Ex No: 7

Date:

PERFORMANCE ANALYSIS OF ROUTING PROTOCOLS USING SIMULATION TOOL.
A) Routing Information Protocol (RIP)
B) Open shortest Path First Protocol (OSPF)

Aim:

To configure and study the implementation of dynamic routing protocols, RIP (Routing Information Protocol) and OSPF (Open Shortest Path First), in a simulated network environment using Cisco Packet Tracer.

Theory:

Dynamic Routing is a method where routers automatically adjust the paths to network destinations based on current network conditions. Unlike static routing, where routes are manually configured, dynamic routing allows routers to share routing information and adapt to network changes such as link failures or topology changes.

A) **RIP (Routing Information Protocol)** is a distance-vector routing protocol that uses hop count as a routing metric. It periodically broadcasts its entire routing table to its neighbours every 30 seconds. RIP is simple but limited to smaller networks due to its maximum hop count of 15.

b) **OSPF (Open Shortest Path First)** is a link-state routing protocol that uses the Dijkstra algorithm to compute the shortest path to each network. Unlike RIP, OSPF sends routing updates only when there are changes in the network, making it more efficient for larger and more complex networks. OSPF supports hierarchical routing using areas, improving scalability and network management.

In this experiment, RIP and OSPF will be configured on routers within a simulated network environment using Cisco Packet Tracer. The performance and behavior of these protocols will be observed by examining how they populate the routing tables and handle network changes.

Routing Information Protocol (RIP) is an active routing protocol that operates hop count as a routing metric to find the most suitable route between the source and the destination network. It is a distance-vector routing protocol that has an AD value of 120 and works on the Network layer of the OSI model.

Steps to Configure and Verify Three Router Connections in Cisco Packet Tracer using RIP Routing:

Step 1: First, open the Cisco packet tracer desktop and select the devices given below:

S.NO	Device	Model Name	Qty.
1.	PC	PC	6
2.	Switch	PT-Switch	3
3.	Router	PT-router	3

IP Addressing Table:

S.NO	Device	IPv4 Address	Subnet mask	Default Gateway
1.	PC0	192.168.10.2	255.255.255.0	192.168.10.1
2.	PC1	192.168.10.3	255.255.255.0	192.168.10.1
3.	PC2	192.168.20.2	255.255.255.0	192.168.20.1

S.NO	Device	IPv4 Address	Subnet mask	Default Gateway
4.	PC3	192.168.20.3	255.255.255.0	192.168.20.1
5.	PC4	192.168.30.2	255.255.255.0	192.168.30.1
6.	PC5	192.168.30.3	255.255.255.0	192.168.30.1

- Then, create a network topology as shown below the image.
- Use an Automatic connecting cable to connect the devices with others.

Step 2: Configure the PCs (hosts) with IPv4 address and Subnet Mask according to the IP addressing table given above.

- To assign an IP address in PC0, click on PC0.
- Then, go to desktop and then IP configuration and there you will IPv4 configuration.
- Fill IPv4 address and subnet mask.
- Assigning an IP address using the ipconfig command, or we can also assign an IP address with the help of a command.
- Go to the command terminal of the PC.
- Then, type iPConfig <IPv4 address><subnet mask><default gateway>(if needed)

Example: iPConfig 192.168.10.2 255.255.255.0 192.168.10.1

 Repeat the same procedure with other PCs to configure them thoroughly.

Step 3: Configure router with IP address and Subnet mask.

IP Addressing Table Router:

S.NO	Device	Interface	IPv4 Address	Subnet mask
1.	router0	FastEthernet0/0	192.168.10.1	255.255.255.0
		Serial2/0	10.0.0.1	255.0.0.0
2.	router1	FastEthernet0/0	192.168.20.1	255.255.255.0
		Serial2/0	10.0.0.2	255.0.0.0
		Serial3/0	11.0.0.1	255.0.0.0
3.	router2	FastEthernet0/0	192.168.30.1	255.255.255.0
		Serial2/0	11.0.0.2	255.0.0.0

- To assign an IP address in router0, click on router0.
- Then, go to config and then Interfaces.
- Make sure to turn on the ports.
- Then, configure the IP address in FastEthernet and serial ports according to IP addressing Table.
- Fill IPv4 address and subnet mask.

