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Computer Networks

Lab No.: 7

Configuration of Dynamic Routing using OSPF

Objectives:

- ❖ To be familiar with OSPF and its configuration

Requirements:

- ❖ Network simulation tool: Packet Tracer

OSPF:

- An Interior Gateway Protocol (IGP)
- Uses a link-state algorithm to build and calculate the shortest path to all known destinations
- Propagates link-state advertisements rather than routing table updates ● Because only LSAs are exchanged instead of the entire routing tables, OSPF networks converge more quickly than RIP networks
- Each router in an OSPF area contains an identical link-state database, which is a list of each of the router usable interfaces and reachable neighbors

Wildcard Masks:

- It is 32 bits long like a subnet mask, and used to specify a range of network addresses ● With wildcard mask, the zero bits indicate that the corresponding bit position must match the same bit position in the IP address and the one bits indicate that the corresponding bit position doesn't have to match the bit position in the IP address ● Used with routing protocols (like OSPF) and ACLs

Configuration of OSPF:

Enable OSPF on a router by using the `router ospf PROCESS-ID` global configuration command. The process ID should be within the 16-bit number range i.e. from 1 to 65535.

The OSPF process number doesn't have to be the same on all routers in order to establish a neighbor relationship.

Next we need to define on which interfaces OSPF will run and what networks will be advertised, which is done by using the `network IP_ADDRESS WILDCARD_MASK AREA_ID` command from the ospf configuration mode.

The Area ID has to be the same on all neighboring routers in order for routers to become neighbors.

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Steps:

- enable
- configure terminal
- router ospf process-id
- network ip-address wildcard-mask area area-id
- end

Example:

- `R1> enable`
- `R1# configure terminal`
- `R1(config)# router ospf 1`
- `R1(config-router)# network 102.108.109.16 0.0.0.3 area 0`
- `R1(config-router)# end`

Configuration in Router R1

- `R1(config)# router ospf 1`
- `R1(config-router)# network 10.0.1.0 0.0.0.255 area 0` ● `R1(config-router)# network 172.16.0.0 0.0.255.255 area 0`

Configuration in Router R2

- `R2(config)# router ospf 1`
- `R2(config-router)# network 192.168.0.0 0.0.0.255 area 0` ● `R2(config-router)# network 172.16.0.0 0.0.255.255 area 0`

Different show commands that can be used to test & verify OSPF routing

- `Show ip route`
- `Show ip route ospf`
- `Show ip ospf neighbor`

Multi-Area OSPF

The given OSPF area is divided into multiple smaller areas to have multiarea OSPF. Multiarea OSPF is useful for larger network deployments to optimize the processing and memory overhead for routing. Multiarea OSPF requires a hierarchical network design. In multiarea OSPF, the backbone area and non-backbone area is connected by a router called an ABR (area border router). Similarly, ASBR is used to exchange routing information with other AS.

The configurations of a router having multiple areas is shown in following example:

- `R3(config)#router ospf 1`
- `R3(config-router)#network 19.16.10.0 0.0.0.255 area 0`
- `R3(config-router)#network 19.16.11.0 0.0.0.255 area 1`

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Activities:

Configuration of OSPF

A. Create the network topology as shown in figure 1 and perform the following activities:

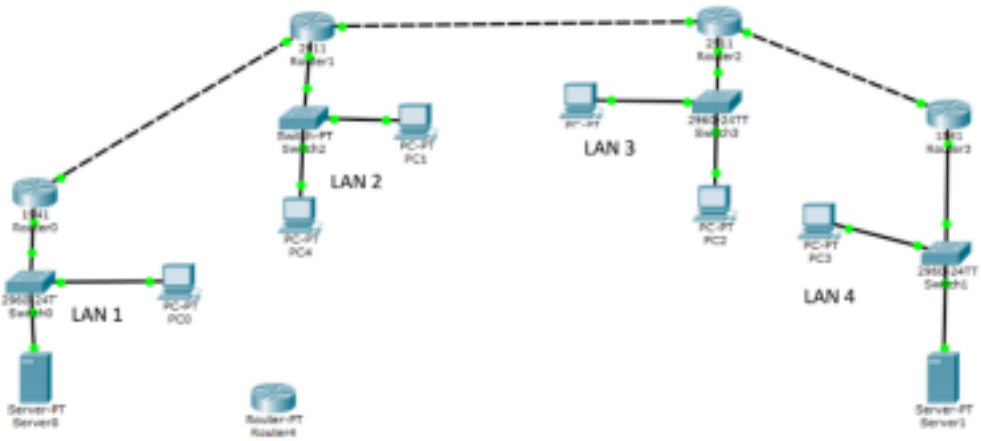

Figure 1: Network Topology 1

1. You have given an IP address of 200.100.100.0/24. You have to divide this address range for different LANs i.e. LAN1, LAN2, LAN3 and LAN4 interconnected as shown in figure above, having 55, 25, 10 and 45 numbers of hosts respectively. In addition to this there are few networks having only two hosts in each (i.e. connection between two routers). Allocate the IP address range for each of the sub-networks with their network address, broadcast address and subnet mask. Also list out the unused range of IP addresses (if any).

2. On the basis of your designed subnets, configure IP addresses for each interface of routers. Also configure the IP address and default gateway of each PC & server. 3. Enable routing in between LANs using **OSPF**. Consider all networks in **area 0**. 4. Test the connectivity from a PC of any LAN to the PC of any other LAN using ping. Assume all the networks are in a single area of "area 0".
5. Note down the result of traceroute using `tracert` command from PC0 to PC3
6. Observe the routing table in each router by using `show ip route` command.

B. Now Connect additional router as shown in figure 2:

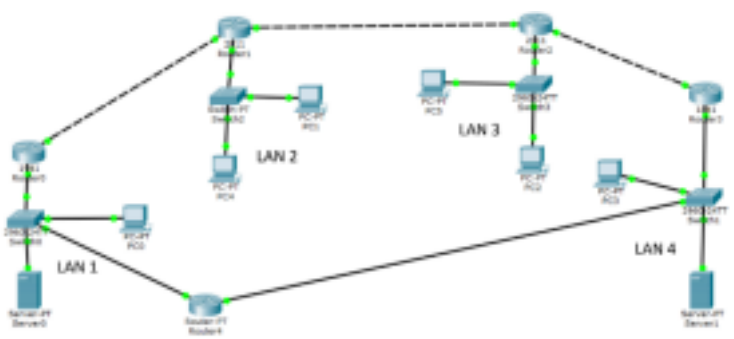

Figure 2: Network Topology 2

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1. Configure the interfaces of Router4 with appropriate IP addresses and enable **OSPF** in it. Now note down the result of `tracert` command from PC0 to PC3 and compare the result with previous activity.
2. Observe the routing table in each router using `show ip route` command and compare it with previous activity.
3. Remove a link i.e. the link between router 4 and switch 0 and then observe the result of traceroute command from PC0 to PC3 and routing table in each router. Compare the result of the previous steps i.e. step 1 and step 2. Note down how the routing is updated to address the changing topology.
4. Again connect the link and observe the routing table of each router. Also observe the result of `tracert` command from PC0 to PC1.
5. Remove another link between Router0 and Router1.
6. Observe the routing table of each router as well as the result of `tracert` command from PC0 to PC1 and compare the result with step 4.
7. Similarly you can observe by removing and connecting other links.
8. Compare with that of RIP in previous lab exercises.

C. Suppose you have obtained the IP addresses of 24.24.24.0/21 from APNIC. You have to divide this address range for different departments with the required number of hosts as given in the table. The networks of departments are interconnected as shown in figure 3. In addition to this there are some networks having only two hosts in each (links between two routers). List out the IP address range for each of the sub-networks with their network address, broadcast address and subnet mask. Also list out the remaining range of IP addresses (if any).

