Module Practice and Quiz

1.4.1

What did I learn in this module?

OSPF Features and Characteristics

Open Shortest Path First (OSPF) is a link-state routing protocol that was developed as an alternative for the distance vector Routing Information Protocol (RIP). OSPF has significant advantages over RIP in that it offers faster convergence and scales to much larger network implementations. OSPF is a link-state routing protocol that uses the concept of areas for scalability. A link is an interface on a router. A link is also a network segment that connects two routers, or a stub network such as an Ethernet LAN that is connected to a single router. All link-state information includes the network prefix, prefix length, and cost. All routing protocols use routing protocol messages to exchange route information. The messages help build data structures, which are then processed using a routing algorithm. Routers running OSPF exchange messages to convey routing information using five types of packets: the Hello packet, the database description packet, the link-state request packet, the link-state update packet, and the link-state acknowledgment packet. OSPF messages are used to create and maintain three OSPF databases: the adjacency database creates the neighbor table, the link-state database (LSDB) creates the topology table, and the forwarding database creates the routing table. The router builds the topology table using results of calculations based on the Dijkstra SPF (shortest-path first) algorithm. The SPF algorithm is based on the cumulative cost to reach a destination. In OSPF, cost is used to determine the best path to the destination. To maintain routing information, OSPF routers complete a generic link-state routing process to reach a state of convergence:

1. Establish Neighbor Adjacencies
2. Exchange Link-State Advertisements
3. Build the Link State Database
4. Execute the SPF Algorithm
5. Choose the Best Route

With single-area OSPF any number can be used for the area, best practice is to use area 0. Single-area OSPF is useful in smaller networks with few routers. With multiarea OSPF, one large routing domain can be divided into smaller areas, to support hierarchical routing. Routing still occurs between the areas (interarea routing), while many of the processor intensive routing operations, such as recalculating the database, are kept within an area. OSPFv3 is the OSPFv2 equivalent for exchanging IPv6 prefixes. Recall that in IPv6, the network address is referred to as the prefix and the subnet mask is called the prefix-length.

OSPF Packets

OSPF uses the following link-state packets (LSPs) to establish and maintain neighbor adjacencies and exchange routing updates: 1 Hello, 2 DBD, 3 LSR, 4 LSU, and 5 LSAck. LSUs are also used to forward OSPF routing updates, such as link changes. Hello packets are used to:

- Discover OSPF neighbors and establish neighbor adjacencies.
- Advertise parameters on which two routers must agree to become neighbors.
- Elect the Designated Router (DR) and Backup Designated Router (BDR) on multiaccess networks like Ethernet. Point-to-point links do not require DR or BDR.

Some important fields in the Hello packet are type, router ID, area ID, network mask, hello interval, router priority, dead interval, DR, BDR and list of neighbors.

OSPF Operation

When an OSPF router is initially connected to a network, it attempts to:

- Create adjacencies with neighbors
- Exchange routing information
- Calculate the best routes
- Reach convergence

The states that OSPF progresses through to do this are down state, init state, two-way state, ExStart state, Exchange state, loading state, and full state. When OSPF is enabled on an interface, the router must determine if there is another OSPF neighbor on the link by sending a Hello packet that contains its router ID out all OSPF-enabled interfaces. The Hello packet is sent to the reserved All OSPF Routers IPv4 multicast address 224.0.0.5. Only OSPFv2 routers will process these packets. When a neighboring OSPF-enabled router receives a Hello packet with a router ID that is not within its neighbor list, the receiving router attempts to establish an adjacency with the initiating router. After the Two-Way state, routers transition to database synchronization states, which is a three step process:

1. Decide First Router
2. Exchange DBDs
3. Send an LSR

Multiaccess networks can create two challenges for OSPF regarding the flooding of LSAs: the creation of multiple adjacencies and extensive flooding of LSAs. A dramatic increase in the number of routers also dramatically increases the number of LSAs exchanged between the routers. This flooding of LSAs significantly impact the operation of OSPF. If every router in a multiaccess network had to flood and acknowledge all received LSAs to all other routers on that same multiaccess network, the network traffic would become quite chaotic. This is why DR and BDR election is necessary. On multiaccess networks, OSPF elects a DR to be the collection and distribution point for LSAs sent and received. A BDR is also elected in case the DR fails.

