from serial 0/0/0 and from serial 0/0/1.
8. Suppose that the primary link between Router 0 and Router 1 (R0→R1) and the primary link between Router 2 and Router 1 (R2→R1) got failed for any reason. Consequently, please configure all remote networks on Router 0 and Router 2 utilizing the floating route with an administrative distance of 100 taking into account the exact use of the same procedure mentioned in the steps 4, 5, and 7.
   - ✓ Use the following command to check your configuration of the primary and floating routes (`Router#show running-config`).
   - ✓ Verify the routing table after configuration (`Router#sh ipv6 route`).
   - ✓ Shut down the interfaces serial 0/0/0 and serial 0/0/1 of Router 1 and verify the routing table after doing the previous step. What do you observe?
   - ✓ Re-enable the serial 0/0/0 and serial 0/0/1 interfaces and recheck the routing table. What do you observe?
9. **Clue: the total number of static routes which should be configured on Routers 0, 1, 2, and ISP are 14, 8, 11, and 4, respectively.**

Table 2: Addressing table for IPv6 configuration

Device	Interface	IPv6 prefix and the prefix length	Connected with
Router 0	GigabitEthernet0/0	2001:DB8:ACAD:1::/64	PC0
	GigabitEthernet0/1	2001:DB8:ACAD:2::/64	Laptop0
	Serial0/0/0	2001:DB8:1:A001::/64	Router 1
	Serial0/0/1	2001:DB8:1:A003::/64	Router 2
Router 1	GigabitEthernet0/0	2001:DB8:ACAD:3::/64	PC1
	GigabitEthernet0/1	2001:DB8:ACAD:4::/64	Laptop1
	Serial0/0/0	2001:DB8:1:A001::/64	Router 0
	Serial0/0/1	2001:DB8:1:A002::/64	Router 2
Router 2	GigabitEthernet0/0	2001:DB8:ACAD:5::/64	PC2
	GigabitEthernet0/1	2001:DB8:ACAD:6::/64	Laptop2
	Serial0/0/0	2001:DB8:1:A002::/64	Router 1
	Serial0/0/1	2001:DB8:1:A003::/64	Router 0
	Serial0/1/0	2001:DB8:1:A009::/64	ISP
ISP	Serial0/0/0	2001:DB8:1:A009::/64	Router 2
PC0	Fa0	Auto Config	Router 0
Laptop0	Fa0	Auto Config	Router 0
PC1	Fa0	Auto Config	Router 1
Laptop1	Fa0	Auto Config	Router 1
PC2	Fa0	Auto Config	Router 2
Laptop2	Fa0	Auto Config	Router 2

The End: Good Luck!

The University of Jordan, Comp. Eng. Dept.
Networks laboratory: Laboratory 5
RIPv2 and RIPng (Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Experiment 1: Configuring RIP v2 (IPv4) routing protocol

In this activity (i.e., Lab_5_Experiment_1_RIPv2.pka), you will configure the PCs and routers interfaces using CIDR for IPv4, which was discussed comprehensively in laboratory 2. Then, you are requested to configure the RIPv2 routing protocol with static and default routing for Internet access and ensure full connectivity between all devices in the network. Figure 1 shows the topology that you want to configure.

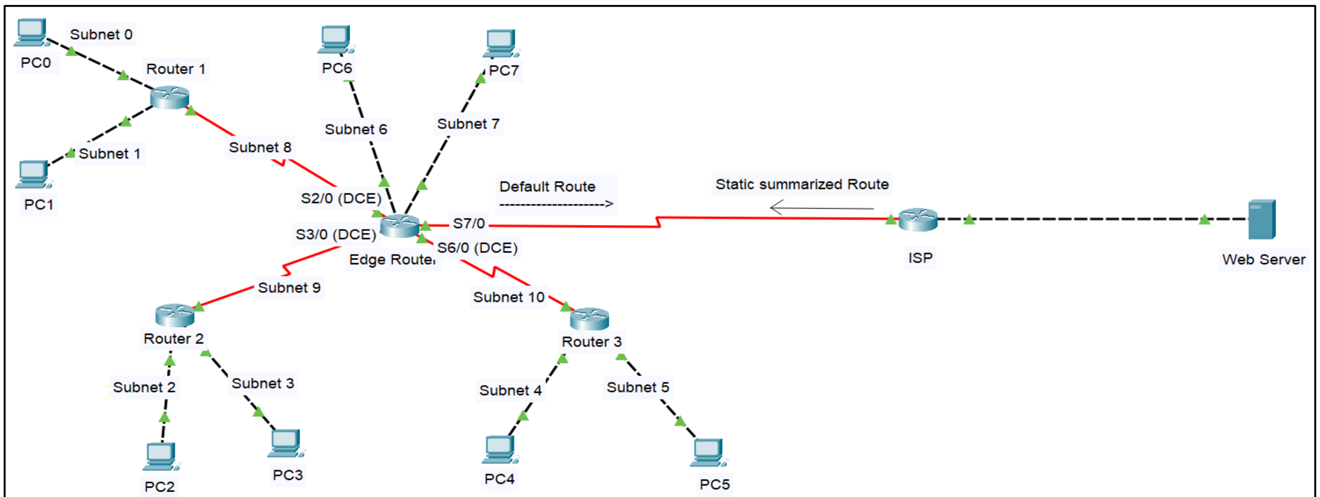


Figure 1. Network topology for experiment 1.

Part 1: Configuring a network with the IPv4 and RIPv2 using the following instructions:

1. You have been given the network address **200.50.0.0/20** to use in your network design. Perform CIDR to minimize the number of routing entries that each router will advertise. Consider that the default gateway IP addresses of the hosts (i.e., the routers' LAN interfaces) are included in the hosts' number.
2. Fill in the table below (i.e., Table 1) with addresses based on the CIDR rules addressed in the handout for experiment 2. Considering these instructions, to make the proper configurations.

- **For each LAN interface:**
  - ✓ The LAN interface is the connection between the PC and the router, where each LAN is represented by a single PC to simplify the network topology.
  - ✓ Assign the first valid host address in each subnet to the LAN interface of each router.
  - ✓ Assign the last valid host address in each subnet to the PC in the corresponding subnet.

    - Subnet 0 supports 500 hosts.
    - Subnet 1 supports 220 hosts.
    - Subnet 2 supports 120 hosts.
    - Subnet 3 supports 60 hosts.
    - Subnet 4 supports 25 hosts.
    - Subnet 5 supports 10 hosts.
    - Subnet 6 supports 5 hosts.

- Subnet 7 supports 5 hosts.

- **For each WAN interface (Subnet 8, Subnet 9, and Subnet 10):**
  - ✓ The WAN interface is the connection between two routers.
  - ✓ Assign the first valid host address in each subnet to the DCE WAN interface on the router.
  - ✓ Set the clock rate of serial DCE interfaces to 128000.
  - ✓ Assign the last valid host address in each subnet to the DTE WAN interface on the router.

3. Configure the routers PCs using your addressing table. Before continuing, make sure that each device can ping its directly connected neighbor (its default gateway).
4. Configure all routers with RIPv2 routing except the ISP. In your configuration, make sure you do the following:
   - Disable automatic summarization.
   - Stop routing updates on interfaces that are not connected to RIP neighbors.
   - Set a default route from the Edge Router to the ISP using the outbound interface.
   - Redistribute the default route from Edge Router.
5. Configure a summarized static route on the ISP using the next hop IP option.

Part 2: Verify Configurations

1. **View the routing tables for Edge Router, Router 1, Router 2, and Router 3.**
   - Use the appropriate command to show the routing table of Edge Router. RIP (R) now appears with connected (C) and local (L) routes in the routing table. All networks have an entry. You also see a default route listed.
   - View the routing tables for Router 1, Router 2, and Router 3. Notice that each router has a full listing of all the networks.
2. **Verify full connectivity to all destinations.**
   - Every device should now be able to ping every other device inside the network. In addition, all devices should be able to ping the ISP and the Web Server.

Table 1: Addressing table for IPv4 configuration for experiment 1

Device	Interface	IPv4 Address	Subnet mask	Default Gateway	Connected with
Edge Router	FastEthernet0/0			--	PC6
	FastEthernet1/0			--	PC7
	Serial2/0 (DCE)			--	S2/0 of Router 1
	Serial3/0(DCE)			--	S2/0 of Router 2
	Serial6/0(DCE)			--	S2/0 of Router 3
	Serial7/0	100.100.100.2	255.255.255.252	--	S2/0 of ISP
Router 1	FastEthernet0/0			--	PC0
	FastEthernet1/0			--	PC1
	Serial2/0			--	S2/0 of Edge Router
Router 2	FastEthernet0/0			--	PC2
	FastEthernet1/0			--	PC3
	Serial2/0			--	S3/0 of Edge Router
Router 3	FastEthernet0/0			--	PC4
	FastEthernet1/0			--	PC5
	Serial2/0			--	S6/0 of Edge Router
ISP	Serial2/0(DCE)	100.100.100.1	255.255.255.252	--	S7/0 of Edge Router

	FastEthernet0/0	108.75.40.1	255.255.255.252	--	Web Server
Web Server	Fa0	108.75.40.2	255.255.255.252	--	ISP
PC0	Fa0				Fa0/0 of Router 1
PC1	Fa0				Fa1/0 of Router 1
PC2	Fa0				Fa0/0 of Router 2
PC3	Fa0				Fa1/0 of Router 2
PC4	Fa0				Fa0/0 of Router 3
PC5	Fa0				Fa1/0 of Router 3
PC6	Fa0				Fa0/0 of Edge Router
PC7	Fa0				Fa1/0 of Edge Router

Experiment 2: Configuring RIPng (IPv6) routing protocol

In this activity, you will configure an IPv6 network with the RIPng routing protocol using the instructions and information given in Figure 2 and Table 2. In a few words, in this activity (Lab 5_Experiment_2_RIPng.pka), you will configure the PCs and routers' interfaces with the IPv6 addresses provided in Table 2. Then, you are requested to configure the RIPng routing protocol with static and default routing for Internet access and ensure full connectivity between all devices in the network. Figure 2 shows the topology that you want to configure.