 Repeat the same procedure with other routers to configure them thoroughly.

Step 4: After configuring all of the devices we need to assign the routes to the routers.

To assign RIP routes to the particular router:

- First, click on router0 then Go to CLI.

- Then type the commands and IP information given below.

CLI command : router rip

CLI command : network <network id>

RIP Routes for Router0 are given below:

Router(config)#router rip
Router(config-router)#network 192.168.10.0
Router(config-router)#network 10.0.0.0

RIP Routes for Router1 are given below:

Router(config)#router rip
Router(config-router)#network 192.168.20.0
Router(config-router)#network 10.0.0.0
Router(config-router)#network 11.0.0.0

RIP Routes for Router2 are given below:

Router(config)#router rip
Router(config-router)#network 192.168.30.0
Router(config-router)#network 11.0.0.0

Step 5: Verifying the network by pinging the IP address of any PC.

- We will use the ping command to do so.
- First, click on PC0 then Go to the command prompt.
- Then type ping <IP address of targeted node>.
- As we can see in the below image we are getting replies which means the connection is working properly.

Example : ping 192.168.20.2

A simulation of the experiment is given below we are sending PDU from PC0 to PC2 and PC3 to PC5

Steps to Execute – Input /Output Sections

(i)   Set Up Network Topology:

- Open Cisco Packet Tracer and create a new project.
- Add three routers, three switches, and six PCs to the workspace.
- Connect the routers to each other and to the switches using serial or Ethernet cables, and connect the PCs to the switches.

(ii)   Assign IP Addresses:

- Configure IP addresses on each router's interfaces to ensure proper communication.
- Example: Router 1 with 192.168.1.1/24 for LAN and 10.0.0.1/30 for WAN; similar configurations for Router 2 and Router 3.

(iii)   Configure RIP on Routers:

- Access the CLI of each router and enable RIP.
- Use network commands to add the directly connected networks to the RIP process.

(iv)   Configure OSPF on Routers:

- Access the CLI of each router and enable OSPF with router ospf 1.
- Use network commands to add networks to OSPF in area 0.

(v)   Verify and Test Configurations:

- Use the show ip route command on each router to verify that RIP and OSPF have correctly populated the routing tables.
- Test connectivity by pinging between PCs across different networks.

(vi)   Observe Dynamic Routing Behaviour:

- Simulate network changes (e.g., disconnect a link) and observe how RIP and OSPF update the routing tables automatically.
- Reconnect the link and verify that the network recovers and reestablishes the routes.

