OSPF Area lab

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Purpose

Set A system of network with 9 routers that has an multiarea OSPF and a RIP protocol running. The Multiarea OSPF should have contain a backbone area, stub area, totally stub area, and a NSSA area. There should be an ASBR router that can redistribute between OSPF and RIP, and device should be able to ping any other device.

Background Information on Lab Concepts

Open Shortest Path First (OSPF) is a routing protocol for Internet Protocol (IP) networks. OSPF was developed as an alternative for Routing Information Protocol (RIP), for it offers faster convergence and scales to much larger network implementations. OSPF is a link-state routing protocol that uses the concept of areas (a link-state is the status of router interfaces or connecting networks). A network administrator can divide the routing domain into distinct areas to help control routing update traffic. OSPF version 2 (OSPFv2) is OSPF for IPv4, and OSPF version 3 (OSPFv3) is OSPF for IPv6. OSPFv3 is unable to generate its own router-id, so it needs manual configuration.

OSPF areas are virtual separations of networks. It can be used for managing system where there are too many routes and processes or for security purposes. All routers in the same area needs to have the same area id. Area 0 is the backbone area, because it is automatic created as the first area. Standard areas are areas that summarizes data to the backbone area. Stub areas are areas that only receives a limit information. Standard areas and stub areas need to connect to backbone area.

Stub areas automatically change external routes into default routes. A totally stubby area changes every route from other areas into default routes. A not so stubby route makes external routes pass through it and then appears as external routes. Totally stubby area filters type 3, 4, and 5 LSA. NSSA area filters type 4 and 5 LSA.

Link state advertisement (LSA) is the way router communicates in OSPF.

LSA 1: Router LSA. Tell other routers to add itself into link state database. The message includes a list of directly connected links of this router. Type 1 LSA message always stays within an area.

LSA 2: Network LSA. Elect a designate router and tell all other routers. LSA 2 is created for multi-access networks, which are networks that have more than 2 devices in it. LSA 2 messages are generated by DR routers. Type 2 LSA message always stays within an area.

LSA 3: Summary LSA. Summarizes data from networks. For example, if R1 sends a type 1 LSA in Area 2, R2 send a LSA 3 that summarizes area 2’s network information and sends it to Area 0 and Area 51.

LSA 4: Summary ASBR LSA. Path to ASBR routers. For example, R1 receives information from a RIP router and redistributes it into OSPF. This makes R1 an autonomous system border router (ASBR). When R2 receives LSA from ASBR R1, it changes it into a type 4 LSA and send it to other areas. The LSA 4 contains information about the route to ASBR routers.

LSA 5: Autonomous system external LSA. Summarizes ASBR router data. For example, R1 will use the prefix (5.5.5.0/24) of RIP router to create a LSA 5 message and send it to all areas.

LSA 6: Multicast OSPF LSA. OSPF multicast extension. This LSA is currently not being used and not supported by Cisco.

LSA 7: Not-so-stubby area LSA. Work as a LSA 5 in NSSA area. NSSA areas don’t allow LSA 5. For example, area 2 is a NSSA area, and the information about RIP router is send in LSA 7. Router 2 then translates it into a LSA 5.

Lab Summary

In packet tracer, I placed 9 CISCO 4321 routers and added NIM-2T module on each one. I connected all routers with their serial ports. Then I set up the OSPfv2 protocol on router 1-8 by enabling it on the routers and addressing their directly connected networks. Then I set up RIP protocol on router 8-9 by enabling it on the routers and addressing their directly connected networks. Last I redistributed OSPF and RIP on router 8 to make OSPF and RIP able to exchange routing information.

