Module Practice and Quiz

2.7.1

Packet Tracer - Single-Area OSPFv2 Configuration

You are helping a network engineer test an OSPF set up by building the network in the lab where you work. You have interconnected the devices and configured the interfaces and have connectivity within the local LANs. Your job is to complete the OSPF configuration according to the requirements left by the engineer.

In this Packet Tracer activity, use the information provided and the list of requirements to configure the test network. When the task has been successfully completed, all hosts should be able to ping the Internet server.

Single-Area OSPFv2 Configuration

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2.7.2

Lab - Single-Area OSPFv2 Configuration

Skills Practice Opportunity

You have the opportunity to practice the following skills:

- Part 1: Build the network and configure basic device settings
- Part 2: Configure and verify single-area OSPFv2 for basic operation
- Part 3: Optimize and verify the single-area OSPFv2 configuration

You can practice these skills using the Packet Tracer or lab equipment, if available.

Packet Tracer - Physical Mode (PTPM)

Configure Single-Area OSPFv2 - Physical Mode

Configure Single-Area OSPFv2 - Physical Mode

Lab Equipment

Configure Single-Area OSPFv2

2.7.3

Packet Tracer - Multiarea OSPF Exploration

This Packet Tracer exploration activity is divided into three parts and uses Packet Tracer Physical Mode (PTPM):

Part 1: The Beginning

Casual Recording Company, based in Sao Paulo, Brazil, provides self-serve, mini-recording studios around the city so that anyone can rent a timeslot and record their songs by themselves. CRC began with a single area OSPF network located in one building. This idea was very popular and consequently the business has grown, creating the company to expand into a branch office in a second building at the far end of the city. They continued to use single-area OSPF. You will evaluate the impact of the expanded network.

Multiarea OSPF Exploration - Physical Mode (Part 1)

Multiarea OSPF Exploration - Physical Mode (Part 1)

Part 2: Business Is Booming

The IT department in CRC decided to migrate to a multiarea OSPF network. You will evaluate the impact and benefits derived from the change to determine if it was a good decision or not.

Multiarea OSPF Exploration - Physical Mode (Part 2)

Multiarea OSPF Exploration - Physical Mode (Part 2)

Part 3: CRC Expansion Continues

CRC has continued to grow and will open a new branch office in Montevideo, Uruguay. You will configure the Area Border Router for the new area and physically connect the branch office network to the corporate headquarters network through the Internet.

Multiarea OSPF Exploration - Physical Mode (Part 3)

Multiarea OSPF Exploration - Physical Mode (Part 3)

2.7.4

What did I learn in this module?

OSPF Router ID

OSPFv2 is enabled using the **router ospf** *process-id* global configuration mode command. The *process-id* value represents a number between 1 and 65,535 and is selected by the network administrator. An OSPF router ID is a 32-bit value, represented as an IPv4 address. The router ID is used by an OSPF-enabled router to synchronize OSPF databases and participate in the election of the DR and BDR. Cisco routers derive the router ID based on one of three criteria, in the following preferential order:

1. The router ID is explicitly configured using the OSPF **router-id** *rid* router configuration mode command. The *rid* value is any 32-bit value expressed as an IPv4 address.
2. If the router ID is not explicitly configured, the router chooses the highest IPv4 address of any of configured loopback interfaces.
3. If no loopback interfaces are configured, then the router chooses the highest active IPv4 address of any of its physical interfaces.

The router ID can be assigned to a loopback interface. The IPv4 address for this type of loopback interface should be configured using a 32-bit subnet mask (255.255.255.255), creating a host route. A 32-bit host route would not get advertised as a route to other OSPF routers. After a router selects a router ID, an active OSPF router does not allow the router ID to be changed until the router is reloaded or the OSPF process is reset. Use the **clear ip ospf process** command to reset the adjacencies. You can then verify that R1 is using the new router ID command with the **show ip protocols** command piped to display only the router ID section.