1.4.2

Module Quiz - Single-Area OSPFv2 Concepts

1. What is a function of OSPF hello packets?
   - ○ to send specifically requested link-state records
   - ○ to request specific link-state records from neighbor routers
   - ○ to ensure database synchronization between routers
   - ● to discover neighbors and build adjacencies between them

2. Which OSPF packet contains the different types of link-state advertisements?
   - ● LSU
   - ○ hello
   - ○ DBD
   - ○ LSAck
   - ○ LSR

3. Which three statements describe features of the OSPF topology table? (Choose three.)
   - ☑ It is a link-state database that represents the network topology.
   - ☐ After convergence, the table only contains the lowest cost route entries for all known networks.
   - ☐ Its contents are the result of running the SPF algorithm.
   - ☑ The table can be viewed via the **show ip ospf database** command.
   - ☐ The topology table contains feasible successor routes.
   - ☑ When converged, all routers in an area have identical topology tables.

4. What does an OSPF area contain?
   - ○ routers whose SPF trees are identical
   - ● routers that have the same link-state information in their LSDBs
   - ○ routers that share the same process ID
   - ○ routers that share the same router ID

5. A router is participating in an OSPFv2 domain. What will always happen if the dead interval expires before the router receives a hello packet from an adjacent DROTHER OSPF router?
   - ○ OSPF will run a new DR/BDR election.
   - ○ SPF will run and determine which neighbor router is "down".
   - ● OSPF will remove that neighbor from the router link-state database.
   - ○ A new dead interval timer of 4 times the hello interval will start.

6. What is the order of packet types used by an OSPF router to establish convergence?
   - ○ LSAck, Hello, DBD, LSU, LSR
   - ○ Hello, LSAck, LSU, LSR, DBD
   - ○ LSU, LSAck, Hello, DBD, LSR
   - ● Hello, DBD, LSR, LSU, LSAck

7. What is a feature of the OSPF routing protocol?
   - ○ Routers can be grouped into autonomous systems to support a hierarchical system.
   - ○ OSPF authentication is configured in the same way on IPv4 and IPv6 networks.
   - ● It scales well in both small and large networks.
   - ○ The SPF algorithm chooses the best path based on 30-second updates.

8. What is used to create the OSPF neighbor table?
   - ○ forwarding database
   - ○ link-state database
   - ● adjacency database
   - ○ routing table

9. What is identical on all OSPF routers within a single area?
   - ○ static routes
   - ● link-state database
   - ○ routing table
   - ○ neighbor table

10. What function is performed by the OSPF designated router?
    - ○ redistribution of external routes into OSPF
    - ○ summarizing routes between areas
    - ○ maintaining the link-state database
    - ● dissemination of LSAs

11. What are two reasons for creating an OSPF network with multiple areas? (Choose two.)
    - ☐ to provide areas in the network for routers that are not running OSPF
    - ☐ to simplify configuration
    - ☑ to reduce use of memory and processor resources
    - ☐ to ensure that an area is used to connect the network to the Internet
    - ☑ to reduce SPF calculations

12. At which OSPF state are neighbor routers converged and able to exchange routing updates?
    - ○ Two-Way
    - ○ Exchange
    - ○ ExStart
    - ● Full

13. The OSPF hello timer has been set to 15 seconds on a router in a point-to-point network. By default, what is the dead interval on this router?
    - ○ 15 seconds
    - ● 60 seconds
    - ○ 45 seconds
    - ○ 30 seconds

14. What happens immediately after two OSPF routers have exchanged hello packets and have formed a neighbor adjacency?
    - ○ They negotiate the election process if they are on a multiaccess network.
    - ○ They request more information about their databases.
    - ○ They exchange DBD packets in order to advertise parameters such as hello and dead intervals.
    - ● They exchange abbreviated lists of their LSDBs.

15. Which statement is correct about multiarea OSPF?
    - ○ All routers are in one area called the backbone area (area 0).
    - ● Arranging routers into areas partitions a large autonomous system in order to lighten the load on routers.
    - ○ OSPF can consolidate a fragmented OSPF area into one large area.
    - ○ OSPF multiarea increases the frequency of SPF calculation.

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