Instructor Materials
Chapter 10: OSPF Tuning and Troubleshooting

CCNA Routing and Switching

Scaling Networks

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Chapter 10: OSPF Tuning and Troubleshooting

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Chapter 10 - Sections & Objectives

- 10.1 Advanced Single-Area OSPF Configurations
  - Configure OSPF to improve network performance.
- 10.2 Troubleshooting Single-Area OSPF Implementations
  - Troubleshoot common OSPF configuration issues in a small to medium-sized business network.

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10.1 Advanced Single-Area OSPF Configurations

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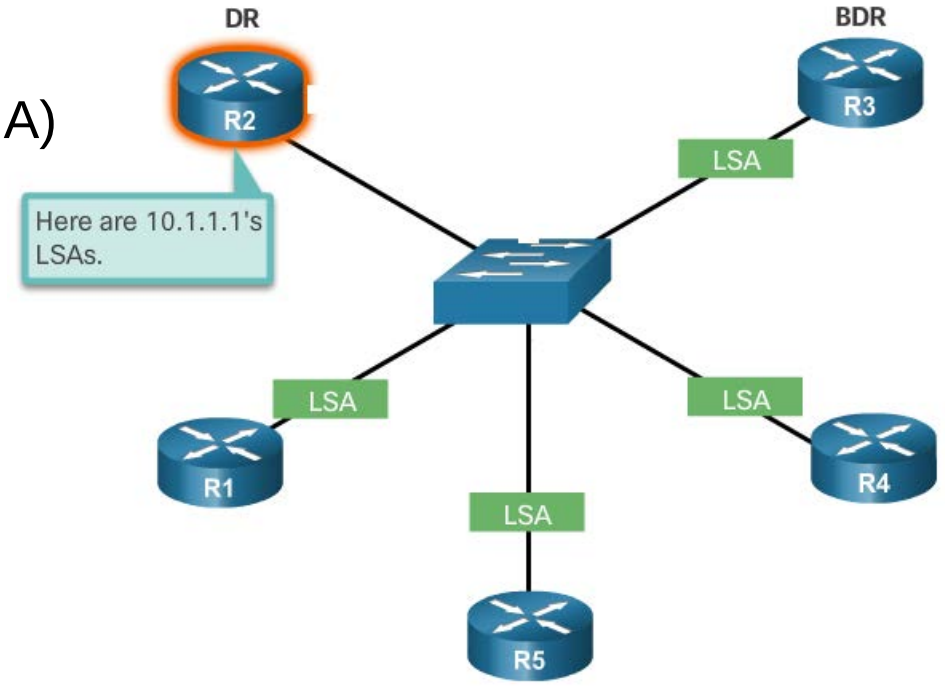
OSPF in Multiaccess Networks

- OSPF Network Types
  - Point-to-point
  - Broadcast multiaccess
  - Nonbroadcast multiaccess (NBMA)
  - Point-to-multipoint
  - Virtual links
- OSPF challenges for OSPF
  - Creation of multiple adjacencies
  - Extensive flooding of LSAs
- OSPF Designated Router
  - OSPF elects a DR to be the collection and distribution point for LSAs sent and received.



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OSPF in Multiaccess Networks (Cont.)

- Verifying DR/BDR Roles
  - To verify the roles of the OSPFv2 router, use the **show ip ospf interface** command.
  - For the equivalent OSPFv3 command, simply substitute **ip** with **ipv6**.
- Verifying DR/BDR Adjacencies
  - To verify the OSPFv2 adjacencies, use the **show ip ospf neighbor** command.
  - The normal state for an OSPF router is usually FULL.
- Default DR/BDR Election Process
  - 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 OSPF Priority
  - To configure the OSPF priority, use the **ip ospf priority** *value* interface command. For the equivalent OSPFv3 command, simply substitute **ip** with **ipv6**.
  - With the OSPF priority of 0, the router does not become a DR or BDR.
  - For values 1 – 255, the higher the value, the more likely the router becomes the DR or BDR on the interface.