Point-to-Point OSPF Networks

The network command is used to determine which interfaces participate in the routing process for an OSPFv2 area. The basic syntax for the **network** command is **network** *network address wildcard mask* **area** *area-id*. Any interfaces on a router that match the network address in the **network** command can and that receive OSPF packets. When configuring single-area OSPFv2, the **network** command must be configured with the same *area-id* value on all routers. The wildcard mask is typically the inverse of the subnet mask configured on that interface. In a wildcard mask:

- **Wildcard mask bit 0** – Matches the corresponding bit value in the address
- **Wildcard mask bit 1** – Ignores the corresponding bit value in the address

Within routing configuration mode, there are two ways to identify the interfaces that will participate in the OSPFv2 routing process. One way is when the wildcard mask is configured with the network command, all interfaces on the router that match the network address will be configured with an IPv4 address belonging to that network will participate in the OSPFv2 routing process. The other way is OSPFv2 can be enabled by specifying the exact interface IPv4 address using a quad zero wildcard mask. To configure OSPF directly on the interface, use the **ip ospf** interface configuration mode command. The syntax is **ip ospf** *process-id* **area** *area-id*. Sending out unneeded messages on a LAN affects the network through inefficient use of bandwidth and resources, and creates an increased security risk. Use the **passive-interface** *router configuration mode* command to stop transmitting routing messages through a router interface, but still allow that network to be advertised to other routers. The **show ip protocols** command is then used to verify that the Loopback 0 interface is listed as passive. The DR/ BDR election process is unnecessary as there can only be two routers on the point-to-point network between R1 and R2. Use the interface configuration command **ip ospf network point-to-point** on all interfaces where you want to disable the DR/BDR election process. Use loopbacks to simulate more networks than the equipment can support. By default, loopback interfaces are advertised as /32 host routes. To simulate a real LAN, the Loopback 0 interface is configured as a point-to-point network.

OSPF Network Types

Routers can be connected to the same switch to form a multiaccess network. Ethernet LANs are the most common example of broadcast multiaccess networks. In broadcast networks, all devices on the network see all broadcast and multicast frames. The DR is responsible for collecting and distributing LSAs . The DR uses the multicast IPv4 address 224.0.0.5 which is meant for all OSPF routers. If the DR stops producing Hello packets, the BDR promotes itself and assumes the role of DR. All other routers become a DROTHER. DROTHERs use the multicasts address 224.0.0.6 (all designated routers) to send OSPF packets to the DR and BDR. Only the DR and BDR listen for 224.0.0.6. To verify the roles of the OSPFv2 router, use the **show ip ospf interface** command. To verify the OSPFv2 adjacencies, use the **show ip ospf neighbour** command. The state of neighbors in multiaccess networks can be:

- **FULL/DROTHER** – This is a DR or BDR router that is fully adjacent with a non-DR or BDR router.
- **FULLER** – The router is fully adjacent with the indicated DR neighbor.
- **FULLBDR** – The router is fully adjacent with the indicated BDR neighbor.
- **2-WAY/DROTHER** – The non-DR or BDR router has a neighbor relationship with another non-DR or BDR router.

The OSPF DR and BDR election decision is based on the following criteria, in sequential order:

1. The routers in the network elect the router with the highest interface priority as the DR. The router with the second highest interface priority is elected as the BDR. The priority can be configured to be any number between 0 – 255. If the interface priority value is set to 0, that interface cannot be elected as DR nor BDR. The default interface priority value for multiaccess is 1. Therefore, unless otherwise configured, all routers have an equal priority value and must rely on another tie breaking method during the DR/BDR election.
2. If the interface priorities are equal, then the router with the highest router ID is elected the DR. The router with the second highest router ID is the BDR.

OSPF DR and BDR elections are not pre-emptive. If the DR fails, the BDR is automatically promoted to DR. This is the case even if another DROTHER with a higher priority or router ID is added to the network after the initial DR/BDR election. However, after a BDR is promoted to DR, a new BDR election occurs and the DROTHER with the highest priority or router ID is elected as the new BDR. To set the priority of an interface, use the command **ip ospf priority** *value*, where value is 0 to 255. If the value is 0, the router will not become a DR or BDR. If the value is 1 to 255, then the router with the higher priority value will more likely become the DR or BDR on the interface.