Lab Commands

Router (Config) # interface ? ----- enter an interface

Router (Config-if) # ip address ? subnet-mask ? ----- set ip address on an interface

Router (Config) # router ospf ? ----- enable ospf on router

Router (Config-router) # network ? area ? ----- ospf network statement

Router (Config-router) # area ? stub ----- set an area as stub area

Router (Config-router) # area ? stub no-summary ----- set an area as totally stub area

Router (Config-router) # area ? nssa ----- set an area as nssa area

Router (Config-router) # redistribute rip ----- redistribute rip protocol

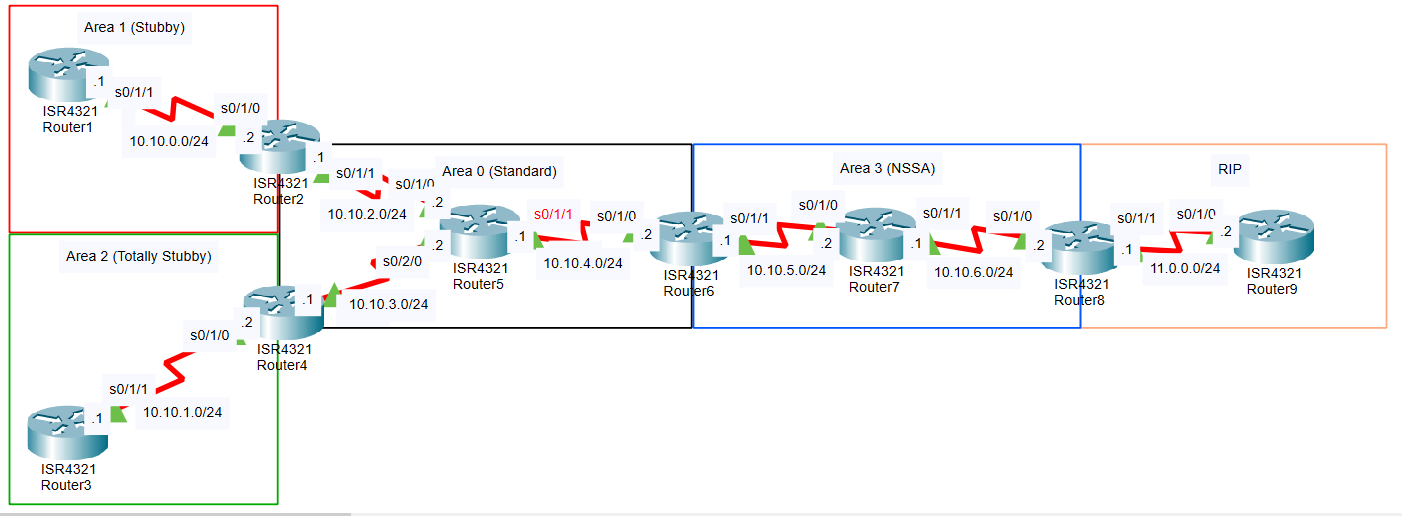
Router (Config-router) # redistribute connected ----- connect all redistributed protocol

Router (Config) # router rip ----- enable rip on router

Router (Config-router) # redistribute ospf ? metric ? ----- redistribute ospf protocol and set metric

Router (Config-router) # redistribute connected ----- connect all redistributed protocol

Network Diagram



Configuration

R1:

*…..*

*interface Serial0/1/1*

*ip address 10.10.0.1 255.255.255.0*

*ip ospf 1 area 1*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 1 stub*

*network 10.10.0.0 0.0.0.255 area 1*

*…..*

*Gateway of last resort is 10.10.0.2 to network 0.0.0.0*

*10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks*

*C 10.10.0.0/24 is directly connected, Serial0/1/1*

*L 10.10.0.1/32 is directly connected, Serial0/1/1*

*O IA 10.10.1.0/24 [110/256] via 10.10.0.2, 00:04:56, Serial0/1/1*

*O IA 10.10.2.0/24 [110/128] via 10.10.0.2, 00:05:06, Serial0/1/1*

*O IA 10.10.3.0/24 [110/192] via 10.10.0.2, 00:04:56, Serial0/1/1*

*O IA 10.10.4.0/24 [110/192] via 10.10.0.2, 00:04:56, Serial0/1/1*

*O IA 10.10.5.0/24 [110/256] via 10.10.0.2, 00:04:56, Serial0/1/1*

*O IA 10.10.6.0/24 [110/320] via 10.10.0.2, 00:04:56, Serial0/1/1*

*O\*IA 0.0.0.0/0 [110/65] via 10.10.0.2, 00:05:06, Serial0/1/1*

R2:

*…..*

*interface Serial0/1/0*

*ip address 10.10.0.2 255.255.255.0*

*ip ospf 1 area 1*

*clock rate 2000000*

*interface Serial0/1/1*

*ip address 10.10.2.1 255.255.255.0*

*ip ospf 1 area 0*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 1 stub*

*network 10.10.0.0 0.0.0.255 area 1*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks*

*C 10.10.0.0/24 is directly connected, Serial0/1/0*

*L 10.10.0.2/32 is directly connected, Serial0/1/0*

*O IA 10.10.1.0/24 [110/192] via 10.10.2.2, 00:12:52, Serial0/1/1*

*C 10.10.2.0/24 is directly connected, Serial0/1/1*

*L 10.10.2.1/32 is directly connected, Serial0/1/1*

*O 10.10.3.0/24 [110/128] via 10.10.2.2, 00:12:52, Serial0/1/1*

*O 10.10.4.0/24 [110/128] via 10.10.2.2, 00:12:52, Serial0/1/1*

*O IA 10.10.5.0/24 [110/192] via 10.10.2.2, 00:12:52, Serial0/1/1*

*O IA 10.10.6.0/24 [110/256] via 10.10.2.2, 00:12:52, Serial0/1/1*

*11.0.0.0/24 is subnetted, 1 subnets*

*O E2 11.0.0.0/24 [110/20] via 10.10.2.2, 00:12:52, Serial0/1/1*

R3:

*…..*

*interface Serial0/1/1*

*ip address 10.10.1.1 255.255.255.0*

*ip ospf 1 area 2*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 2 stub no-summary*

*network 10.10.1.0 0.0.0.255 area 2*

*…..*

*Gateway of last resort is 10.10.1.2 to network 0.0.0.0*

*10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks*

*C 10.10.1.0/24 is directly connected, Serial0/1/1*

*L 10.10.1.1/32 is directly connected, Serial0/1/1*

*O\*IA 0.0.0.0/0 [110/65] via 10.10.1.2, 00:16:03, Serial0/1/1*

R4:

*…..*

*interface Serial0/1/0*

*ip address 10.10.1.2 255.255.255.0*

*ip ospf 1 area 2*

*clock rate 2000000*

*interface Serial0/1/1*

*ip address 10.10.3.1 255.255.255.0*

*ip ospf 1 area 0*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 2 stub no-summary*

*network 10.10.1.0 0.0.0.255 area 2*

*network 10.10.3.0 0.0.0.255 area 0*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks*

*O IA 10.10.0.0/24 [110/192] via 10.10.3.2, 00:18:55, Serial0/1/1*

*C 10.10.1.0/24 is directly connected, Serial0/1/0*

*L 10.10.1.2/32 is directly connected, Serial0/1/0*

*O 10.10.2.0/24 [110/128] via 10.10.3.2, 00:19:05, Serial0/1/1*

*C 10.10.3.0/24 is directly connected, Serial0/1/1*

*L 10.10.3.1/32 is directly connected, Serial0/1/1*

*O 10.10.4.0/24 [110/128] via 10.10.3.2, 00:19:05, Serial0/1/1*

*O IA 10.10.5.0/24 [110/192] via 10.10.3.2, 00:18:55, Serial0/1/1*

*O IA 10.10.6.0/24 [110/256] via 10.10.3.2, 00:18:55, Serial0/1/1*

*11.0.0.0/24 is subnetted, 1 subnets*

*O E2 11.0.0.0/24 [110/20] via 10.10.3.2, 00:18:55, Serial0/1/1*

R5:

*…..*

*interface Serial0/1/0*

*ip address 10.10.2.2 255.255.255.0*

*ip ospf 1 area 0*

*clock rate 2000000*

*interface Serial0/1/1*

*ip address 10.10.4.1 255.255.255.0*

*ip ospf 1 area 0*

*interface Serial0/2/0*

*ip address 10.10.3.2 255.255.255.0*

*ip ospf 1 area 0*

*clock rate 2000000*

*…..*

*router ospf 1*

*log-adjacency-changes*

*network 10.10.2.0 0.0.0.255 area 0*

*network 10.10.3.0 0.0.0.255 area 0*

*network 10.10.4.0 0.0.0.255 area 0*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks*