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Default Route Propagation

- Propagating a Default Static Route in OSPFv2
  - To propagate a default route, the edge router must be configured with:
    - A default static route using the **ip route 0.0.0.0 0.0.0.0** {*ip-address* **|** *exit-intf*} command.
    - The **default-information originate** router configuration mode command.
- Verifying the Propagated IPv4 Default Route
  - Verify the default route settings on using the **show ip route** command

```
R2# show ip route | begin Gateway

Gateway of last resort is 209.165.200.226 to network 0.0.0.0

S* 0.0.0.0/0 [1/0] via 209.165.200.226, Loopback0
   172.16.0.0/16 is variably subnetted, 5 subnets, 3 masks
O  172.16.1.0/24 [110/65] via 172.16.3.1, 00:01:44,
   Serial0/0/0
C  172.16.2.0/24 is directly connected, GigabitEthernet0/0
L  172.16.2.1/32 is directly connected, GigabitEthernet0/0
C  172.16.3.0/30 is directly connected, Serial0/0/0
L  172.16.3.2/32 is directly connected, Serial0/0/0
O  192.168.1.0/24 [110/65] via 192.168.10.10, 00:01:12,
   Serial0/0/1
   192.168.10.0/24 is variably subnetted, 3 subnets, 2
    masks
O  192.168.10.4/30 [110/128] via 192.168.10.10, 00:01:12,
   Serial0/0/1
           [110/128] via 172.16.3.1, 00:01:12, Serial0/0/0
C  192.168.10.8/30 is directly connected, Serial0/0/1
L  192.168.10.9/32 is directly connected, Serial0/0/1
   209.165.200.0/24 is variably subnetted, 2 subnets, 2
    masks
C  209.165.200.224/30 is directly connected, Loopback0
L  209.165.200.225/32 is directly connected, Loopback0
R2#
```


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Default Route Propagation (Cont.)

- Propagating a Default Static Route in OSPFv3
  - The process of propagating a default static route in OSPFv3 is almost identical to OSPFv2
  - To propagate a default route, the edge router must be configured with:
    - A default static route using the **ipv6 route ::/0** {*ipv6-address* | *exit-intf*} command
    - The **default-information originate** router configuration mode command.
- Verifying the Propagated IPv6 Default Route
  - Verify the default static route setting on R2 using the **show ipv6 route static** command

```
R2# show ipv6 route static
IPv6 Routing Table - default - 12 entries
Codes:C -Connected, L - Local, S - Static, U - Per-user Static route
      B -BGP, R - RIP, H - NHRP, I1 - ISIS L1
      I2 -ISIS L2, IA - ISIS interarea, IS-ISIS summary,D-EIGRP
      EX -EIGRP external, ND-ND Default,NDp-ND Prefix,
      DCE-Destination, NDr -Redirect, O - OSPF Intra,OI-OSPF Inter
      OE1-OSPF ext 1, OE2 -OSPF ext 2, ON1 - OSPF NSSA ext 1
      ON2 - OSPF NSSA ext 2
S   ::/0 [1/0]
     via 2001:DB8:FEED:1::2, Loopback0
R2#
```


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Fine-tuning OSPF Interfaces

- OSPF Hello and Dead Intervals
  - The OSPF Hello and Dead intervals are configurable on a per-interface basis.
  - The OSPF intervals must match or a neighbor adjacency does not occur.
- Modifying OSPFv2 Intervals
  - OSPFv2 Hello and Dead intervals can be modified manually:
    - **ip ospf hello-interval** *seconds*
    - **ip ospf dead-interval** *seconds*
  - Use the **no ip ospf hello-interval** and **no ip ospf dead-interval** commands to reset the intervals to their default.

```
R2(config)# interface serial 0/0/0
R2(config-if)# ip ospf hello-interval 5
R2(config-if)#
*Apr  7 17:41:49.001: %OSPF-5-ADJCHG: Process 10, Nbr 1.1.1.1
on Serial0/0/0 from LOADING to FULL, Loading Done
R2(config-if)# end
R2#
```


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Fine-tuning OSPF Interfaces (Cont.)