Output / Screenshot

RIP
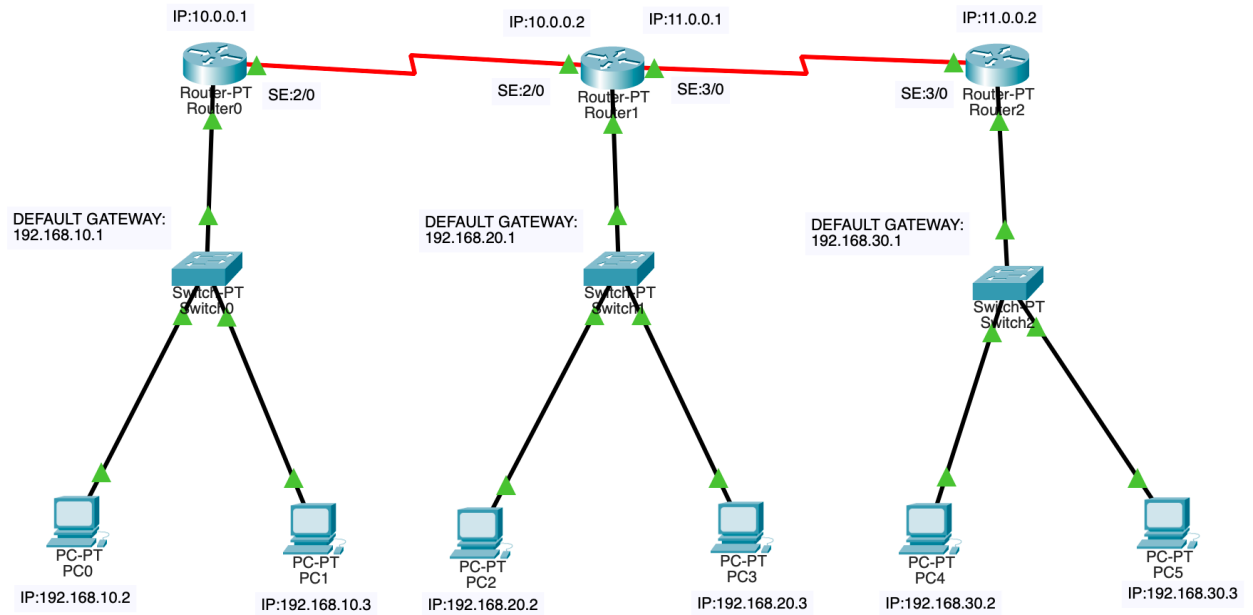
```
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#clear
% Incomplete command.
Router#
Router#