*O IA 10.10.0.0/24 [110/128] via 10.10.2.1, 00:21:40, Serial0/1/0*

*O IA 10.10.1.0/24 [110/128] via 10.10.3.1, 00:21:40, Serial0/2/0*

*C 10.10.2.0/24 is directly connected, Serial0/1/0*

*L 10.10.2.2/32 is directly connected, Serial0/1/0*

*C 10.10.3.0/24 is directly connected, Serial0/2/0*

*L 10.10.3.2/32 is directly connected, Serial0/2/0*

*C 10.10.4.0/24 is directly connected, Serial0/1/1*

*L 10.10.4.1/32 is directly connected, Serial0/1/1*

*O IA 10.10.5.0/24 [110/128] via 10.10.4.2, 00:21:40, Serial0/1/1*

*O IA 10.10.6.0/24 [110/192] via 10.10.4.2, 00:21:40, Serial0/1/1*

*11.0.0.0/24 is subnetted, 1 subnets*

*O E2 11.0.0.0/24 [110/20] via 10.10.4.2, 00:21:40, Serial0/1/1*

R6:

*…..*

*interface Serial0/1/0*

*ip address 10.10.4.2 255.255.255.0*

*ip ospf 1 area 0*

*clock rate 2000000*

*interface Serial0/1/1*

*ip address 10.10.5.1 255.255.255.0*

*ip ospf 1 area 3*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 3 nssa*

*network 10.10.4.0 0.0.0.255 area 0*

*network 10.10.5.0 0.0.0.255 area 3*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks*

*O IA 10.10.0.0/24 [110/192] via 10.10.4.1, 00:30:07, Serial0/1/0*

*O IA 10.10.1.0/24 [110/192] via 10.10.4.1, 00:30:07, Serial0/1/0*

*O 10.10.2.0/24 [110/128] via 10.10.4.1, 00:30:07, Serial0/1/0*

*O 10.10.3.0/24 [110/128] via 10.10.4.1, 00:30:07, Serial0/1/0*

*C 10.10.4.0/24 is directly connected, Serial0/1/0*

*L 10.10.4.2/32 is directly connected, Serial0/1/0*

*C 10.10.5.0/24 is directly connected, Serial0/1/1*

*L 10.10.5.1/32 is directly connected, Serial0/1/1*

*O 10.10.6.0/24 [110/128] via 10.10.5.2, 00:30:13, Serial0/1/1*

*11.0.0.0/24 is subnetted, 1 subnets*

*O N2 11.0.0.0/24 [110/20] via 10.10.5.2, 00:30:13, Serial0/1/1*

R7:

*…..*

*interface Serial0/1/0*

*ip address 10.10.5.2 255.255.255.0*

*ip ospf 1 area 3*

*clock rate 2000000*

*interface Serial0/1/1*

*ip address 10.10.6.1 255.255.255.0*

*ip ospf 1 area 3*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 3 nssa*

*network 10.10.5.0 0.0.0.255 area 3*

*network 10.10.6.0 0.0.0.255 area 3*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks*

*O IA 10.10.0.0/24 [110/256] via 10.10.5.1, 00:35:56, Serial0/1/0*

*O IA 10.10.1.0/24 [110/256] via 10.10.5.1, 00:35:56, Serial0/1/0*

*O IA 10.10.2.0/24 [110/192] via 10.10.5.1, 00:35:56, Serial0/1/0*

*O IA 10.10.3.0/24 [110/192] via 10.10.5.1, 00:35:56, Serial0/1/0*

*O IA 10.10.4.0/24 [110/128] via 10.10.5.1, 00:35:56, Serial0/1/0*

*C 10.10.5.0/24 is directly connected, Serial0/1/0*

*L 10.10.5.2/32 is directly connected, Serial0/1/0*

*C 10.10.6.0/24 is directly connected, Serial0/1/1*

*L 10.10.6.1/32 is directly connected, Serial0/1/1*

*11.0.0.0/24 is subnetted, 1 subnets*

*O E2 11.0.0.0/24 [110/20] via 10.10.5.1, 00:35:56, Serial0/1/0*

R8:

*…..*

*interface Serial0/1/0*

*ip address 10.10.6.2 255.255.255.0*

*ip ospf 1 area 3*

*clock rate 2000000*

*interface Serial0/1/1*

*ip address 11.0.0.1 255.255.255.0*

*…..*

*router ospf 1*

*log-adjacency-changes*

*area 3 nssa*

*redistribute rip subnets*

*network 10.10.6.0 0.0.0.255 area 3*

*router rip*

*version 2*

*redistribute ospf 1 metric 3*

*network 11.0.0.0*

*no auto-summary*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks*

*O IA 10.10.0.0/24 [110/320] via 10.10.6.1, 00:39:53, Serial0/1/0*

*O IA 10.10.1.0/24 [110/320] via 10.10.6.1, 00:39:53, Serial0/1/0*

*O IA 10.10.2.0/24 [110/256] via 10.10.6.1, 00:39:53, Serial0/1/0*

*O IA 10.10.3.0/24 [110/256] via 10.10.6.1, 00:39:53, Serial0/1/0*

*O IA 10.10.4.0/24 [110/192] via 10.10.6.1, 00:39:53, Serial0/1/0*

*O 10.10.5.0/24 [110/128] via 10.10.6.1, 00:40:04, Serial0/1/0*

*C 10.10.6.0/24 is directly connected, Serial0/1/0*

*L 10.10.6.2/32 is directly connected, Serial0/1/0*

*11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks*

*C 11.0.0.0/24 is directly connected, Serial0/1/1*

*L 11.0.0.1/32 is directly connected, Serial0/1/1*

R9:

*…..*

*interface Serial0/1/0*

*ip address 11.0.0.2 255.255.255.0*

*clock rate 2000000*

*…..*

*router rip*

*version 2*

*network 11.0.0.0*

*no auto-summary*

*…..*

*Gateway of last resort is not set*

*10.0.0.0/24 is subnetted, 7 subnets*

*R 10.10.0.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*R 10.10.1.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*R 10.10.2.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*R 10.10.3.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*R 10.10.4.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*R 10.10.5.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*R 10.10.6.0/24 [120/3] via 11.0.0.1, 00:00:18, Serial0/1/0*

*11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks*

*C 11.0.0.0/24 is directly connected, Serial0/1/0*

*L 11.0.0.2/32 is directly connected, Serial0/1/0*

Problems

1. When I first set up all the OSPF command, the routers with OSPF were not able to ping each other. The problem was solved when I went back to the lab the next day, the problem was gone when all routers restarted.
2. When I have redistribution on router 8, router 9 was unable to route to rest of the areas while other areas have routes to the RIP area. I solved the problem by adding a metric number where RIP redistributes OSPF.

Conclusion

R1:

*Router#ping 11.0.0.2*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 11.0.0.2, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 11/19/27 ms*

*Router#ping 10.10.6.1*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.6.1, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 4/11/20 ms*

*Router#ping 10.10.1.1*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.1.1, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 4/12/33 ms*

*Router#ping 10.10.4.1*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.4.1, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 2/4/10 ms*

R5:

*Router#ping 10.10.1.2*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.1.2, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms*

*Router#ping 10.10.5.1*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.5.1, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 1/7/23 ms*

*Router#ping 11.0.0.1*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 11.0.0.1, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 3/12/31 ms*

R7:

*Router#ping 10.10.1.1*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.1.1, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 4/8/16 ms*

*Router#ping 11.0.0.2*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 11.0.0.2, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 2/7/23 ms*

R9:

*Router#ping 10.10.1.2*

*Type escape sequence to abort.*

*Sending 5, 100-byte ICMP Echos to 10.10.1.2, timeout is 2 seconds:*

*!!!!!*

*Success rate is 100 percent (5/5), round-trip min/avg/max = 6/18/55 ms*

All areas are connected to each other. In this lab, I used the concept of multiarea OSPF and redistribution of different routing protocol. The lab took about three hours to complete.