- Modifying OSPFv3 Intervals
  - OSPFv2 Hello and Dead intervals can be modified manually:
    - **ipv6 ospf hello-interval** *seconds*
    - **ipv6 ospf dead-interval** *seconds*
  - Use the **no ipv6 ospf hello-interval** and **no ipv6 ospf dead-interval** commands to reset the intervals to their default.

```
R1(config)# interface serial 0/0/0
R1(config-if)# ipv6 ospf hello-interval 5
R1(config-if)# ipv6 ospf dead-interval 20
R1(config-if)# end
R1#
*Apr 10 15:03:51.175: %OSPFv3-5-ADJCHG: Process 10, Nbr
2.2.2.2 on Serial0/0/0 from FULL to DOWN, Neighbor Down:
Dead timer expired
R1#
```


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10.2 Troubleshooting Single-Area OSPF Implementations

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Components of Troubleshooting Single-Area OSPF

OSPF adjacencies will not form if:

- The interfaces are not on the same network.
- OSPF network types do not match.
- OSPF Hello or Dead Timers do not match.
- Interface to neighbor is incorrectly configured as passive.
- There is a missing or incorrect OSPF **`network`** command.
- Authentication is misconfigured.
- Each interface must be properly addressed and in the " up and up" condition.

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Components of Troubleshooting Single-Area OSPF (Cont.)

- OSPF States
  - When troubleshooting OSPF neighbors, be aware that the FULL or 2WAY states are normal.
  - All other states are transitory.
- OSPF Troubleshooting Commands
  - **show ip protocols**
  - **show ip ospf neighbor**
  - **show ip ospf interface**
  - **show ip ospf**
  - **show ip route ospf**
  - **clear ip ospf** [*process-id*] **process**
  - For the equivalent OSPFv3 command, simply substitute **ip** with **ipv6**.

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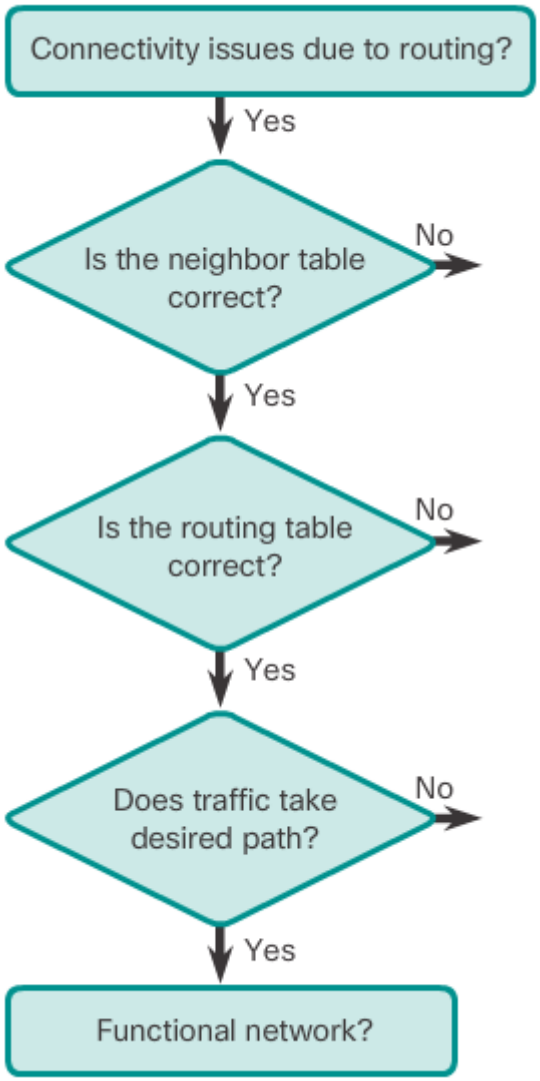
Components of Troubleshooting Single-Area OSPF (Cont.)



- Components of Troubleshooting OSPF
  - Neighbor table is not correct
    - Are the interfaces operational? Are the interfaces enabled for OSPF? Does the OSPF area match? Is there an interface that is configured as passive?
  - Routing table is not correct
    - Are the networks being advertised? Is there an ACL that is blocking advertisements? Is there another routing protocol with a lower AD being used as well? Are all areas connected to Area 0?
  - Traffic does not take the desired path
    - Verify the OSPF cost on an interface. Verify the OSPF reference bandwidth.

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Troubleshoot Single-Area OSPFv2 Routing Issues

- Troubleshooting Neighbor Issues
  - For an interface to be enabled for OSPFv2, a matching **network** command must be configured under the OSPFv2 routing process.
  - If connected interfaces on two routers are not enabled for OSPF, the neighbors will not form an adjacency
  - Recall that the **passive-interface** command stops both outgoing and incoming routing updates because the effect of the command causes the router to stop sending and receiving Hello packets over an interface.

```
R1(config)# router ospf 10
R1(config-router)# no passive-interface s0/0/0
R1(config-router)#
*Apr  9 13:14:15.454: %OSPF-5-ADJCHG: Process 10, Nbr
2.2.2.2 on Serial0/0/0 from LOADING to FULL, Loading Done
R1(config-router)# end
R1#
```


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Troubleshoot Single-Area OSPFv2 Routing Issues (Cont.)

