# Lab 3

## Routing Protocol using Packet Tracer

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**Introduction**

You are given a Packet Tracer file with a network topology shown in Figure 1 below, which requires some work on IP addressing and routing protocol configuration. You must follow all the steps carefully and answer the given questions.

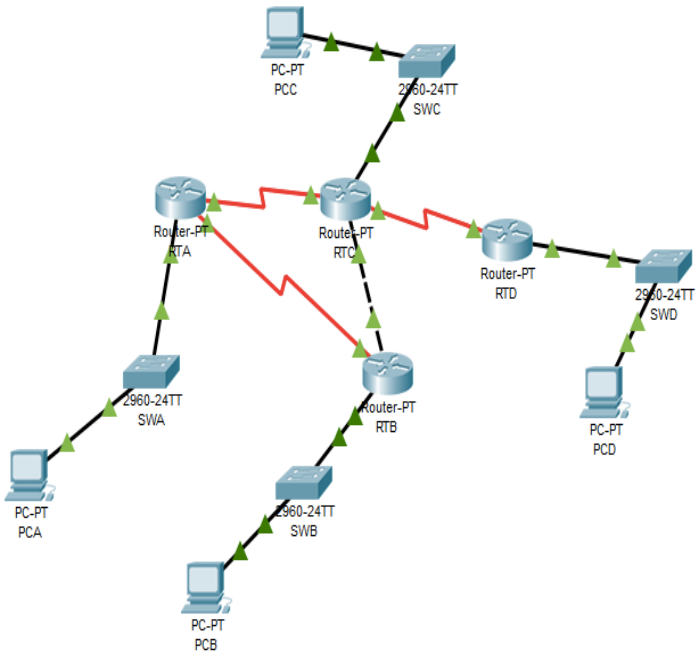



Figure 1

**Task 1: IP addressing**

**Step 1:** Fill in Table 1 (on next page) with the correct information. Note: The information may be found under the ***Config*** tab of each router (refer to Figure2).

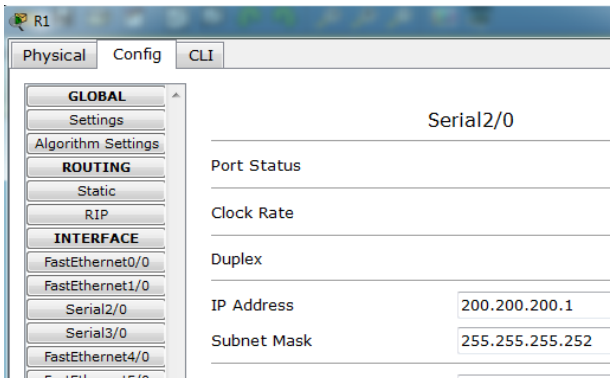



Figure 2

**Table 1**

| # | Device Name | Interface | IP Address | Subnet Mask |
|---|---|---|---|---|
| 1 | RTA | Se2/0 | 172.16.230.5 | 255.255.255.252 |
| 2 | | Se3/0 | 172.16.230.1 | 255.255.255.252 |
| 3 | | Fa0/0 | 172.16.224.255 | 255.255.254.0 |
| 4 | RTB | Se2/0 | 172.16.230.2 | 255.255.255.252 |
| 5 | | Fa0/0 | 172.16.230.9 | 255.255.255.252 |
| 6 | | Fa1/0 | 172.16.226.11 | 255.255.254.0 |
| 7 | RTC | Se2/0 | 172.16.230.6 | 255.255.255.252 |
| 8 | | Se3/0 | 172.16.230.13 | 255.255.255.252 |
| 9 | | Fa0/0 | 172.16.230.10 | 255.255.255.252 |
| 10 | | Fa1/0 | 172.16.228.11 | 255.255.255.0 |
| 10 | RTD | Se2/0 | 172.16.230.14 | 255.255.255.252 |
| 11 | | Fa0/0 | 172.16.229.222 | 255.255.255.0 |

**Step 2:** Based on the result and observation in **Step 1**, answer the following questions:

a. How many different subnets are there? **8**

b. What is the network address of each of these subnets? (*Hint: Given the IP address and the subnet mask, you can calculate the network address using logical **AND** operation*). Complete Table 2 below.