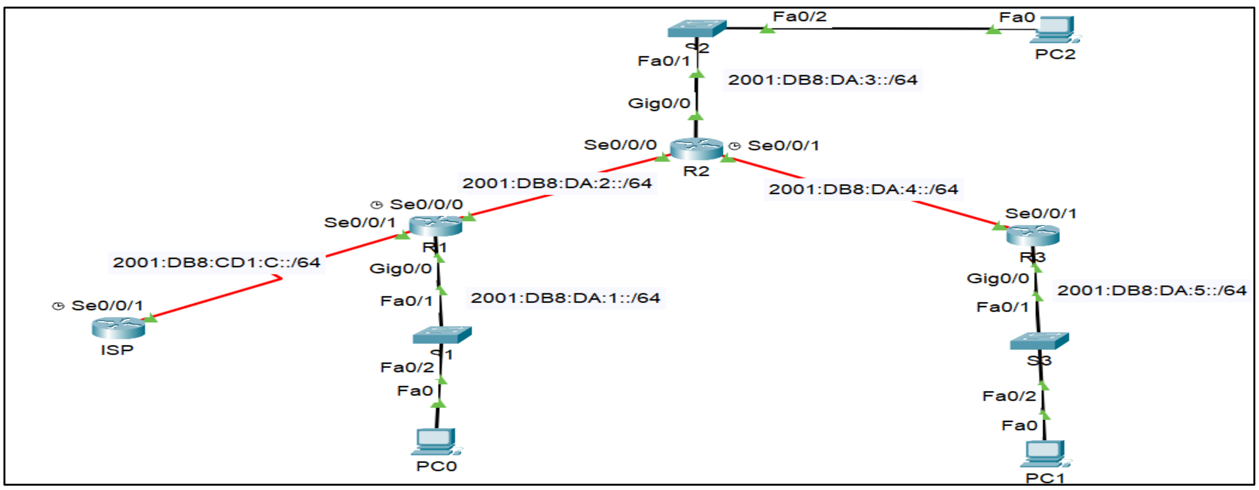


Figure 2. Network topology for experiment 2.

Table 2: Addressing table for IPv6 configuration for experiment 2

Device	Interface	IPv6 Address	Link-local	Default Gateway	Connected with
R1	S0/0/0(DCE)	2001:DB8:DA:2::1/64	FE80::1	--	R2
	S0/0/1	2001:DB8:CD1:C::2/64	FE80::1	--	ISP
	G0/0	2001:DB8:DA:1::1/64	FE80::1	--	PC0
R2	S0/0/0	2001:DB8:DA:2::2/64	FE80::2	--	R1
	S0/0/1(DCE)	2001:DB8:DA:4::1/64	FE80::2	--	R3
	G0/0	2001:DB8:DA:3::1/64	FE80::2	--	PC2
R3	S0/0/1	2001:DB8:DA:4::2/64	FE80::3	--	R2
	G0/0	2001:DB8:DA:5::1/64	FE80::3	--	PC1
ISP	S0/0/1(DCE)	2001:DB8:CD1:C::1/64	FE80::C	--	R1
PC0	Fa0	2001:DB8:DA:1::A/64	--	FE80::1	R1
PC1	Fa0	2001:DB8:DA:5::A/64	--	FE80::3	R3
PC2	Fa0	2001:DB8:DA:3::A/64	--	FE80::2	R2

Part1: Configuring a network with IPv6 and RIPng:

1. **Configure each PC with:**
   - The 10th address of the IPv6 subnet provided in the network topology (i.e., A).
   - a /64 network prefix length.
   - The default gateway using the router's link-local addresses.
   - **Note:** The link-local of each PC is already automatically configured, therefore, there is no need to configure it.
2. **On all routers, configure the following:**
   - Enable IPv6 routing.
   - Configure all interfaces with the assigned IPv6 link-local address, and global unicast IPv6 address.
   - Enable the interfaces.
   - Set the clock rate of serial DCE interfaces to 128000.
3. **On all routers except the ISP:**
   - Enable RIPng on each interface except serial 0/0/1 of Router 1.
   - Use the name: **RIPv6** in all caps as the **RIPng routing process name** (please note that this name is case-sensitive).
4. **On Router 1:**
   - Configure an IPv6 default route out of the s0/0/01 interface and propagate that route to the rest of the network using RIPng. Also, on the interface Serial0/0/1 of Router 2 only propagate that route using the following command, on the interface mode:

     ```
     ipv6 rip RIPv6 default-information originate
     ```
5. **On the ISP router:**
   - Configure an Ipv6 summary route, out of the s0/0/1 interface, to reach all Router 0, Router 1, and Router 2 subnets.

Part 2: Verify Configurations

1. **View routing tables of Router 1, Router 2, and Router 3.**
   - Use the appropriate command to show the routing table of Router 1. RIP (R) now appears with connected (C) and local (L) routes in the routing table. All networks have an entry. You also see a default route listed.
   - View the routing tables for Router 2 and Router 3. Notice that each router has a full listing of all the networks.
2. **Verify full connectivity to all destinations.**
   - Every device should now be able to ping every other device inside the network. In addition, all devices should be able to ping the ISP.

The End. Good Luck!

The University of Jordan, Comp. Eng. Dept.
Networks laboratory: Laboratory 6
EIGRP (IPv4 and IPv6) (Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Student Name:	**ID:**	**Section Number:**

Experiment 1: Configuring EIGRP (IPv4) routing protocol

In this activity (i.e., Lab_6_Experiment_1_EIGRP_IPv4.pka), you are requested to configure the EIGRP for IPv4 routing protocol with static and default routing for Internet access and ensure full connectivity between all devices in the network. Figure 1 shows the topology that you want to configure. **The PCs and routers' interfaces are already configured for you.** Accordingly, routers have information about the direct networks that they have on their own interfaces. Routers will not exchange this information between themselves. We need to implement the EIGRP routing protocol, which will insist they share this information.

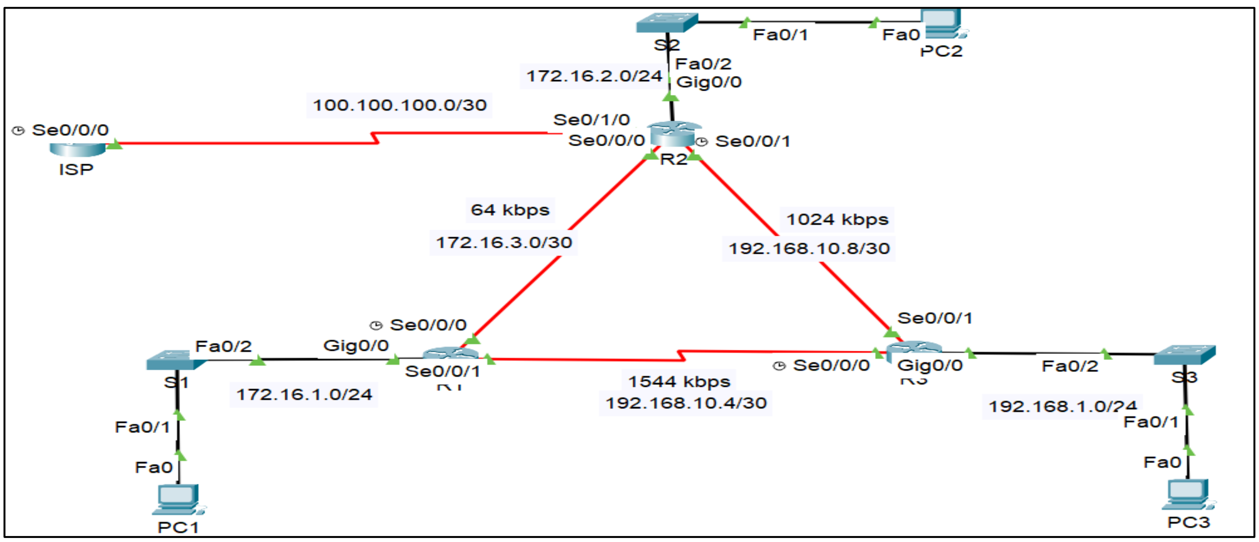


Figure 1. Network topology for experiment 1.

Part 1: Configuring EIGRP for IPv4 on R1, R2, and R3 using the following instructions:

1. Verify IP addressing and interfaces. Use the `show ip interface brief` command to verify that the IP addressing is correct and that the interfaces are active.
2. Configure all routers with EIGRP routing except the ISP. In your configuration, make sure you do the following:
   - Enable the EIGRP routing process on each router using AS number 10.
   - Advertise directly connected networks with the correct wild mask.
   - Configure LAN interfaces to not advertise EIGRP updates as a passive interface on all routers.
   - Set a default route from R2 to the ISP using the outbound interface.
   - Redistribute the default route from R2.
3. Configure a summarized static route on the ISP using the directly connected option.

Part 2: Verify Configurations

1. **Verify full connectivity to all destinations.**
   - Every device should now be able to ping every other device inside the network. In addition, all devices should be able to ping the ISP and the Web Server.

2. **View the routing tables for Router 1, Router 2, and Router 3.**
   - Use the appropriate command to view the routing tables for Router 3. Notice that each router has a full listing of all the networks. You also see the default route listed. How does EIGRP appear in the routing table? Write the code and AD for both EIGRP and default route listed in the routing table.