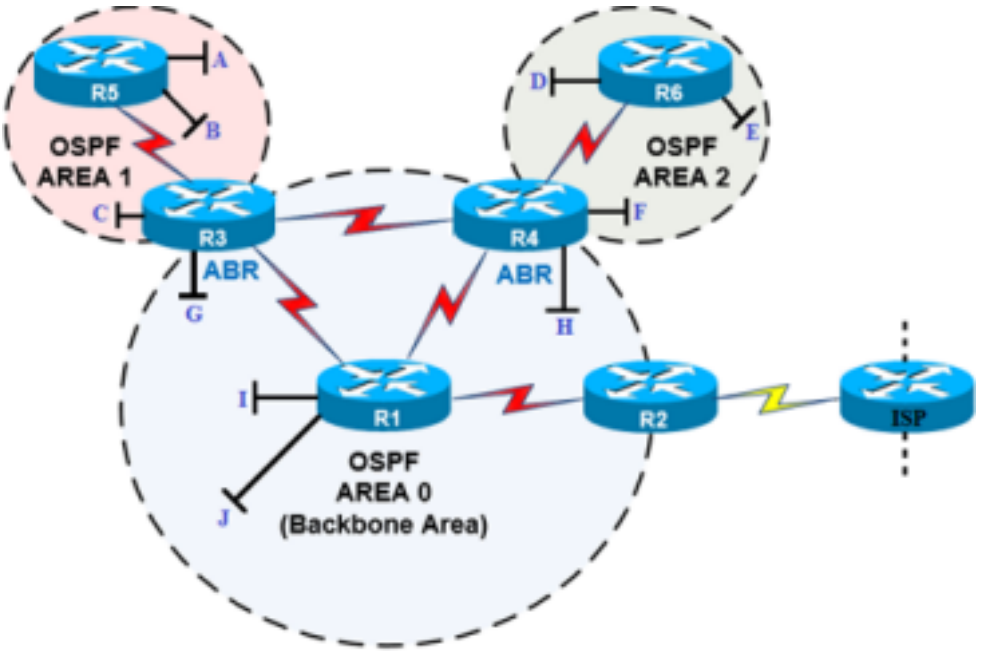

Figure 3: Network Topology 3

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Department's Name	A	B C D E F G H	I	J
No. of hosts	400	500 90 100 80 200 40 20	110	120

Table: List of hosts in different networks

1. Create the network as shown in figure 3, in which for each network use at least one PC connected to the router via a switch. [You have to use **serial link** for point-to-point connection between routers as shown in figure 3]
2. On the basis of your designed subnet, configure each interface of the router with appropriate IP addresses & subnet mask. Similarly configure the appropriate IP address, subnet mask and default gateway on each computer. However you can use an IP network of **/30** to connect router R2 with ISP router.
3. Observe and note down the output of the command `show ip route` in each router.
4. Configure the OSPF in all routers with respective networks and areas (refer figure 3). 5. Observe and note down the output of the command `show ip route` in each router. 6. Test the connectivity from the computer of each network to the computer of each other networks.
7. Observe the output of traceroute from a computer of network A to the computer of each other networks and each IP of routers. Similarly, observe from the computers of other networks such as D, J and so on.
8. Observe the output of tracert from the computer of network A to 1.1.1.1. Similarly, observe from the computers of other networks such as D, J and so on.
9. Now configure the default route in each router to forward any Internet traffic toward ISP Router. Also configure a static route in the ISP router to forward the packets destined for our network.
10. Observe and note down the output of the command `show ip route` in each router. 11. Observe the output of `tracert` from the computer of network A to 1.1.1.1. Compare the result with that of step 9. Similarly, observe from the computers of other networks such as D, J and so on.
12. Remove the link between router R1 and R3 and observe the routing table of routers in area 0. Also the output of tracert from the computer of network A to 1.1.1.1. Again observe the output of the tracert by removing the link between R1 and R4 and reconnecting the link between R1 and R3.

Note: You can observe the routing table of different routers by removing a link and reconnecting the link again. Similarly you can observe the output of tracert by removing a link and reconnecting the link, to understand the working of dynamic routing.

Exercises:

1. What is OSPF? How does it differ from RIP? Explain OSPF configurations with examples.

2. What is multi-area OSPF? Why is it used? How can the multi-area OSPF be configured? Explain with examples.
3. How can dynamic routing address the changing topology of the network? Explain with reference to the observation of your lab exercise.

4. Note down the observation of each step with necessary commands specified in activities A, B and C mentioned above and comment on the result by explaining the reason in detail.

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