Table 2

| Subnet # | Network Address | Broadcast Address | Range of usable addresses |
|---|---|---|---|
| 1 | 172.16.224.0 | 172.16.225.255 | 172.16.224.1 - 172.16.225.254 |
| 2 | 172.16.230.0 | 172.16.230.3 | 172.16.230.1 - 172.16.230.2 |
| 3 | 172.16.226.0 | 172.16.227.255 | 172.16.226.1-172.16.227.254 |
| 4 | 172.16.230.4 | 172.16.230.7 | 172.16.230.5-172.16.230.6 |
| 5 | 172.16.230.12 | 172.16.230.15 | 172.16.230.13-172.16.230.14 |
| 6 | 172.16.230.8 | 172.16.230.11 | 172.16.230.9-172.16.230.10 |
| 7 | 172.16.228.0 | 172.16.228.255 | 172.16.228.1-172.16.228.254 |
| 8 | 172.16.229.0 | 172.16.229.255 | 172.16.229.1-172.16.229.254 |

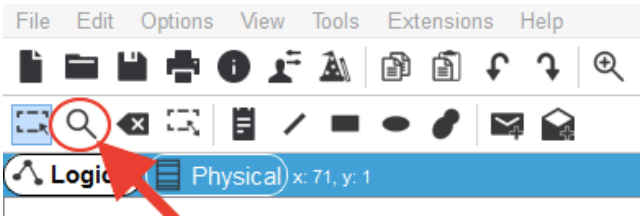
c. Provided that all PC will use the last usable address in its subnet, fill in Table 3 below with the correct information.

Table 3

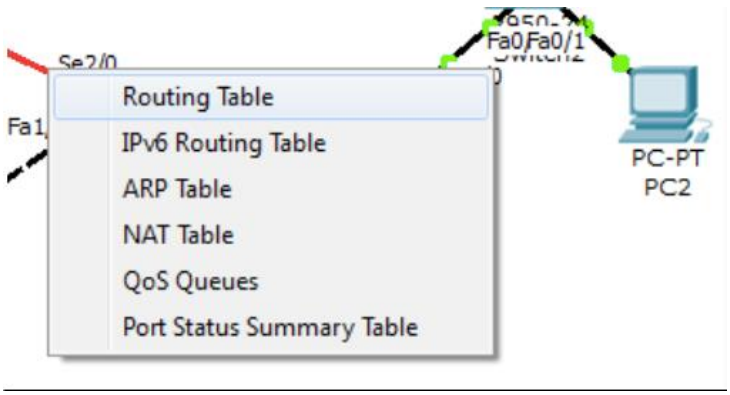
| # | Device Name | IP Address | Subnet Mask | Default Gateway |
|---|---|---|---|---|
| 1 | PCA | 172.16.225.254 | 255.255.254.0 | 172.16.224.255 |
| 2 | PCB | 172.16.227.254 | 255.255.254.0 | 172.16.226.11 |
| 3 | PCC | 172.16.228.254 | 255.255.255.0 | 172.16.228.11 |
| 4 | PCD | 172.16.229.254 | 255.255.255.0 | 172.16.229.222 |

**Step 3:** Complete the IP addressing information on all the PCs in the topology. (Hint: Click on the PC, choose the ***Desktop*** tab, then click ***IP Configuration***).

**Step 4:** Open the routing table for each router. *(Hint: you can use the 'magnifying glass' icon* from the secondary toolbar, *then point & click to a router and choose 'Routing Table'. See Figure 3 below.)*




(a)




(b)

Figure 3

**Step 5:** Copy the image of the routing table for each router. *(Hint: You can use Window's 'Print Scrn' command OR 'Snipping Tool' to copy / screenshot the image.)*

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.224.0/23 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.0/30 | Serial3/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |

Routing Table for RTB

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.226.0/23 | FastEthernet1/0 | --- | 0/0 |
| C | 172.16.230.0/30 | Serial2/0 | --- | 0/0 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |

Routing Table for RTC

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.228.0/24 | FastEthernet1/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.12/30 | Serial3/0 | --- | 0/0 |

Routing Table for RTD

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.229.0/24 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.12/30 | Serial2/0 | --- | 0/0 |

**Step 6:** Answer the questions below:

a. Do all the routers have the same information in its routing table?