Answer:

3. **View neighbors.**
   - On the Router2, use the `show ip eigrp neighbors` command to view the neighbor table and verify that EIGRP has established an adjacency with the R1 and R3 routers. You should be able to see the IP address of each adjacent router and the interface that R2 uses to reach that EIGRP neighbor. **Take screen shots of R2 neighbors table.**

Answer:

4. **View routing protocol information.**
   - On the R1 router, use the `show ip protocols` command to view information about the routing protocol operation.
   - Answer the following questions?
     - ✓ What is the AS of EIGRP?_______________
     - ✓ What are the values of weight metrics used in EIGRP to calculate the metric?_________________
     - ✓ What is the router ID?
     - ✓ What do you observe about the summarization?_____________

5. **Use the `show ip protocols` command on R2 to verify the static route is being distributed.**

Answer: Redistributing: eigrp 10, static

6. **On R1, issue the `show ip route eigrp | include 0.0.0.0` command to view statements specific to the default route. How is the static default route represented in the output? What is the administrative distance (AD) for the propagated route? Write here the statement.**

Answer:

Part 3: Configure EIGRP Metrics.

1. **View the EIGRP metric information.**

- Use the `show ip interface interface name` command to view the EIGRP metric information for the Serial0/0/0 interface on the R1 router. Notice the values that are shown for the bandwidth, delay, reliability, and load. `R1#show interface serial0/0/0`. What are the values of EIGRP metrics?

Answer:

2. **Modify the bandwidth of the Serial interfaces.**

- For this lab, the link between R1 and R2 will be configured with a bandwidth of 64 kbps, and the link between R2 and R3 will be configured with a bandwidth of 1024 kbps. Use the bandwidth command to modify the bandwidth of the Serial interfaces of each router.

3. **Verify the bandwidth modifications.**

- Use the `show ip interface interface name` command to view the EIGRP metric information for the Serial0/0/0 interface on the R1, R2, and R3 routers. Notice the values that are shown for the bandwidth, delay, reliability, and load. `R1#show interface serial0/0/0`. What do you observe when it is compared to step 1?

Answer:

Part 4: Examine Successors and Feasible Distances.

1. **Examine the successors and feasible distances in the routing table on R2.**

- Use the `show ip route` command on R2.
- Answer the following questions:
  - **What is the best path to PC1 (172.16.1.0/24)?**

Answer:

  - **What is the IP address and exit name of the successor in this route?**

Answer:

  - **What is the feasible distance to the network that PC1 is on?**

Answer:

  - A successor is a neighboring router that is currently being used for packet forwarding. A successor is the least-cost route to the destination network. The IP address of a successor is shown in a routing table entry right after the word "via".
  - Feasible distance (FD) is the lowest calculated metric to reach that destination. FD is the metric listed in the routing table entry as the second number inside the brackets.
  - A feasible successor is a neighbor who has a viable backup path to the same network as the successor. In order to be a feasible successor, R1 must satisfy the feasibility condition. The feasibility condition (FC) is met when a neighbor's reported distance (RD) to a network is less than the local router's feasible distance to the same destination network.

Part 5: Determine if R1 is a Feasible Successor for the Route from R2 to the 192.168.1.0 Network.

1. **Examine the routing table on R1 using the following `show ip route` command.**
2. **What is the reported distance to the 192.168.1.0 network?**

Answer:

3. **Examine the routing table on R2.**
4. **What is the feasible distance to the 192.168.1.0 network?**

Answer:

5. **Would R2 consider R1 to be a feasible successor to the 192.168.1.0 network? Discuss your answer?**

Answer:

Part 6: Disable EIGRP Automatic Summarization.

1. **Disable automatic summarization on all three routers with the** `no auto-summary` **command.**
2. **Examine the routing table of the R3 router. What do you observe about 172.16.0.0 network? Explain your answer?**

Answer:

3. **Why is the R1 router (192.168.10.5) the only successor for the route to the 172.16.0.0/16 network?**

Answer:

Part 7: Configure Manual Summarization.

1. **Step 1: Add loopback addresses to R3 router.**

- Add two loopback addresses, loopback1: 192.168.2.1/24 and loopback2:192.168.3.1/24, to the R3 router. These virtual interfaces will be used to represent networks to be manually summarized along with the 192.168.1.0/24 LAN.
- Add the 192.168.2.0 and 192.168.3.0 networks to the EIGRP configuration on R3.
- Verify new routes. View the routing table on the R1 router to verify that the new routes are being sent out in the EIGRP updates sent by R3. **Write down the roaring table entries about the 192.168.1.0 192.168.2.0 and 192.168.3.0 networks**

Answer:

- Apply manual summarization to outbound interfaces. The routes to the 192.168.1.0/24, 192.168.2.0/24, and 192.168.3.0/24 networks can be summarized in the single network 192.168.0.0/22. Use the `ip summary-address eigrp as-number networkaddress subnet-mask` command to configure manual summarization on each of the outbound interfaces connected to EIGRP neighbors.
- Verify the summary route. View the routing table on the R1 router to verify that the summary route is being sent out in the EIGRP updates sent by R3. **Take screen shot of R1' routing table.**

Answer:

- What is the purposes of route summarization as you observed from the prior steps?

Answer:

Part 8: Examine the EIGRP Topology Table.

1. **View the EIGRP topology table. Use the** `show ip eigrp topology` **command to view the EIGRP topology table on R2.**

Answer:

2. **View detailed EIGRP topology information on R2. Use the [network] parameter of the** `show ip eigrp topology` **command to view detailed EIGRP topology information for the 192.168.0.0 network.**

```
show ip eigrp topology 192.168.0.0 255.255.252.0
```

- Answer the following questions:
  - **How many successors are there for this network? __________**
  - **What is the feasible distance to this network? ___________**
  - **What is the IP address of the feasible successor? ___________**
  - **What is the reported distance for 192.168.1.0 from the successor? __________**
  - **What is the reported distance for 192.168.1.0 from the feasible successor? __________**
  - **Why R3 is considered a successor for R2?___________________**
  - **Why R1 is considered a feasible successor for R2?___________________**

Table 1: Addressing table for IPv4 configuration for experiment 1

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0	172.16.1.1	255.255.255.0	--
	S0/0/0 (DCE)	172.16.3.1	255.255.255.252	--
	S0/0/1	192.168.10.5	255.255.255.252	--
R2	G0/0	172.16.2.1	255.255.255.0	--
	S0/0/0	172.16.3.2	255.255.255.252	--
	S0/0/1 (DCE)	192.168.10.9	255.255.255.252	--
	Serial0/1/0	100.100.100.2	255.255.255.252	--
R3	G0/0	192.168.1.1	255.255.255.0	--
	S0/0/0 (DCE)	192.168.10.6	255.255.255.252	--
	S0/0/1	192.168.10.10	255.255.255.252	--
	Loopback1	192.168.2.1	255.255.255.0	--
	Loopback2	192.168.3.1	255.255.255.0	--
ISP	Serial0/0/0	100.100.100.1	255.255.255.252	--
PC1	Fa0	172.16.1.100	255.255.255.0	172.16.1.1
PC2	Fa0	172.16.2.100	255.255.255.0	172.16.2.1
PC3	Fa0	192.168.1.100	255.255.255.0	192.168.1.1

Experiment 2: Configuring EIGRP (IPv6) routing protocol

In this activity, you will configure an IPv6 network with the EIGRP routing protocol using the instructions and information given in Figure 2 and Table 2. In a few words, in this activity (Lab 6_Experiment_2_EIGRP_IPv6.pka), you are requested to configure the EIGRP routing protocol with static and default routing for Internet access and ensure full connectivity between all devices in the network. Figure 2 shows the topology that you want to configure.

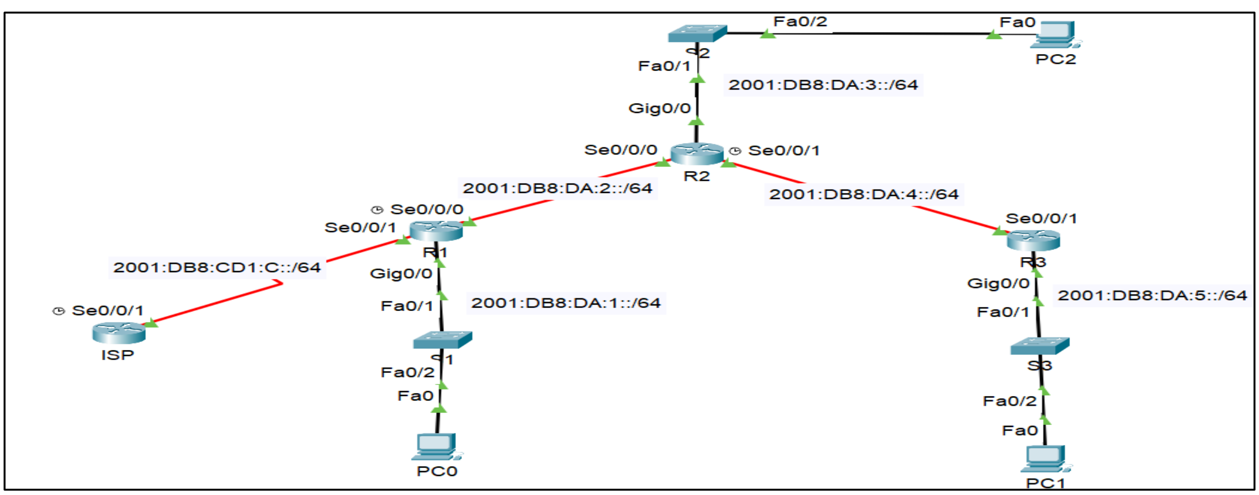


Figure 2. Network topology for experiment 2.