Modify Single-Area OSPFv2

OSPF uses cost as a metric. A lower cost indicates a better path than a higher cost. The Cisco cost of an interface is inversely proportional to the bandwidth of the interface. Therefore, a higher bandwidth indicates a lower cost. The formula used to calculate the OSPF cost is: Cost = reference bandwidth / interface bandwidth. Because the OSPF cost value must be an integer, FastEthernet, Gigabit Ethernet, and 10 Gigd Interfaces share the same cost. To correct this situation, you can adjust the reference bandwidth with the **auto-cost reference–bandwidth** command on each OSPF router, or manually set the OSPF cost value with the **ip ospf cost** command. To adjust the reference bandwidth, use the **auto-cost reference-bandwidth** *Mbps* router configuration command. The cost of an OSPF route is the accumulated value from one router to the destination network. OSPF cost values can be manipulated to influence the route chosen by OSPF. To change the cost value report by the local OSPF router to other OSPF routers, use the interface configuration command **ip ospf cost** *value*. If the Dead Interval expires before the routers receive a Hello packet, OSPF removes that neighbor from its link-state database (LSDB). The router floods the LSDB with information about the down neighbor out all OSPF-enabled interfaces. Cisco uses a default of 4 times the Hello Interval or 40 seconds on multiaccess and point-to-point networks. To verify the OSPFv2 Interface Intervals, use the **show ip ospf Interface** command. OSPFv2 Hello and Dead Intervals can be modified manually using the following interface configuration mode commands: **ip ospf hello-interval** *seconds* and **ip ospf dead-interval** *seconds*.

Default Route Propagation

In OSPF terminology, the router located between an OSPF routing domain and a non-OSPF network is called the ASBR. To propagate a default route, the ASBR must be configured with a default static route using the **ip route 0.0.0.0 0.0.0.0** *{next-hop address | exit-int}* command, and the **default-information originate** *router configuration* command. This instructs the ASBR to be the source of the default route information and propagate the default static route in OSPF updates. Verify the default route settings on the ASBR using the **show ip route** command.

Verify Single-Area OSPFv2

The following two commands are used to verify routing:

- **show ip interface brief** – Used to verify that the desired interfaces are active with correct IP addressing.
- **show ip route**– Used to verify that the routing table contains all the expected routes.

Additional commands for determining that OSPF is operating as expected include: **show ip ospf neighbor**, **show ip protocols**, **show ip ospf**, and **show ip ospf interface**.

Use the **show ip ospf neighbor** command to verify that the router has formed an adjacency with its neighboring routers. For each neighbor, this command displays:

- **Neighbor ID** – The router ID of the neighboring router.
- **Pri** – The OSPFv2 priority of the interface. This value is used in the DR and BDR election.
- **State** – The OSPFv2 state of the interface. FULL state means that the router and its neighbor have identical OSPFv2 LSDBs. On multiaccess networks, such as Ethernet, two routers that are adjacent may have their states displayed as 2WAY. The dash indicates that no DR or BDR is required because of the network type.
- **Dead Time** – The amount of time remaining that the router waits to receive an OSPFv2 Hello packet from the neighbor before declaring the neighbor down. This value is reset when the interface receives a Hello packet.
- **Address** – The IPv4 address of the neighbor's interface to which this router is directly connected.
- **Interface** – The interface on which this router has formed adjacency with the neighbor.

The **show ip protocols** command is a quick way to verify vital OSPF configuration information such as the OSPFv2 process ID, the router ID, interfaces explicitly configured to advertise OSPF routes, the neighbors the router is receiving updates from, and the default administrative distance, which is 110 for OSPF. Use the **show ip ospf** command to examine the OSPFv2 process ID and router ID. This command displays the OSPFv2 area information and the last time the SPF algorithm was executed. The **show ip ospf interface** command provides a detailed list for every OSPFv2-enabled interface. Specify an interface for just one interface to display the process ID, the local router ID, the type of network, OSPF cost, DR and BDR information on multiaccess links, and adjacent neighbors.