No.

b. What is the difference that can be seen?

The network addresses are different from one and another.

c. Can all the PCs ping each other successfully? (Fill in the Table 4 below)

**Table 4**

| # | Ping between devices | Successful ☑ | Unsuccessful ☒ |
|---|---|---|---|
| 1 | PCA-PCB | | ☒ |
| 2 | PCA-PCC | | ☒ |
| 3 | PCA-PCD | | ☒ |
| 4 | PCB-PCC | ☑ | |
| 5 | PCB-PCD | | ☒ |
| 6 | PCC-PCD | | ☒ |

d. Reflection: what is the reason for your answer in (c)?

Most of them are unsuccessful because they cannot establish connections between each other.

**Task 2: Dynamic routing configuration – RIP**

Dynamic routing allows the network to be more flexible to changes. It can help the routers adapt to the changes in the pathways without much intervention from network administrators.

In this part of the lab, you will learn how to configure RIP routing protocol, and see how changes happen in the routing tables.

**Step 1:** Choose Router RTA. Click the **CLI** tab. Copy the following text into the command line interface.

```
RTA>enable
RTA#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
RTA(config)#router rip
RTA(config-router)#version 2
RTA(config-router)#network 172.16.0.0
RTA(config-router)#no auto-summary
RTA(config-router)#exit
RTA(config)#exit
RTA#
%SYS-5-CONFIG_I: Configured from console by console

RTA#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
RTA#
```

When asked this just press ENTER

**Task 1.1:**

(a) Copy (OR paste image / screenshot) of the RTA routing table here.

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.224.0/23 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.0/30 | Serial3/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |

**Step 2:** Choose Router RTB. Click the **CLI** tab. Copy the following text into the command line interface.

```
RTB>enable
RTB#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
RTB(config)#router rip
RTB(config-router)#version 2
RTB(config-router)#network 172.16.0.0
RTB(config-router)#no auto-summary
RTB(config-router)#exit RTB(config)#exit
RTB#
%SYS-5-CONFIG_I: Configured from console by console

RTB#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
RTB#
```

When asked this just press ENTER

**Task 2.1:**

(a) Copy (OR paste image / screenshot) of the RTA and RTB routing table below:

RTA:

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.224.0/23 | FastEthernet0/0 | --- | 0/0 |
| R | 172.16.226.0/23 | Serial3/0 | 172.16.230.2 | 120/1 |
| C | 172.16.230.0/30 | Serial3/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |
| R | 172.16.230.8/30 | Serial3/0 | 172.16.230.2 | 120/1 |

RTB:

Routing Table for RTB

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| R | 172.16.224.0/23 | Serial2/0 | 172.16.230.1 | 120/1 |
| C | 172.16.226.0/23 | FastEthernet1/0 | --- | 0/0 |
| C | 172.16.230.0/30 | Serial2/0 | --- | 0/0 |
| R | 172.16.230.4/30 | Serial2/0 | 172.16.230.1 | 120/1 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |

(b) **Reflection:** what difference do you see between routing tables of RTA and RTB?

The difference between the routing table are on the Next Hop IP. This is because the IP addresses are different from each other. However, their network address does not change.

**Step 3:** Copy the same configuration instructions to RTC and RTD ( as indicated in **Step 2**)

RTC:

Routing Table for RTC

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| R | 172.16.224.0/23 | Serial2/0 | 172.16.230.5 | 120/1 |
| R | 172.16.226.0/23 | FastEthernet0/0 | 172.16.230.9 | 120/1 |
| C | 172.16.228.0/24 | FastEthernet1/0 | --- | 0/0 |
| R | 172.16.229.0/24 | Serial3/0 | 172.16.230.14 | 120/1 |
| R | 172.16.230.0/30 | Serial2/0 | 172.16.230.5 | 120/1 |
| R | 172.16.230.0/30 | FastEthernet0/0 | 172.16.230.9 | 120/1 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.12/30 | Serial3/0 | --- | 0/0 |

RTD:

Routing Table for RTD

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| R | 172.16.224.0/23 | Serial2/0 | 172.16.230.13 | 120/2 |
| R | 172.16.226.0/23 | Serial2/0 | 172.16.230.13 | 120/2 |
| R | 172.16.228.0/24 | Serial2/0 | 172.16.230.13 | 120/1 |
| C | 172.16.229.0/24 | FastEthernet0/0 | --- | 0/0 |
| R | 172.16.230.0/30 | Serial2/0 | 172.16.230.13 | 120/2 |
| R | 172.16.230.4/30 | Serial2/0 | 172.16.230.13 | 120/1 |
| R | 172.16.230.8/30 | Serial2/0 | 172.16.230.13 | 120/1 |
| C | 172.16.230.12/30 | Serial2/0 | --- | 0/0 |

**Step 4:** Answer the questions below.

a. Do all the routers have the same information in its routing table?

No.

b. Write down routing table information (Next Hop IP, Metric) for RTC and RTD to the network 172.16.224.0/23

| | Next Hop IP | Metric |
|---|---|---|
| RTC | 172.16.230.5 | 120/1 |
| RTD | 172.16.230.13 | 120/2 |

c. What is the difference that can be seen? Why is this?

The Next Hop Ip and the metric are different. This is because RTC used FastEthernet 1/0 while RTD used FastEthernet 0/0.

d. Can all the PCs ping each other successfully? (Fill in the Table 5 below)

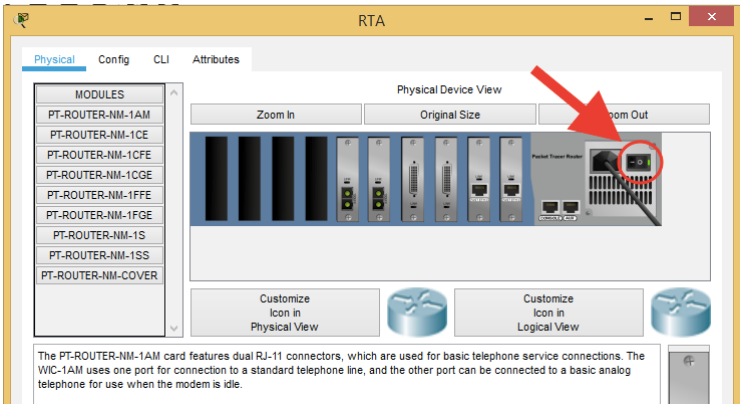
Table 5

| # | Ping between devices | Successful ☑ | Unsuccessful ☒ |
|---|---|---|---|
| 1 | PCA-PCB | ☑ | |
| 2 | PCA-PCC | ☑ | |
| 3 | PCA-PCD | ☑ | |
| 4 | PCB-PCC | ☑ | |
| 5 | PCB-PCD | | ☒ |
| 6 | PCC-PCD | ☑ | |

e. Reflection: what is the reason for your answer in (d)?

Some routers are not configured propoerly via the switches so they are not connected properly to each other. It makes the outcome to be one of it cannot ping correctly.

**Step 5:** Switch **off** router RTA. (Hint: Click on the RTA router (i.e. using the 'Select' tool =>  ), on the **Physical** tab, click the **ON/OFF switch** to turn ON or OFF, as shown below:)




What are the changes noted in the routing tables?

**Ans:** The routing table is blank.

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|

**Step 6:** Switch **on** router RTA. What are the changes noted in the routing tables?

**Ans:** All the routing table data is displayed back again.

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.224.0/23 | FastEthernet0/0 | --- | 0/0 |

**Step 7: Reflection:** What have you learned in this task?

**Ans:** All router configuration is saved in NVRAM. When there is no power, settings are preserved in NVRAM.

## Task 3: Dynamic routing configuration – OSPF

Make sure that you have all the routing tables on display on one side (as before). As you go through the steps, look at the changes happening in the routing tables.