Table 2: Addressing table for IPv6 configuration for experiment 2

Device	Interface	IPv6 Address	Link-local	Default Gateway	Connected with
R1	S0/0/0(DCE)	2001:DB8:DA:2::1/64	FE80::1	--	R2
	S0/0/1	2001:DB8:CD1:C::2/64	FE80::1	--	ISP
	G0/0	2001:DB8:DA:1::1/64	FE80::1	--	PC0
R2	S0/0/0	2001:DB8:DA:2::2/64	FE80::2	--	R1
	S0/0/1(DCE)	2001:DB8:DA:4::1/64	FE80::2	--	R3
	G0/0	2001:DB8:DA:3::1/64	FE80::2	--	PC2
R3	S0/0/1	2001:DB8:DA:4::2/64	FE80::3	--	R2
	G0/0	2001:DB8:DA:5::1/64	FE80::3	--	PC1
ISP	S0/0/1(DCE)	2001:DB8:CD1:C::1/64	FE80::C	--	R1
PC0	Fa0	2001:DB8:DA:1::A/64	--	FE80::1	R1
PC1	Fa0	2001:DB8:DA:5::A/64	--	FE80::3	R3
PC2	Fa0	2001:DB8:DA:3::A/64	--	FE80::2	R2

It is worth mentioning that we have taken care of configuring the PCs and routers' interfaces with the IP addresses mentioned in Table 2. Furthermore, the clock rates were set 128000.

Part 1: Configuring a network with EIGRP (IPv6): Routers will not exchange this information between themselves. We need to implement the EIGRP routing protocol, which will insist they share this information.

1. **On all routers, configure the following:**
   - Enable IPv6 routing.
2. **On all routers except the ISP:**
   - Enable EIGRP with AS equal to 7 on each router.
   - Configure LAN interfaces to not advertise EIGRP updates as a passive interface on all routers.
   - Configure EIGRP for IPv6 on each interface
   - Set the router ID as follows:
     - ✓ R1: 1.1.1.1
     - ✓ R2: 2.2.2.2
     - ✓ R3: 3.3.3.3
3. **On Router 1:** Configure an IPv6 default route out of the s0/0/01 interface and propagate that route to the rest of the network using EIGRP.
4. **On the ISP router:** Configure an Ipv6 summary route, out of the s0/0/1 interface, to reach all Router 0, Router 1, and Router 2 subnets.

Part 2: Verify Configurations

1. **View routing tables of Router 1, Router 2, and Router 3.**
   - Use the appropriate command to show the routing table of Router 1. EIGRP (D) now appears with connected (C) and local (L) routes in the routing table. All networks have an entry. You also see a default route listed.
   - View the routing tables for Router 2 and Router 3. Notice that each router has a full listing of all the networks. You also see a default route listed, as EX.
2. **Verify full connectivity to all destinations.**
   - Every device should now be able to ping every other device inside the network. In addition, all devices should be able to ping the ISP.

The University of Jordan, Comp. Eng. Dept.
Networks laboratory: Laboratory 7
Distance Vector Routing Protocols (RIP and EIGRP): Troubleshooting: Link Failures and Recovery
(Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Student Name:	ID:	Section Number:

Experiment 1: Examining the routing loops and counting to infinity problem in RIP

In the handout provided earlier, we discussed the RIP routing loops and the mechanisms that are used to prevent the loops. However, in this activity, *Lab_7_Experiment_1_RIP_IPv4.pka*, you have given a network topology, the PCs and routers' interfaces are configured and RIP version 2 is enabled. Moreover, PC0 can ping PC1 successfully. Interestingly, as mentioned in the handout, routing loops can occur in RIP due to mainly two possible cases, one of which is due to having link-failure which may result in reaching count-to-infinity problem. In a few words, you are requested to investigate the routing loops by doing the following steps in sequence:

1. Set the interface Fa1/0 of Router 1 **as a passive interface**, and set the interface Fa0/0 of Router 3 **as a passive interface**.
2. Please use the `Router#show ip route` to see the routing tables of Routers 1, 2, and 3. In particular, observe the existence of network **192.168.3.0/24,** and mention how it can be reached in the blank below.

Answer:

3. Disable the split horizon mechanism in routers' interfaces, by typing the following command in each router interface: (`Router(config-if) no ip split-horizon`).
4. **Shut down the interface Fa0/2 of switch1 (i.e., link failure).**
    - Please use the `Router#show ip route` to see the routing tables of Routers 1, 2, and 3. In particular, observe the existence of network **192.168.3.0/24,** and mention how it can be reached in the blank below.

Answer:

- **Is there any routing loop available?**

Answer:

5. **Turn the interface Fa0/2 of switch1 on (i.e., no link failure).**
    - Please use the Router#show ip route to see the routing tables of Routers 1, 2, and 3. In particular, observe the existence of network **192.168.3.0/24,** and mention how it can be reached in the blank below.

Answer:

6. The basic default timers in RIP are 30, 180, 180, and 240 for update, invalid, **hold-down**, and flush timers, respectively, as mentioned in the handout. **Please change the basic timers of RIP based on the following cases:**
7. **Case 1:**
    - Set the basic timers on Router 1 to **30**, 180, **180**, and 240.
    - Set the basic timers on Router 2 to **30**, 180, 30, and 240.
    - Set the basic timers on Router 3 to **30**, 180, 30, and 240.
8. **Shut down the interface Fa0/2 of switch1 (i.e., link failure).**
    - Please use the Router#show ip route to see the routing tables of Routers 1, 2, and 3. In particular, observe the existence of network **192.168.3.0/24,** and mention how it can be reached in the blank below.

Answer:

- **Is there any routing loop available?**

Answer:

9. **Turn the interface Fa0/2 of switch1 on (i.e., no link failure).**
10. **Case 2:**
    - Set the basic timers on Router 1 to **60**, 180, **10**, and 240.
    - Set the basic timers on Router 2 to **30**, 180, 30, and 240.
    - Set the basic timers on Router 3 to **30**, 180, 30, and 240.
11. **Shut down the interface Fa0/2 of switch1 (i.e., link failure).**
    - Please debug the events of RIP to check the sent and received updates at **Router 2** using the following command: (Router#debug ip rip).
12. **Is there any routing loop available? Kindly notice that in this case, we delayed the occurrence of updates and make further the hold-down timer very short and this is just to help notice the loop! What do you see out there?**

Answer:

13. To this end, please turn on the Fa0/2 of switch 1, debugging the events of RIP to check the sent and received updates **at Router 2**. What do you observe?

Answer:

15. **What do you conclude after the prior tracing and configuration?**

Answer:

Experiment 2: EIGRP Troubleshooting Scenario: Analysis and Discussion

Through this experiment, you will find a Packet Tracer activity along with a necessary discussion. In other words, you are required to handle the activity and answer all empty blanks available throughout this experiment. The main objective of this experiment is to analyze and perfectly understand the way the EIGRP works. Particularly, it is anticipated that you deal with the following cases/parts in a very professional manner, which are, examining the DUAL algorithm, configuring EIGRP for automatic summarization, changing EIGRP metrics, and well as fine-tuning EIGRP. Please make sure to solve all cases/parts in your own as the cheating won't be tolerated and will be subject to severe penalty referring to the university rules and regulations. The experiment's parts are found below. In this activity (i.e., *Lab_7_Experiment_2_EIGRP_IPv4.pka*), you are kindly requested to troubleshoot the EIGRP considering IPv4. Figure 1, found below, shows the topology that you want to configure. The PCs and routers' interfaces have been already configured.

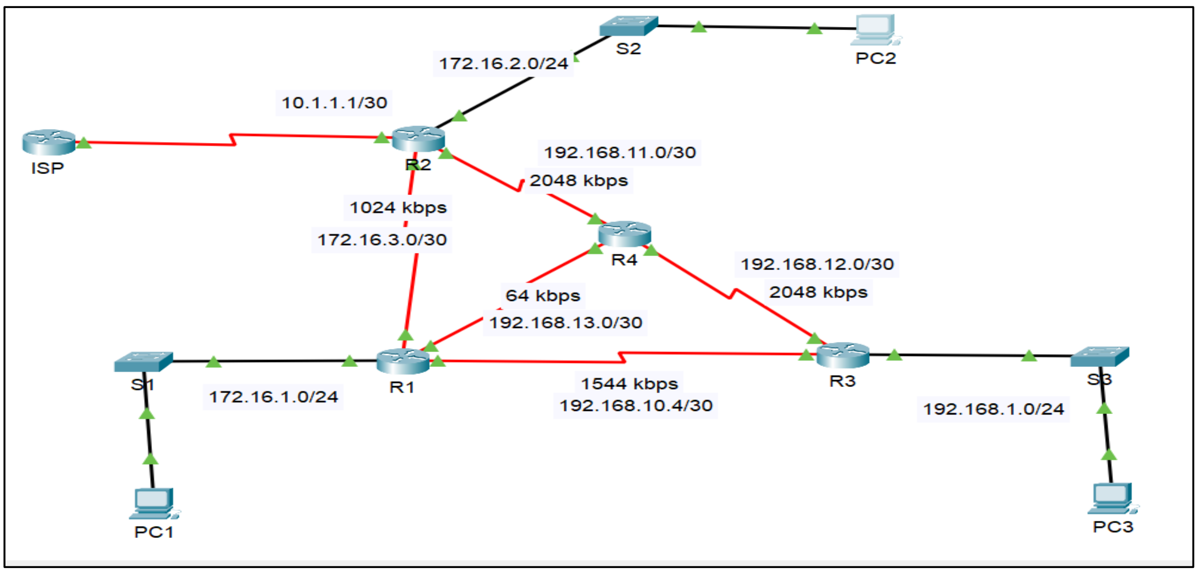


Figure 1: EIGRP network topology

<u>Experiment 2: Part 1:</u> Examining the DUAL algorithm

1. Determine the possible paths to PC3 (i.e., Network 192.168.1.0) from R1.

Answer:

2. Track the journey of a packet from PC1 to PC3 using the simulation tab and PDU message, and write down the path from the source to destination:

Answer:

3. Based on R1'routing table, what are the successor and feasible distance to this network? Accordingly, determine the best path from the prior step to reach this network.