2.7.5

Module Quiz - Single-Area OSPFv2 Configuration

1. Which criterion is preferred by the router to choose a router ID?
   - the IP address of the highest configured loopback interface on the router
   - [x] the **router-id** rid command
   - the IP address of the highest active OSPF-enabled interface
   - the IP address of the highest active interface on the router
2. Which wildcard mask would be used to advertise the 192.168.5.96/27 network as part of an OSPF configuration?
   - 0.0.0.32
   - 255.255.255.224
   - 255.255.255.223
   - [x] 0.0.0.31
3. The following three networks are directly connected to an OSPF router; 192.168.0.0/24, 192.168.1.0/24, and 192.168.2.0/24. Which OSPF network command would advertise only the 192.168.1.0 network to neighbors?
   - router(config-router)# **network 192.168.1.0 0.0.0.0 area 0**
   - router(config-router)# **network 192.168.0.0 0.0.1.255 area 0**
   - [x] router(config-router)# **network 192.168.1.0 0.0.0.255 area 0**
   - router(config-router)# **network 192.168.1.0 255.255.255.255 area 0**
4. Which three parameters should match in order for a pair of routers to form an adjacency when running OSPFv2? (Choose three.)
   - interface priority
   - [x] subnet mask
   - [x] OSPFv2 type of network
   - router ID
   - [x] hello timer
   - OSPFv2 process number
5. What are two features of the OSPF routing protocol? (Choose two.)
   - has an administrative distance of 100
   - [x] uses Dijkstra's algorithm to build the SPF tree
   - used primarily as an EGP
   - automatically summarizes networks at the classful boundaries
   - [x] calculates its metric using bandwidth
6. A router with two LAN interfaces, two WAN interfaces, and one configured loopback interface is operating with OSPF as its routing protocol. What does the router OSPF process use to assign the router ID?
   - the IP address of the interface that is configured with priority 0
   - the highest IP address on the LAN interfaces
   - the OSPF area ID that is configured on the interface with the highest IP address
   - the highest IP address that is configured on the WAN interfaces
   - [x] the loopback interface IP address
7. Which verification command would identify the specific interfaces on a router that were configured with the **passive-interface** command?
   - **show ip interface brief**
   - [x] **show ip protocols**
   - **show ip route ospf**
   - **show ip ospf neighbors**
8. Which command, if applied on an OSPF router, would give a Gigabit Ethernet interface a lower cost than a Fast Ethernet interface?
   - (config-rt)# **ip ospf priority 1**
   - [x] (config-router)# **auto-cost reference-bandwidth 1000**
   - (config-rt)# **bandwidth 100**
   - (config-rt)# **ip ospf cost 100**
9. A network administrator has just changed the router ID on a router that is working in an OSPFv2 environment. What should the administrator do to reset the adjacencies and use the new router ID?
   - Change the interface priority.
   - [x] Issue the **clear ip ospf process** privileged mode command.
   - Configure the network statements.
   - Change the OSPFv2 process ID.
10. Which command can be used to view the OSPF hello and dead time intervals?
    - **show ip ospf route**
    - **show ip protocols**
    - **show ip ospf neighbor**
    - [x] **show ip ospf interface**
11. What does the SPF algorithm consider to be the best path to a network?
    - The path with the least number of hops.
    - The path that includes the fastest single bandwidth link.
    - The path with the smallest delays.
    - [x] The path that includes the fastest cumulative bandwidth links.
12. What is one use of the router ID in OSPF routing?
    - The router ID indicates the highest IPv4 address of all routers that are participating in OSPF routing.
    - [x] The router ID can be used to break a tie in the election process.
    - The router ID indicates the router priority value.
    - The router ID identifies the OSPF area.
13. What is the first criterion used by OPSF routers to elect a DR?
    - highest router ID
    - highest IP address
    - highest MAC address
    - [x] highest priority
14. Which command could be used on a router to ensure that an OSPF adjacency is formed with another router?
    - **show ip interface brief**
    - [x] **show ip ospf neighbor**
    - **show ip ospf interface**
    - **show ip protocols**
    - **show ip route**
15. A router in an OSPF enterprise network has a default static route that has been configured via the interface that connects to the ISP. Which command would the network administrator apply on this router so that other routers in the OSPF network will use this default route?
    - **redistribute static subnets**
    - **redistribute connected**
    - [x] **default-information originate**
    - **redistribute static**

Check

Show Me

Reset