**Step 1:** For all the routers, click the **CLI** tab and copy the following text into the command line interface.

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#no router rip
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

**Step 2:** Copy and paste the image of the routing table for each router below:

| | |
|---|---|
| RTA | Routing Table for RTA<br>Type Network Port Next Hop IP Metric<br>C 172.16.224.0/23 FastEthernet0/0 --- 0/0<br>C 172.16.230.0/30 Serial3/0 --- 0/0<br>C 172.16.230.4/30 Serial2/0 --- 0/0 |
| RTB | Routing Table for RTB<br>Type Network Port Next Hop IP Metric<br>C 172.16.226.0/23 FastEthernet1/0 --- 0/0<br>C 172.16.230.0/30 Serial2/0 --- 0/0<br>C 172.16.230.8/30 FastEthernet0/0 --- 0/0 |

RTC

Routing Table for RTC

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.228.0/24 | FastEthernet1/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.12/30 | Serial3/0 | --- | 0/0 |

RTD

Routing Table for RTD

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.229.0/24 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.12/30 | Serial2/0 | --- | 0/0 |

**Step 3:** For Router RTA, Click the **CLI** tab. Copy the following text into the command line interface.

```
RTA>enable
RTA# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
RTA(config)#router ospf 1
RTA(config-router)#network 172.16.224.0 0.0.1.255 area 0
RTA(config-router)#network 172.16.230.0 0.0.0.3 area 0
RTA(config-router)#network 172.16.230.4 0.0.0.3 area 0
RTA(config-router)#end
RTA#
%SYS-5-CONFIG_I: Configured from console by console

RTA# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
RTA#
```

**Task 3.1:** Copy and paste the image of RTA's routing table below:

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.224.0/23 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.0/30 | Serial3/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |

**Task 3.2:**

a. Does RTA have a path to ALL the different subnet?
No.

b. Try pinging the different PCs and jot down your results. (Fill in the Table 6 below)

Table 6

| # | Ping between devices | Result | Successful ☑ | Unsuccessful ☒ |
|---|---|---|---|---|
| 1 | PCA-PCB | Cisco Packet Tracer PC Command Line 1.0<br>C:\>ping 172.16.227.254<br><br>Pinging 172.16.227.254 with 32 bytes of data:<br><br>Request timed out.<br>Request timed out.<br>Request timed out.<br>Request timed out.<br><br>Ping statistics for 172.16.227.254:<br>Packets: Sent = 4, Received = 0, Lost = 4 (100% loss), | | ☒ |
| 2 | PCA-PCC | C:\> ping 172.16.228.254<br><br>Pinging 172.16.228.254 with 32 bytes of data:<br><br>Request timed out.<br>Request timed out.<br>Request timed out.<br>Request timed out.<br><br>Ping statistics for 172.16.228.254:<br>Packets: Sent = 4, Received = 0, Lost = 4 (100% loss), | | ☒ |
| 3 | PCA-PCD | C:\>ping 172.16.229.254<br><br>Pinging 172.16.229.254 with 32 bytes of data:<br><br>Request timed out.<br>Request timed out.<br>Request timed out.<br>Request timed out.<br><br>Ping statistics for 172.16.229.254:<br>Packets: Sent = 4, Received = 0, Lost = 4 (100% loss), | | ☒ |

**Step 4:** Configure the other routers with OSPF routing algorithm.

**Step 4.1:** For Router RTB, Click the **CLI** tab. Copy the following text into the command line interface.

```
RTA>enable
RTB# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
RTB(config)#router ospf 1
RTB(config-router)#network 172.16.226.0 0.0.1.255 area 0
RTB(config-router)#network 172.16.230.0 0.0.0.3 area 0
RTB(config-router)#network 172.16.230.8 0.0.0.3 area 0
RTB(config-router)#end
RTB#
%SYS-5-CONFIG_I: Configured from console by console

RTB# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
RTB#
```

**Step 4.2:** For Router RTC, Click the **CLI** tab. Copy the following text into the command line interface.

```
RTC>enable
RTC# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
RTC(config)#router ospf 1
RTC(config-router)#network 172.16.228.0 0.0.0.255 area 0
RTC(config-router)#network 172.16.230.4 0.0.0.3 area 0
RTC(config-router)#network 172.16.230.8 0.0.0.3 area 0
RTC(config-router)#network 172.16.230.12 0.0.0.3 area 0
RTC(config-router)#end
RTC#
%SYS-5-CONFIG_I: Configured from console by console

RTC# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
RTC#
```