Router#enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.10.0
Router(config-router)#network 10.0.0.0
Router(config-router)#
```
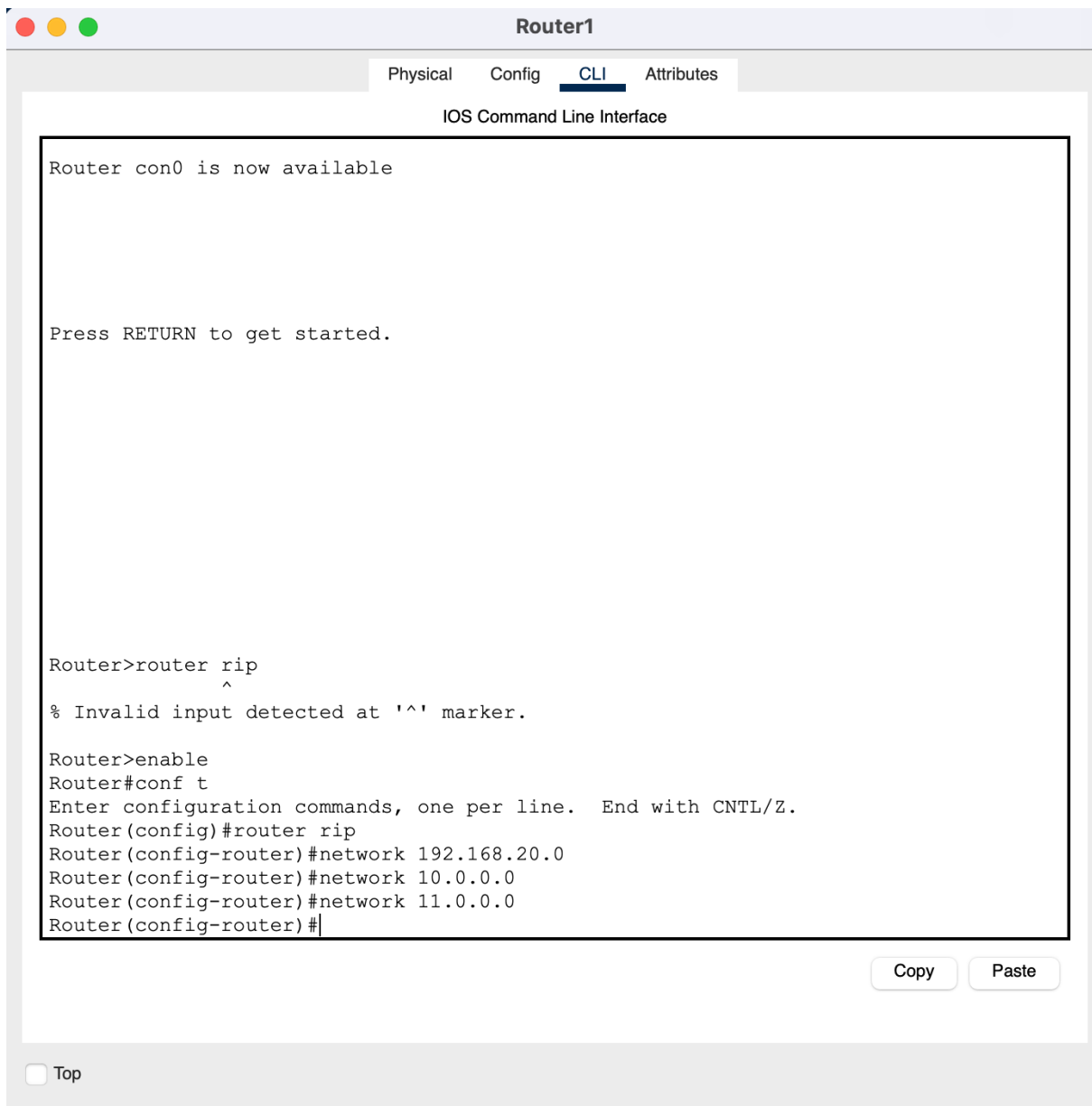
Physical   Config   CLI   Attributes