Answer:

4. Examine the feasible successor of this network using the command, namely, show ip eigrp topology on R1:

Answer:

5. In the topology table, we will certainly see that there are only two routes to this network. Explain why the second route is found in the topology table and why the third route is not found there. In other words, Would R1 consider R2 to be a feasible successor to that network, 192.168.1.0? Discuss your answer clearly.

Answer:

6. To explain why the third route is not listed in the topology table, please go to router R2, and then type show ip route to examine the feasible distance to that network, 192.168.1.0, which is also the reported distance to the destination from router R1.

Answer:

7. Figure 2 presents the debugging commands and their usage in the ERIGRP protocol. In the privileged mode, type the following command on the CLI of R1 to investigate the types of sent and received messages. Take a screenshot of the output after applying this command and name the type of generated message.
   - ✓ Router#debug eigrp packets

debug eigrp fsm	This command helps in observing EIGRP feasible successor activity and to determine whether route updates are being installed and deleted by the routing process.
debug eigrp packet	The output of the command shows transmission and receipt of EIGRP packets. These packet types may be hello, update, request, query, or reply packets. The sequence and acknowledgment numbers by the EIGRP reliable transport algorithm are shown in the output.

Figure 2: Debugging commands for EIGRP protocol

Answer:

8. Now, turn off the debug through typing the command, namely, Router#no debug eigrp packets

9. To track the changes in the DUAL algorithm and recalculation process, in the privileged mode of R1, type this command: Router #debug eigrp fsm.

10. **Turn off the Serial0/0/0** of router R3, and simultaneously **open the CLI of R1**, take a screenshot of the output. You must take the screenshot quickly to observe the change in the DUAL algorithm before finishing the recalculation process.

Answer:

11. To this extent, turn off the debug by typing this command: Router#no debug eigrp fsm

12. **Turn on** the Serial0/0/0 of router R3.
13. To investigate the type of sent and received messages if there are any changes on the topology, in the privileged mode of R1, type this command: Router #debug eigrp packets.
14. **Turn off** the Serial0/0/0 of router R3, and simultaneously open the CLI of R1, take a screenshot of the output and name the types of generated messages. You must take the screenshot quickly to observe the type of sent and received messages before finishing the recalculation process.

Answer:

15. To continue with the forthcoming steps, you must **turn off** the debugging commands, as shown below, due to the large number of generated messages, which hinder you from pursing the next steps as anticipated:
    - ✓ Router#no debug eigrp packets
    - ✓ Router #no debug eigrp fsm
16. Keep the Serial0/0/0 of router R3 off, and then track the journey of a packet from PC1 to PC3 using the simulation tab and PDU message, write down the path of the message.

Answer:

17. View a detailed EIGRP topology information of router R1 for that network, 192.168.1.0/24. To do that, use the [network] parameter of the show ip eigrp topology[network address] [subnet mask] command. Take a screenshot of router R1 after applying this command. You must now recognize the difference(s) between the topology table' entries and that obtained from step 5. Write down your conclusion.

Answer:

18. **Turn off** the s0/0/1 and s0/1/0 of router R1, track the journey of a packet from PC1 to PC3 using the simulation tab and PDU message, write down the path from the source to the destination.

Answer:

19. View a detailed EIGRP topology information on router R1 for that network, 192.168.1.0/24. To do that, use the [network] parameter of the show ip eigrp topology [network address] [subnet mask] command. Take a screenshot of router R1 after applying this command. You must now recognize the difference(s) between the topology table' entries and that obtained from steps 5 and 17. Write down your conclusion.

Answer:

20. After finishing the debugging process, type show ip eigrp traffic on the CLI of router R1 to monitor the type and number of messages sent and received.

Answer:

<u>Experiment 2: Part 2:</u> Configuring EIGRP for Automatic Summarization

In this part, you are required to enable EIGRP automatic summarization on R1, as shown in Table 1. You are also expected to notice the effects on the routing table of router R2. Please perform the steps below in sequence. **The loopback interfaces have been already configured.**

Table1. Addressing table for loopback networks

Device	Interface	IP Address	Subnet Mask	Network Address
R1	Loopback1	192.168.111.1	255.255.255.252	192.168.111.0
	Loopback5	192.168.111.5	255.255.255.252	192.168.111.4
	Loopback9	192.168.111.9	255.255.255.252	192.168.111.8
	Loopback13	192.168.111.13	255.255.255.252	192.168.111.12

1. Advertise the networks of the loopback interfaces to the EIGRP process **with AS = 10** on router R1.
2. Issue the show ip protocols command on router R1. What is the default status of automatic summarization in EIGRP?

Answer:

3. On the CLI of router R2, issue the show ip route eigrp command. Take a screenshot of the output that shows how the loopback networks appear in the output.

Answer:

4. On the CLI of router R1, issue the auto-summary command inside the EIGRP process. Take a screenshot of the statements, which appeared after issuing this command.

Answer:

5. How does the routing table of R2 change for the loopback networks? Record the routing table entry that represents the loopback interfaces' network in the space below.

Answer:

<u>Experiment 2: Part 3:</u> Analyzing the Impact of Changing EIGRP Metrics on the Feasible Distance Calculation

In this part, you are requested to change the EIGRP metrics through following the steps below. Please keep the s0/0/1 and s0/1/0 of router R1 off.

1. On the CLI of router R1, type the show ip eigrp topology command to view the feasible distance and reported distance of the network 192.168.1.0. Write down these values.

Answer:

2. Use the command, show interfaces s0/0/0, to display the delay metric of router R1 exit interface s0/0/0 before making any changes. Record this value (default value).

Answer:

3. Set the delay metric for the interface s0/0/0 of router R1 to 10000 μs.
4. Use the command, show interfaces s0/0/0 again, to display the delay metric of router R1 exit interface s0/0/0. Record this value (after update the delay metric).

Answer:

5. On the CLI of router R1, type the show ip eigrp topology command again to view the feasible distance and reported distance of the network 192.168.1.0. Write down these values. Additionally, compare the obtained values at this moment with the values obtained in step 1 and consequently write down why these values changed.

Answer:

Experiment 2: Part 4: Fine-Tuning EIGRP

In this part, you are required to answer the question from 1-4 and then change the hello interval for EIGRP interfaces through following the steps below.

1. What is the default value of hello time over LAN interfaces? __________
2. What is the default value of hold time over LAN interfaces? __________
3. What is the default value of hello time over WAN interfaces? __________
4. What is the default value of hold time over WAN interfaces? ___________
5. On the CLI of router R2, use the show ip eigrp neighbors command to view the hold timer for EIGRP. Take a screenshot of the output.

Answer:

6. Configure the S0/0/1 exit interface of router R1 to use a hello interval of 60 seconds. Display the output after setting the command. Please, make sure that the AS of EIGRP is 10.

Answer:

7. Configure the S0/0/1 exit interface of router R2 to use a hello interval of 300 seconds. Display the output after setting the command. Please, make sure that the AS of EIGRP is 10.

Answer:

8. When setting EIGRP timers, why is it important to make the hold time value equal to or greater than the hello interval?

Answer:

Experiment 2: Part 5: Studying the effects of changing EIGRP weight metrics

You are kindly requested to follow the exact steps below.

1. On the CLI of router R1, type the following command to see the weight of metrics: `R1# sh ip protocols`. Write down the default values of EIGRP weight metrics.

Answer:

2. On the CLI of router R1, change the values of **K1, K2, K3, K4, and K5 to become 2**, and set the **tos to 0**. You can get this successfully done through using the following command: `Router(config-router)# metric weights tos k1 k2 k3 k4 k5.` Please, make sure that the AS of EIGRP is 10.

3. Open the CLI of router R2. What do you observe about the other routers? Take a screenshot of the output.

Answer:

Important Clues and Tips:

- ✓ tos is always set to 0; at one time it was Cisco's intent to use it, but it was never implemented.
- ✓ EIGRP neighbors must agree on K values to establish an adjacency and avoid routing loops.
- ✓ You should be aware of the change impact in ahead (i.e., before changing the defaults). It can give you unexpected results if you do not know what you are doing!
- ✓ If you modify the weights on a router, you should configure all routers accordingly, hereby maintaining the same weight values over all routers.

The End: Good Luck!

The University of Jordan, Comp. Eng. Dept.
Networks laboratory: Laboratory 8
OSPFv2 and OSPFv3 (Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Student Name:	**ID:**	**Section Number:**

<u>Experiment 1:</u> Configuring OSPFv2 (IPv4) routing protocol

In this activity (i.e., *Lab_8_Experiment_1_OSPFv2.pka*), you are requested to configure the OSPF for IPv4 routing protocol with multiple areas and virtual links, which were discussed thoroughly in the handout. Thereafter, you are requested to configure the static and default routing for Internet access and ensure full connectivity between all devices in the network. Figure 1 shows the topology that you want to configure. The PCs and routers' interfaces have been already configured. Accordingly, routers have information about their direct networks whereas they will not exchange this information among each other. Interestingly, we need to implement the OSPF routing protocol, which will insist sharing this information. However, Tables 1 and 2 show the addressing of the networks and interfaces, respectively.