**Step 4.3:** For Router RTD, Click the **CLI** tab. Copy the following text into the command line interface.

```
RTD>enable
RTD# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
RTD(config)#
RTD(config)#router ospf 1
RTD(config-router)#network 172.16.229.0 0.0.0.255 area 0
RTD(config-router)#network 172.16.230.12 0.0.0.3 area 0
RTD(config-router)#end
RTD#
%SYS-5-CONFIG_I: Configured from console by console

RTD# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
RTD#
```

**Step 5:** Copy the image of the routing table for each router and paste it here.

RTA

Routing Table for RTA

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| C | 172.16.224.0/23 | FastEthernet0/0 | --- | 0/0 |
| O | 172.16.226.0/23 | Serial3/0 | 172.16.230.2 | 110/65 |
| O | 172.16.228.0/24 | Serial2/0 | 172.16.230.6 | 110/65 |
| O | 172.16.229.0/24 | Serial2/0 | 172.16.230.6 | 110/129 |
| C | 172.16.230.0/30 | Serial3/0 | --- | 0/0 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |
| O | 172.16.230.8/30 | Serial3/0 | 172.16.230.2 | 110/65 |
| O | 172.16.230.8/30 | Serial2/0 | 172.16.230.6 | 110/65 |
| O | 172.16.230.12/30 | Serial2/0 | 172.16.230.6 | 110/128 |

RTB

Routing Table for RTB

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| O | 172.16.224.0/23 | Serial2/0 | 172.16.230.1 | 110/65 |
| C | 172.16.226.0/23 | FastEthernet1/0 | --- | 0/0 |
| O | 172.16.228.0/24 | FastEthernet0/0 | 172.16.230.10 | 110/2 |
| O | 172.16.229.0/24 | FastEthernet0/0 | 172.16.230.10 | 110/66 |
| C | 172.16.230.0/30 | Serial2/0 | --- | 0/0 |
| O | 172.16.230.4/30 | FastEthernet0/0 | 172.16.230.10 | 110/65 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |
| O | 172.16.230.12/30 | FastEthernet0/0 | 172.16.230.10 | 110/65 |

RTC

Routing Table for RTC

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| O | 172.16.224.0/23 | Serial2/0 | 172.16.230.5 | 110/65 |
| O | 172.16.226.0/23 | FastEthernet0/0 | 172.16.230.9 | 110/2 |
| C | 172.16.228.0/24 | FastEthernet1/0 | --- | 0/0 |
| O | 172.16.229.0/24 | Serial3/0 | 172.16.230.14 | 110/65 |
| O | 172.16.230.0/30 | FastEthernet0/0 | 172.16.230.9 | 110/65 |
| C | 172.16.230.4/30 | Serial2/0 | --- | 0/0 |
| C | 172.16.230.8/30 | FastEthernet0/0 | --- | 0/0 |
| C | 172.16.230.12/30 | Serial3/0 | --- | 0/0 |

RTD

Routing Table for RTD

| Type | Network | Port | Next Hop IP | Metric |
|---|---|---|---|---|
| O | 172.16.224.0/23 | Serial2/0 | 172.16.230.13 | 110/129 |
| O | 172.16.226.0/23 | Serial2/0 | 172.16.230.13 | 110/66 |
| O | 172.16.228.0/24 | Serial2/0 | 172.16.230.13 | 110/65 |
| C | 172.16.229.0/24 | FastEthernet0/0 | --- | 0/0 |
| O | 172.16.230.0/30 | Serial2/0 | 172.16.230.13 | 110/129 |
| O | 172.16.230.4/30 | Serial2/0 | 172.16.230.13 | 110/128 |
| O | 172.16.230.8/30 | Serial2/0 | 172.16.230.13 | 110/65 |
| C | 172.16.230.12/30 | Serial2/0 | --- | 0/0 |

**Step 6:** Switch off router RTA. What are the changes noted in the routing tables?

The routing table is blank.

**Step 7:** Switch on router RTA. Wait a few minutes. What are the changes noted in the routing tables?

All the routing table data is displayed back again.

**Step 8: Reflection:** What have you learned in this task?

Configuration of OSPF restore the connection to its previous state without requiring any new settings if one of the routers is turned off