IOS Command Line Interface

```
Router con0 is now available




Press RETURN to get started.








Router>router rip
                ^
% Invalid input detected at '^' marker.

Router>enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.20.0
Router(config-router)#network 10.0.0.0
Router(config-router)#network 11.0.0.0
Router(config-router)#
```

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Physical   Config   **CLI**   Attributes
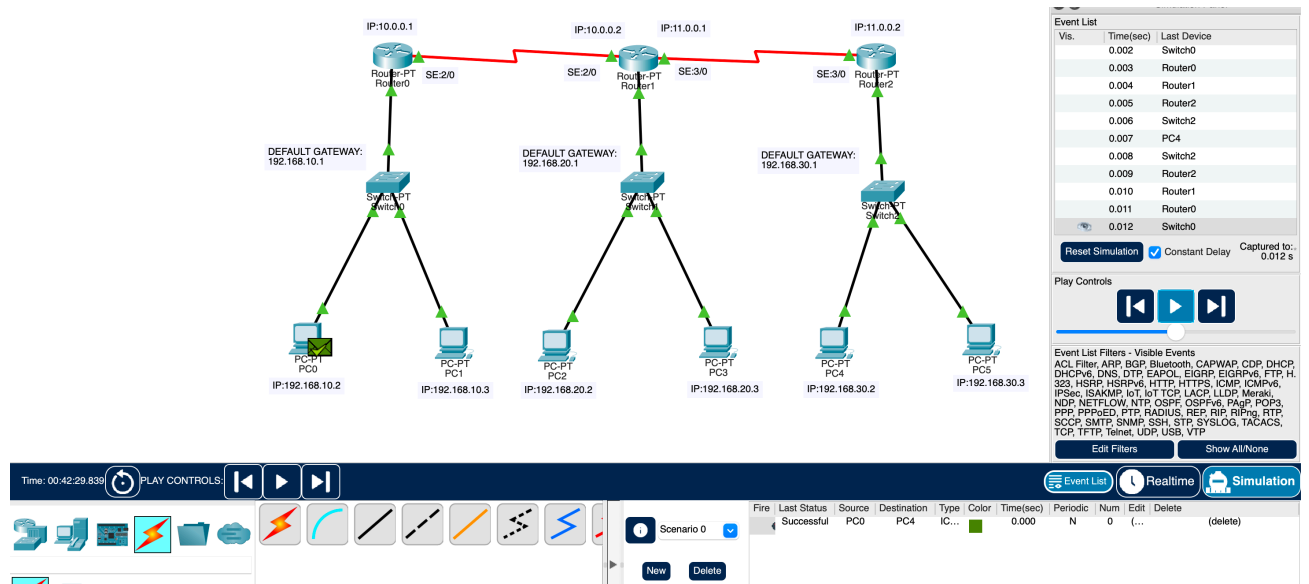
IOS Command Line Interface

```
Router(config)#router rip
Router(config-router)#network 19.168.30.0
Router(config-router)#network 11.0.0.0
Router(config-router)#network 192.168.30.0
Router(config-router)#clear
                        ^
% Invalid input detected at '^' marker.

Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#
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Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#
Router(config-router)#clear
                        ^
% Invalid input detected at '^' marker.

Router(config-router)#exit
Router(config)#router rip
Router(config-router)#network 192.168.30.0
Router(config-router)#network  11.0.0.0
Router(config-router)#
```
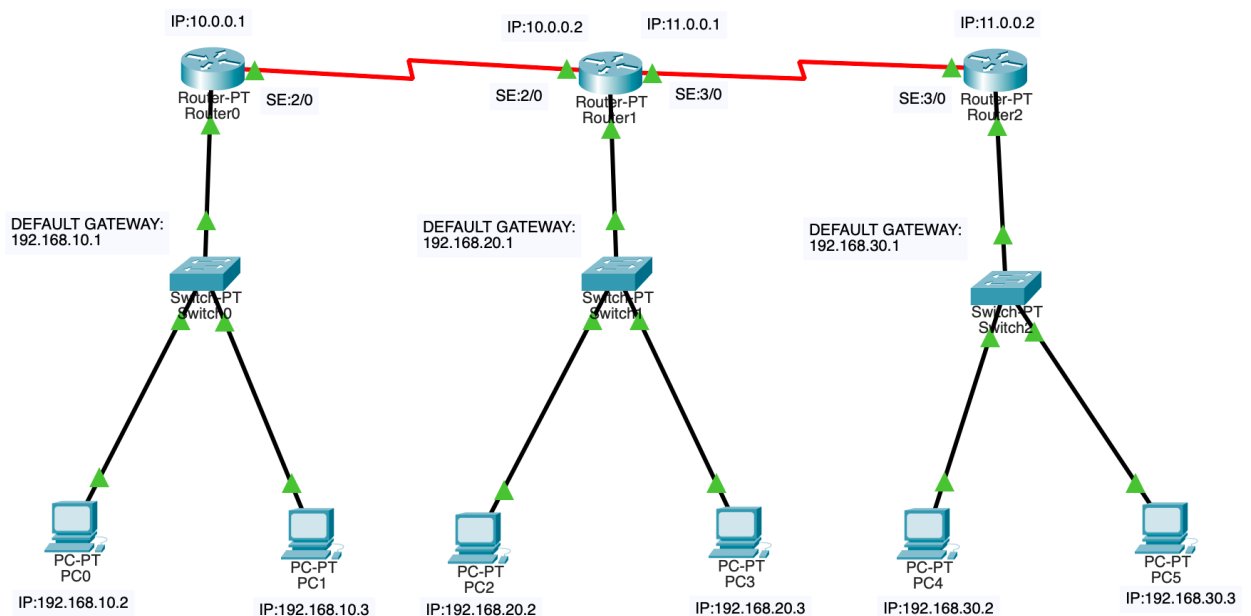
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OSPF