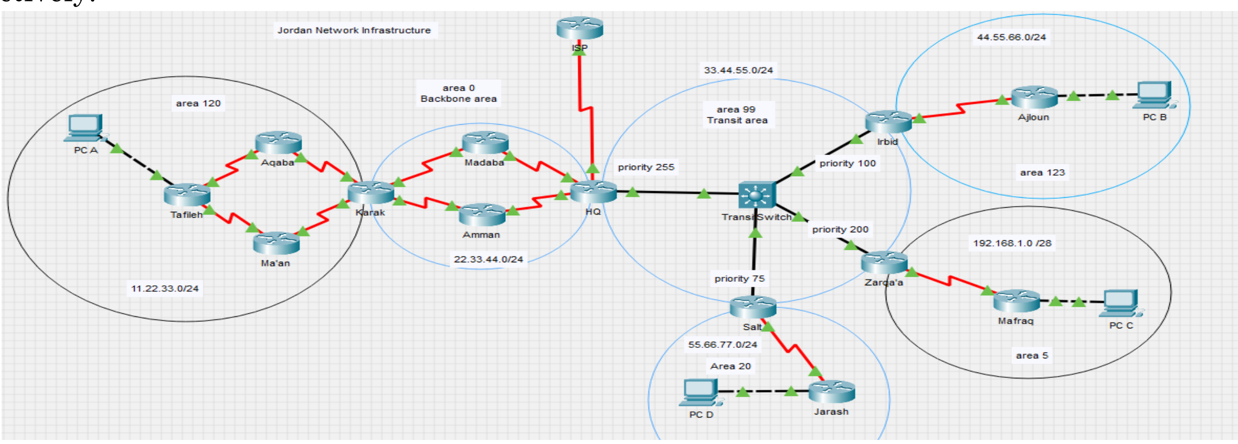


Figure 1. Network topology for experiment 1.

Table 1: Network address for IPv4 configuration for experiment 1

Routers	Network Address
Tafileh and PC A	11.22.33.0/28
Tafileh and Ma'an	11.22.33.16/28
Tafileh and Aqaba	11.22.33.32/28
Aqaba and Karak	11.22.33.64/28
Ma'an and Karak	11.22.33.48/28
Karak and Madaba	22.33.44.0/28
Karak and Amman	22.33.44.16/28
Madaba and HQ	22.33.44.48/28
Amman and HQ	22.33.44.32/28
HQ and Transient switch	33.44.55.0/24
Irbid and Transient switch	33.44.55.0/24
Irbid and Ajloun	44.55.66.0/28
Ajloun and PC B	44.55.66.16/28
Zarqa'a and Transient switch	33.44.55.0/24
Zarqa'a and Mafraq	192.168.1.0/30
Mafraq and PC C	192.168.1.4/30
Salt and Transient switch	33.44.55.0/24
Salt and Jarash	55.66.77.0/28
Jarash and PC D	55.66.77.16/28

Part 1: Configuring OSPF for IPv4 on all routers except ISP router using the following instructions:

1) Verify IP addressing and interfaces. Use the show ip interface brief command to verify that the IP addressing is correct and that the interfaces are active.
2) Configure all routers with OSPF routing except the ISP. In your configuration, make sure you do the following:
   - Enable the OSPF routing process on each router using a process ID number of 1.
   - Advertise directly connected networks with the correct wild mask and correct area number.
   - Configure LAN interfaces to not advertise OSPF updates as a passive interface on all routers.
   - To see the adjacency formed, type the following command: log-adjacency-changes.
   - Set a default route from the HQ router to the ISP using the exit interface.
   - Redistribute the default route from HQ router.
3) Set the OSPF priority on the interface Fast Ethernet 0/0 and the router ID as shown in the following table.

Router Name	OSPF priority	router ID
HQ router	255	33.44.55.254
Irbid router	100	44.55.66.1
Zarqa'a router	200	33.44.55.253
Salt router	75	55.66.77.1

4) The clear ip ospf process command is used to activate the RID on a router that is already running OSPF: Router# clear ip ospf process.
5) Configure **a summarized static route on the ISP** using the directly connected option. **Tip**: Each area has a summarized network address as shown in Figure 1.

Part 2: Verify Configurations

1) Verify full connectivity to all destinations between area 0 and other areas.
   - Every device between area 120, area 99, and area 0 should now be able to ping every other device inside this area. In addition, all devices should be able to ping the ISP.
     - ✓ Ping between the PC A and HQ router.
     - ✓ Ping between the PC A and Irbid router.
     - ✓ Ping between the PC A and Zaraqa'a router.
     - ✓ Ping between the PC A and Salt router.

   What is the result of ping?

Answer:

   - Now try to ping between:
     - ✓ Ping between the PC A and PC B.
     - ✓ Ping between the PC A and PC C.
     - ✓ Ping between the PC A and PC D.

   What is the result of ping? Justify your answer?

Answer:

2) View the routing tables using the appropriate command to view the routing table for HQ. Notice that HQ router has a full listing of all the networks. You also see the default route listed.
   - How does the OSPF appear in the routing table? **Take screen shot of HQ router 'routing table.**

Answer:

- Write the code and the AD for OSPF and for the default route listed in the routing table.

Answer:

3) View neighbors.
   - On the HQ, use the **show ip ospf neighbor** command to view the neighbor table and verify that OSPF has established an adjacency with the other routers. You should be able to see the Neighbor ID, priority value, state, and the interface of each adjacent router used to reach that OSPF neighbor. **Take screen shots of HQ router's neighbors table.**

Answer:

   - On the Irbid, use the **show ip ospf neighbor** command to view the neighbor table and verify that OSPF has established an adjacency with the other routers. You should be able to see the Neighbor ID, priority value, state, and the interface of each adjacent router used to reach that OSPF neighbor. **Take screen shots of Irbid router's neighbors' table.**

Answer:

4) View routing protocol information.
   - On the HQ router, use the show ip protocols command to view information about the routing protocol operation.
   - Answer the following questions?
     - ✓ What is the process ID of OSPF?_____________
     - ✓ What is the router ID?____________
     - ✓ What is the number of areas?________________-
     - ✓ How do you know about the static route that is being distributed?_____________________
5) View the database. **Take screen shot of the HQ router' database.**

Answer:

6) On Salt Router, issue the show ip route ospf | include 0.0.0.0 command to view statements specific to the default route. How is the static default route represented in the output? What is the administrative distance (AD) for the propagated route? Write here the statement.

Answer:

Part 3: Configuring virtual links:

1) We configure the virtual link between ABRs, and we use the area [area #]virtual-link router-id command.
2) To get started with the correct configuration of the virtual links, do the following:
   - Identify isolated areas that require connecting to area 0.

Answer:

- Identify appropriate ABRs and make sure the above requirements are met.

Answer:

- After determining these areas, you need **configure the virtual links between the ABRs of isolated areas and the HQ** under the OSPF process using the above command.
- You must specify the router ID of ABRs. Use the following command show ip ospf interface f0/0. You need to configure the OSPF router ID and NOT the IP address of the ABR. If everything is OK, the isolated area will be directly connected to area 0 through our virtual link. Keep this in mind, that we configure the router ID for HQ manually.
- **Important note:** In case that your activity does not correct the virtual links on the HQ router, do the following steps to reset the OSPF process: go the HQ router, in the privileged mode type show run command, copy the commands that related to the OSPF, then go to configuration mode, and type the no router ospf 1, then paste your commands.

Part 4: Verification of the configuration:

- Verify the configuration of virtual links on HQ, by using this command show ip ospf virtual-links. **Take screen shot of HQ's output.**

Answer:

- Verify the configuration of virtual links on Irbid router by using this command show ip ospf virtual-links. **Take screen shot of Irbid's router output.**

Answer:

- Verify the OSPF neighbors on the HQ router. **Take a screen shot of the output.** Explain how the virtual links appear.

Answer:

- On Zaraq'a router, verify whether OSPF routes are learnt by using this command show ip route ospf. **Take a screen shot of the output.**

Answer:

- If you look at the LSDB on the HQ router you will see that the virtual link shows up as a type 1 router LSA. You can also see DNA which means do not age by using this command show ip ospf database. **Take a screen shot of the output.**

Answer:

Part 5: Verification of the configuration:

- Ping ISP from PC A.
- Ping PC B from PC A.
- Ping PC C from PC A.
- Ping PC D from PC A.