- Troubleshooting OSPFv2 Routing Table Issues
  - For an interface to be enabled for OSPFv2, a matching **network** command must be configured under the OSPFv2 routing process.

```
R3# show running-config | section router ospf
router ospf 10
 router-id 3.3.3.3
 passive-interface default
 no passive-interface Serial0/0/1
 network 192.168.10.8 0.0.0.3 area 0
R3#
```


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Troubleshoot Single-Area OSPFv3 Routing Issues

- OSPFv3 Troubleshooting Commands
  - **show ipv6 protocols**
  - **show ipv6 ospf neighbor**
  - **show ipv6 ospf interface**
  - **show ipv6 ospf**
  - **show ipv6 route ospf**
  - **clear ip ospfv6** [*process-id*] **process**
- Troubleshooting OSPFv3
  - Unlike OSPFv2, OSPFV3 does not use the **network** command. Instead OSPFv3 is enabled directly on the interface.

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Troubleshoot Multiarea OSPFv2 and OSPFv3

- Multiarea OSPF Troubleshooting Skills
  - Before you can begin to diagnose and resolve problems related to a multiarea OSPF implementation, you must be able to do the following:
    - Understand the processes OSPF uses to distribute, store, and select routing information.
    - Understand how OSPF information flows within and between areas.
    - Use Cisco IOS commands to gather and interpret the information necessary to troubleshoot OSPF operation.
- Multiarea OSPF Troubleshooting Data Structures
  - OSPF stores routing information in four main data structures:
    - Interface table
    - Neighbor table
    - Link-state database (LSDB)
    - Routing table

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10.3 Chapter Summary

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Summary

- OSPF defines five network types: point-to-point, broadcast multiaccess, nonbroadcast multiaccess, point-to-multipoint, and virtual links.
- Multiaccess networks can create two challenges for OSPF regarding the flooding of LSAs: creation of multiple adjacencies and extensive flooding of LSAs. The solution to managing the number of adjacencies and the flooding of LSAs on a multiaccess network is the DR and BDR. If the DR stops producing Hellos, the BDR promotes itself and assumes the role of DR.
- The routers in the network elect the router with the highest interface priority as DR. The router with the second highest interface priority is elected the BDR. The higher the priority, the likelier the router will be selected as the DR. If set to 0, the router is not capable of becoming the DR. The default priority of multiaccess broadcast interfaces 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. 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. The addition of a new router does not initiate a new election process.
- To propagate a default route in OSPF, the router must be configured with a default static route and the **default-information originate** command must be added to the configuration. Verify routes with the **show ip route** or **show ipv6 route** command.
- To assist OSPF in making the correct path determination, the reference bandwidth must be changed to a higher value to accommodate networks with links faster than 100 Mb/s. To adjust the reference bandwidth, use the **auto-cost reference-bandwidth** *Mbps* router configuration mode command. To adjust the interface bandwidth, use the **bandwidth** *kilobits* interface configuration mode command. The cost can be manually configured on an interface using the **ip ospf cost** *value* interface configuration mode command.

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Summary (Cont.)

- The OSPF Hello and Dead intervals must match or a neighbor adjacency does not occur. To modify these intervals, use the following interface commands:

  ip ospf hello-interval *seconds*

  ip ospf dead-interval *seconds*

  ipv6 ospf hello-interval *seconds*

  ipv6 ospf dead-interval *seconds*

- When troubleshooting OSPF neighbors, be aware that the FULL or 2WAY states are normal. The following commands summarize OSPFv2 troubleshooting:

  show ip protocols

  show ip ospf neighbor

  show ip ospf interface

  show ip ospf

  show ip route ospf

  clear ip ospf [*process-id*] **process**

- Troubleshooting OSPFv3 is similar to OSPFv2. The following commands are the equivalent commands used with OSPFv3: **show ipv6 protocols**, **show ipv6 ospf neighbor**, **show ipv6 ospf interface**, **show ipv6 ospf**, **show ipv6 route ospf**, and **clear ipv6 ospf** [*process-id*] **process**.

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