Router0

IOS Command Line Interface

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#exit
Router(config)#router ospf 1
Router(config-router)#network 192.168.10.0 0.0.0.255 area 0
Router(config-router)#router-id 10.0.0.1
Router(config-router)#Reload or use "clear ip ospf process" command, for this to take effect


Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    10.0.0.0/8 is directly connected, Serial2/0
R    11.0.0.0/8 [120/1] via 10.0.0.2, 00:00:03, Serial2/0
C    192.168.10.0/24 is directly connected, FastEthernet0/0
R    192.168.20.0/24 [120/1] via 10.0.0.2, 00:00:03, Serial2/0
R    192.168.30.0/24 [120/2] via 10.0.0.2, 00:00:03, Serial2/0

Router#show ip ospf
 Routing Process "ospf 1" with ID 192.168.10.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm executed 1 times
        Area ranges are
        Number of LSA 1. Checksum Sum 0x005d9a
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0

Router#
```

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Router1

Physical   Config   **CLI**   Attributes

IOS Command Line Interface

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#exit
Router(config)#router ospf 2
Router(config-router)#network 192.168.20.0 0.0.0.255 area 0
Router(config-router)#router-id 10.0.0.2
Router(config-router)#Reload or use "clear ip ospf process" command, for this to take effect


Router(config-router)#show ip route
                           ^
% Invalid input detected at '^' marker.

Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    10.0.0.0/8 is directly connected, Serial2/0
C    11.0.0.0/8 is directly connected, Serial3/0
R    192.168.10.0/24 [120/1] via 10.0.0.1, 00:00:25, Serial2/0
C    192.168.20.0/24 is directly connected, FastEthernet0/0
R    192.168.30.0/24 [120/1] via 11.0.0.2, 00:00:27, Serial3/0

Router#show ip ospf
 Routing Process "ospf 2" with ID 192.168.20.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm executed 1 times
        Area ranges are
        Number of LSA 1. Checksum Sum 0x0003d6
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

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Router2

Physical   **Config**   **CLI**   **Attributes**

IOS Command Line Interface

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#nterface FastEthernet 0/0
                ^
% Invalid input detected at '^' marker.

Router(config)#interface FastEthernet 0/0
Router(config-if)#exit
Router(config)#router ospf 3
Router(config-router)#network 192.168.30.0 0.0.0.255 area 0
Router(config-router)#router-id 11.0.0.2
Router(config-router)#Reload or use "clear ip ospf process" command, for this to take effect


Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

R    10.0.0.0/8 [120/1] via 11.0.0.1, 00:00:14, Serial2/0
C    11.0.0.0/8 is directly connected, Serial2/0
R    192.168.10.0/24 [120/2] via 11.0.0.1, 00:00:14, Serial2/0
R    192.168.20.0/24 [120/1] via 11.0.0.1, 00:00:14, Serial2/0
C    192.168.30.0/24 is directly connected, FastEthernet0/0

Router#show ip ospf
 Routing Process "ospf 3" with ID 192.168.30.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm executed 1 times
        Area ranges are
        Number of LSA 1. Checksum Sum 0x00a813
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```
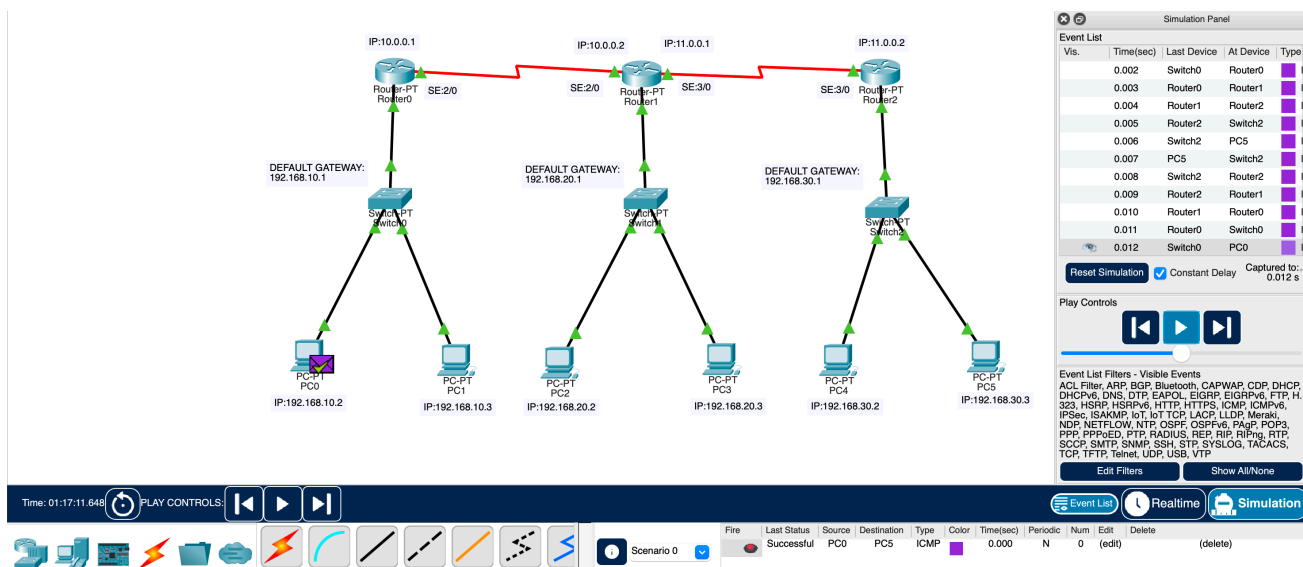
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Result:

Thus, the RIP (Routing Information Protocol) and OSPF (Open Shortest Path First)
is studied and the dynamic routing protocols implemented in a simulated
environment using Cisco Packet Tracer.