Table 2: Addressing table for IPv4 configuration for problem 1

Device	Interface	Area	IPv4 Address	Subnet mask	Default Gateway	Connected with
PC A	Fa0/0	120	11.22.33.14/28	255.255.255.240	11.22.33.1	FastEthernet0/0 of Tafileh Router
Tafileh Router	FastEthernet0/0	120	11.22.33.1	255.255.255.240	--	PC X
	Serial0/0/0	120	11.22.33.38	255.255.255.240	--	Serial0/0/0 of Aqaba Router
	Serial0/0/1	120	11.22.33.18	255.255.255.240	--	Serial0/0/1of Ma'an Router
Aqaba Router	Serial0/0/0	120	11.22.33.39	255.255.255.240	--	Serial0/0/0 of Tafileh Router
	Serial0/0/1	120	11.22.33.65	255.255.255.240	--	Serial0/0/1 of Karak Router
Ma'an Router	Serial0/0/0	120	11.22.33.49	255.255.255.240	--	Serial0/0/0 of Karak Router
	Serial0/0/1	120	11.22.33.19	255.255.255.240	--	Serial0/0/0 of Tafileh Router
Karak Router	Serial0/0/0	120	11.22.33.62	255.255.255.240	--	Serial0/0/0 of Ma'an Router
	Serial0/0/1	120	11.22.33.78	255.255.255.240	--	Serial0/0/1 of Aqaba Router
	Serial0/1/0	0	22.33.44.1	255.255.255.240	--	Serial0/1/0 of Madaba Router
	Serial0/1/1	0	22.33.44.18	255.255.255.240	--	Serial0/1/1 of Amman Router
Madaba Router	Serial0/0/0	0	22.33.44.49	255.255.255.240	--	HQ Router
	Serial0/1/0	0	22.33.44.2	255.255.255.240	--	Serial0/1/0 of Karak Router
Amman Router	Serial0/0/1	0	22.33.44.33	255.255.255.240	--	HQ Router
	Serial0/1/1	0	22.33.44.19	255.255.255.240	--	Serial0/1/1 of Karak Router
HQ Router	FastEthernet0/0	99	33.44.55.254	255.255.255.0	--	FastEthernet0/1 of Transient Switch
	Serial0/0/0	0	22.33.44.62	255.255.255.240	--	Madaba Router
	Serial0/0/1	0	22.33.44.46	255.255.255.240	--	Amman Router
	Serial0/1/0	--	200.200.100.2	255.255.255.252	--	ISP Router
Irbid Router	FastEthernet0/0	99	33.44.55.252	255.255.255.0	--	FastEthernet0/2 Transient Switch
	Serial0/0/0	123	44.55.66.1	255.255.255.240	--	Serial0/0/0 of Ajloun Router
Ajloun Router	FastEthernet0/0	123	44.55.66.17	255.255.255.240	--	PC Y
	Serial0/0/0	123	44.55.66.14	255.255.255.240	--	Serial0/0/0 of Irbid Router
PC B	Fa0/0	123	44.55.66.30	255.255.255.240	44.55.66.17	FastEthernet0/0 of Ajloun Router
Zarqa'a Router	FastEthernet0/0	99	33.44.55.253	255.255.255.0	--	FastEthernet0/3 Transient Switch
	Serial0/0/0	5	192.168.1.1	255.255.255.252	--	Serial0/3/0 of Mafraq Router
Mafraq Router	FastEthernet0/0	5	192.168.1.6	255.255.255.252		PC C
	Serial0/3/0	5	192.168.1.2	255.255.255.252	--	Serial0/0/0 of Zarqa'a Router
PC C	Fa0/0	5	192.168.1.5	255.255.255.252	192.168.1.6	FastEthernet0/0 of Mafraq Router
Salt Router	FastEthernet0/0	99	33.44.55.250	255.255.255.0	--	FastEthernet0/4 Transient Switch
	Serial0/0/0	20	55.66.77.1	255.255.255.240	--	Serial0/0/0 of Jarash Router
Jarash Router	FastEthernet0/0	20	55.66.77.17	255.255.255.240	--	PC D
	Serial0/0/0	20	55.66.77.14	255.255.255.240	--	Serial0/0/0 of Salt Router
PC D	Fa0/0	20	55.66.77.30	255.255.255.240	55.66.77.17	FastEthernet0/0 of Jarash Router
ISP Router	Serial0/0/0	--	200.200.100.1	255.255.255.252	--	Serial0/1/0 of HQ Router

Experiment 2: Configuring OSPV3 (IPv6) routing protocol

In this activity, you will configure an IPv6 network with the OSPFv3 routing protocol using the instructions and information given in Figure 2 and Table 3. In a few words, in this activity (*Lab 8_Experiment_2_OSPFv3.pka*), you will build an IPv6 routing table by OSPFv3. This is a configuration activity for a normal OSPF process. The IPv6 addresses provided in Table 3. Figure 2 shows the topology that you want to configure.

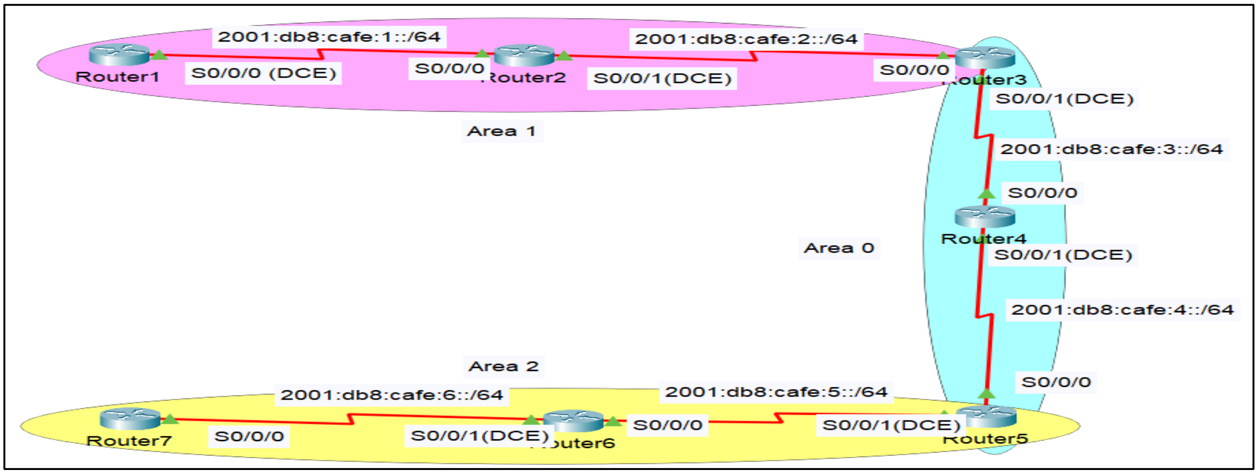


Figure 2. Network topology for experiment 2.

Table 2: Addressing table for IPv6 configuration for experiment 2

Device	Interface	IPv6 address	Link-local
Router 1	S0/0/0 (DCE)	2001:db8:cafe:1::1/64	FE80::1
	Loopback0	2001:100:1::1/64	FE80::1
Router 2	S0/0/0	2001:db8:cafe:1::2/64	FE80::2
	S0/0/1 (DCE)	2001:db8:cafe:2::1/64	FE80::2
	Loopback0	2001:100:2::2/64	FE80::2
Router 3	S0/0/0	2001:db8:cafe:2::2/64	FE80::3
	S0/0/1 (DCE)	2001:db8:cafe:3::1/64	FE80::3
	Loopback0	2001:100:3::3/64	FE80::3
Router 4	S0/0/0	2001:db8:cafe:3::2/64	FE80::4
	S0/0/1 (DCE)	2001:db8:cafe:4::1/64	FE80::4
	Loopback0	2001:100:4::4/64	FE80::4
Router 5	S0/0/0	2001:db8:cafe:4::2/64	FE80::5
	S0/0/1 (DCE)	2001:db8:cafe:5::1/64	FE80::5
	Loopback0	2001:100:5::5/64	FE80::5
Router 6	S0/0/0	2001:db8:cafe:5::2/64	FE80::6
	S0/0/1 (DCE)	2001:db8:cafe:6::1/64	FE80::6
	Loopback0	2001:100:6::6/64	FE80::6
Router 7	S0/0/0	2001:db8:cafe:6::2/64	FE80::7
	Loopback0	2001:100:7::7/64	FE80::7

Part 1: Configuring a network with IPv6 and OSPV3:

1. **On all routers, configure the following:**
   - Enable IPv6 routing.
   - Make sure that the Loopback0 prefix of each router is registered in the routing table with a prefix length of /64.

- Configure the loopback interface for each router with the assigned IPv6 link-local address, and global unicast IPv6 address, as shown in Table 2.
- Other routers' interfaces were configured for you with the assigned IPv6 link-local address, and global unicast IPv6 address, and the clock rate for serial DCE interfaces were set to 64000. Moreover, the interfaces were enabled.

Part 2: Configuration and Verification

1. **Enabling OSPFv3 on each router:**
   - Enable OSPFv3 for each router interface with process ID equal to 1.
   - Set the router ID of each router will be X.X.X.X, where X is the Router number (i.e., for router 1 the router ID is 1.1.1.1, and so on). Since it is considered that some routers do not have IPv4 addresses, **the router ID is basically configured statically in OSPFv3.**
   - Type the following command: log-adjacency-changes
2. **Enabling OSPFv3 on each router' interfaces:**
   - Enable OSPFv3 based on the area layout shown in Figure 2 for each router interface with process ID equal to 1.
3. **Verify Neighbors:**
   - Verify that OSPFv3 neighbors have been established by using the show ipv6 ospf neighbor command on Router 3. **Take a screen shot of the output.**

Answer:

4. **Verify OSPFv3 routes**
   - Use the appropriate command to show the routing table of Router 5. OSPF now appears with connected (C) and local (L) routes in the routing table. All networks have an entry. Verify whether OSPFv3 routes can be learned by using the show ipv6 route ospf command on Router 5. **Take a screen shot of the output.**

Answer:

5. **Verify full connectivity to all destinations.**
   - Every device should now be able to ping every other device inside the network. Try to ping this IPv6 address 2001:db8:cafe:1::1 from Router 7. **Take a screen shot of the output.**

Answer:

The End. Good Luck!

The University of Jordan, Comp. Eng. Dept.
Networks laboratory: Laboratory 9
Configuration of Basic and Real Devices
(Laboratory Sheet)

Prepared by: Prof. Khalid A. Darabkh and Eng. Muna Al-Akhras

Experiment 1: Basic Device Configuration (Packet Tracer)

In this activity (i.e., ***Lab_9_Experiment_1.pka***), you are requested to do the following configuration relying on Figure 1.

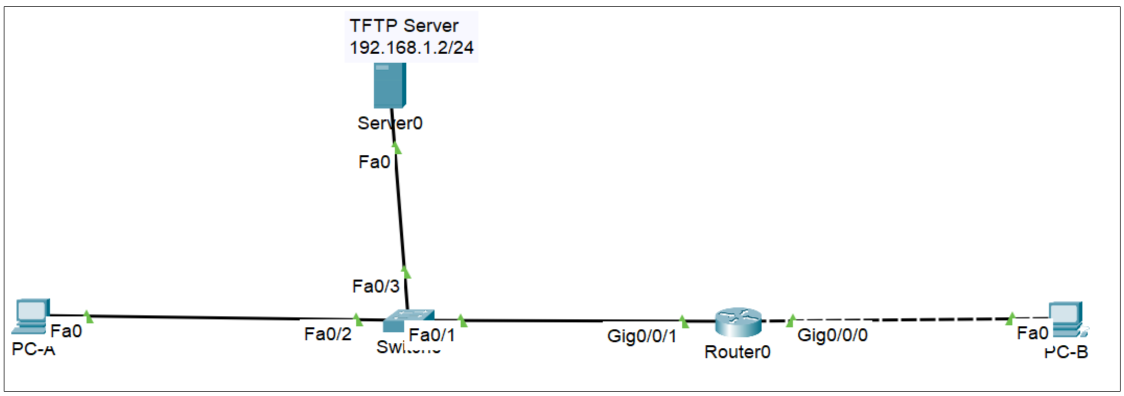


Figure 1: Network topology for experiment 1

Configure Devices based on the following:

1. Specify the name of the switch as "**S1**"

For the router do the following:

2. Specify the name of the router as "**R1**"
3. Configure MOTD banner on R1 to be as "**Unauthorized access to this device is prohibited!**". Tip: take this statement without quotations.
4. Specify an encrypted password on R1 as "**networkslab**".
5. Specify a password to prevent unauthorized access to the console of R1 as "**Laboratory 9**".
6. Specify a password to prevent unauthorized telnet access to R1 as "**Networks_lab_students**". To verify your configuration: click on PC-B, go to the command prompt tab, type telnet 192.168.0.1, then you are requested to enter the password of telnet to access to R1.
7. Enter the command that encrypts plain text passwords.
8. **Configure SSH on R1:**

   a. Configure the domain name to be "**ju.com**".

   b. Secure keys are needed to encrypt the data. Generate the RSA keys using a 1024 key length.

c. Create an "**administrator**" user with "**ssh123**" as the secret password.

d. Configure the VTY lines to check the local username database for login credentials.

e. Attempt to log in R1 using SSH from PC-A. Type **ssh -l administrator 192.168.1.1,** then enter **ssh123**

Hint: The -l option is the letter "L", not the number 1. Upon successful login, enter privileged EXEC mode and save the configuration.

9. Type this command to show the startup configuration file. R1#sh start. What do you observe?

Answer:

10. Save the running configuration into the NVRAM. Issue R1# show startup-config command to verify. What do you observe?

Answer:

11. Use TFTP server to **save configuration files and IOS Images**.
12. Discuss all the previous points with the lab supervisor.

<u>Experiment 2:</u> Basic Device Configuration (Real Devices)

In this experiment, you are requested to bull up a router and cables from the devices' cabinet in the lab. Thereafter, do the following in sequence:

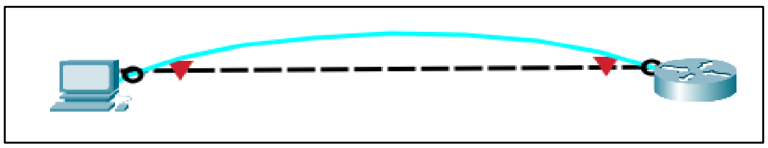


Figure 2: Network topology for experiment 2

- Cable the network as shown in Figure 2 with crossover cable between Ethernet interfaces of the devices and console cable for configuration as illustrated in the handout.
- Establish a *Console Session* using "**Putty**". Select appropriate serial port that your console cable is connected to (Device Manager→Ports (COM&LPT).
- You should see a response from the router via screen (press enter several times). If you were asked "Continue with configuration dialog? [yes/no]: ", then press no.
- Configure your router with the following taking into account that the words are **case-sensitive**:
  1. Set the device hostname to **"Router1"**
  2. Configure the MOTD banner to be **"Welcome to Computer Networks Lab"**.
  3. Set the secret password to **"cisco"**.
  4. Set the console access password to **"networks"**.
  5. Specify a password to prevent unauthorized telnet access as **"networkstelnet"**.
  6. Configure the router Giga0/0 interface (20.0.0.1/8).
  7. Configure the host computer (20.0.0.10/8) whereas the default gateway is the router interface. Particularly, follow these steps:

Go to (Control Panel→Network and Internet→Network and Sharing Center→Change Adapter settings→Right-click on the Local Area Connection icon, and select Properties→Highlight the Internet Protocol(TCP/IPv4) field, and select Properties)

- After performing all the lab procedure, do the following:
  1. Verify Router1's configuration using this command: Router1#show running-config command, how large is the configuration file in bytes?
  2. Verify host computer configuration with the ipconfig command from the command prompt of the host computer.
  3. Ping the router from the host computer (make sure the firewall is turned off), is it successful?
  4. Attempt to log in Router1 using telnet from PC command prompt window (to enable telenet on window, follow this: Control Panel→Programs and Features→turn windows features on or off→Telnet Client ✓). Type **telnet 20.0.0.1**. After the successful login, change the router name to "**NetworksLabRouter"**.
  5. Discuss all the previous points with the lab supervisor.

<u>Experiment 3:</u> Enabling Routing Protocols on Real Devices

In this experiment, you are requested to bull up routers and cables from the devices' cabinet in the lab. Thereafter, you are requested to cable the network as shown in Figure 3 with crossover cable between *Ethernet* interfaces of the devices and console cable for configuration as extensively illustrated in the handout.

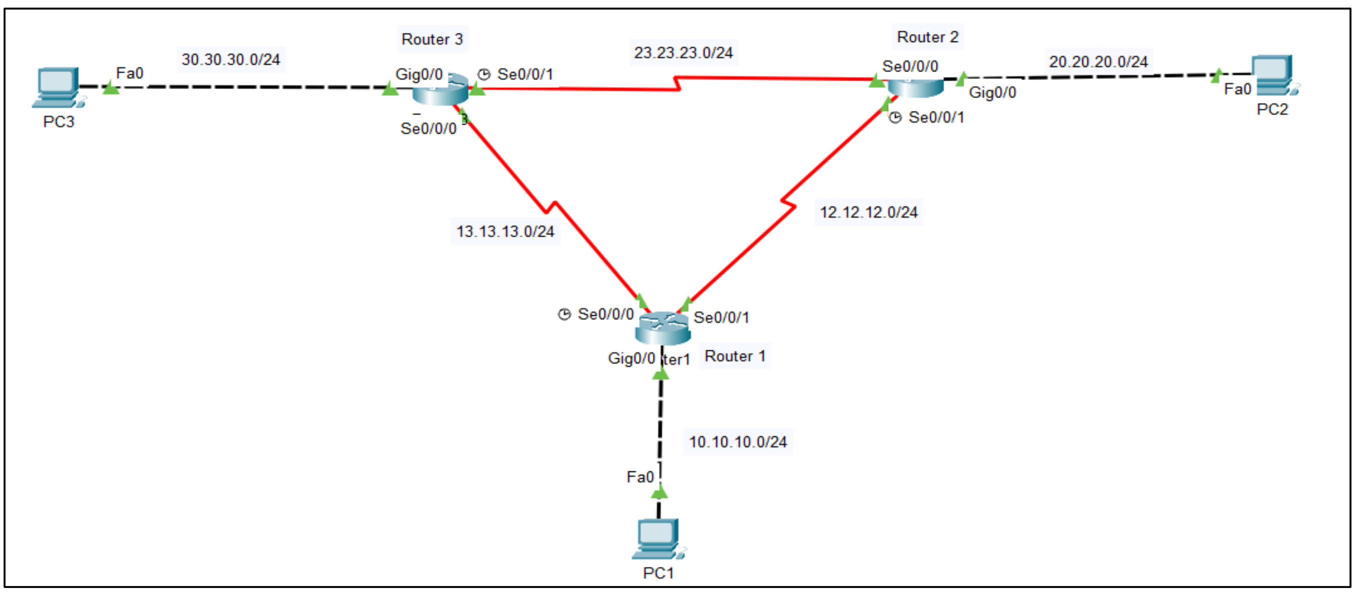


Figure 3: Network topology for experiment 3

To this end, you must follow these steps in sequence:

1. Configure the PCs and routers interfaces with the correct IP addresses as displayed in Table 2. You must be able to ping each PC with its default gateway. Tip: use the following command to verify the exact name of router interfaces (**show ip interface brief)**

2. `After that, you should enable the **RIP v2** routing protocol on each router with the correct network addresses to check the connectivity of your network and make sure that each device can reach another without any problems.
3. After that, you should enable the **OSPF** routing protocol on each router with the correct network address and wild mask to check the connectivity of your network and make sure that each device can reach another without any problems.
4. After that, you should enable the **EIGRP** routing protocol on each router with the correct network address and wild mask to check the connectivity of your network and make sure that each device can reach another without any problems.
5. The following are helpful commands to test the connectivity and check the configurations:
    a. **ping:** to test connectivity with neighboring devices.
    b. **telnet:** log in remotely to a device for accessing configuration information.
    c. **show ip interface brief:** to display the up or down status and IP address of all interfaces.
    d. **show running:** to display the configuration that you did by yourself.
    e. **show ip route:** to display the routing table in a router to learn the directly connected neighbors, more remote devices (through learned routes), and the routing protocols.

Table 2: Addressing Table for experiment 3

Device	Interface	Address		Subnet mask	Default gateway	Connected with
R1	Giga0/0	IPv4	10.10.10.1	255.0.0.0	--	PC1
	S0/0/0 (DCE)	IPv4	13.13.13.1	255.0.0.0	--	R3
	S0/0/1	IPv4	12.12.12.1	255.0.0.0	--	R2
R2	Giga0/0	IPv4	20.20.20.2	255.0.0.0	--	PC2
	S0/0/0	IPv4	23.23.23.1	255.0.0.0	--	R3
	S0/0/1(DCE)	IPv4	12.12.12.2	255.0.0.0	--	R1
R3	Giga0/0	IPv4	30.30.30.3	255.0.0.0	--	PC3
	S0/0/0	IPv4	13.13.13.2	255.0.0.0	--	R1
	S0/0/1(DCE)	IPv4	23.23.23.2	255.0.0.0	--	R2
PC1	Fa0	IPv4	10.10.10.10	255.0.0.0	10.10.10.1	R1
PC2	Fa0	IPv4	20.20.20.20	255.0.0.0	20.20.20.2	R2
PC3	Fa0	IPv4	30.30.30.30	255.0.0.0	30.30.30.3	R3

The End: Good Luck!