**Configuring a Single OSPF Area**

Student Version



Huawei Technologies Co., Ltd.

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# Configuring a Single OSPF Area

## Background

Assume that you are a network administrator of a company. The company requires that routing information be transmitted on the company network using OSPF and all the routers on the network belong to OSPF area 0. Default routes need to be advertised using OSPF. In addition, you want to learn about DR and BDR election.

## Objectives

Upon completion of this task, you will be able to:

Configure an OSPF router ID.

Configure OSPF.

Use display commands to check the OSPF running status.

Use OSPF to advertise default routes.

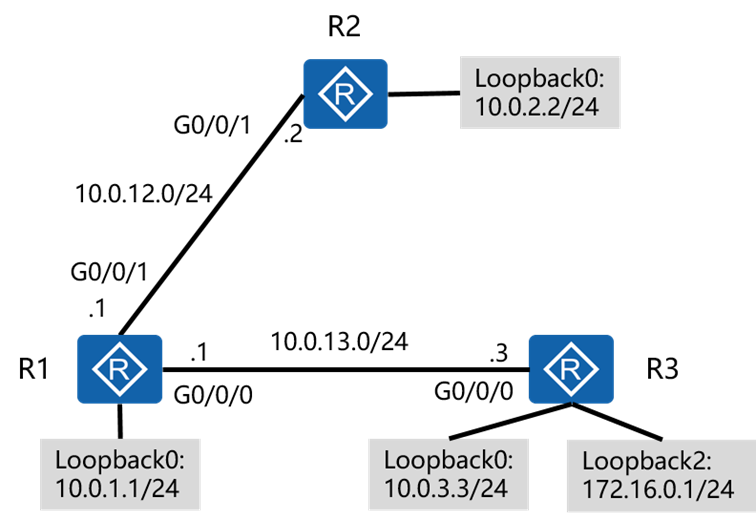
Configure the OSPF Hello interval and Dead interval.

Understand DR and BDR election on a multi-access network.

Change the OSPF route preference.

## Topology

Network topology



## Implementation

### Roadmap

1. Configure interfaces on the routers.
2. Deploy a single-area OSPF network.
3. Configure an IP address and gateway address for each PC.

### Procedure

Configure IP addresses for the interconnection

#Configure R1

#Configure R2

#Configure R3

Configure OSPF.

#On R1, set the router ID to 10.0.1.1 (IP address of the logical interface Loopback 0), enable OSPF process 1 (default process), and advertise network segments 10.0.1.0/24, 10.0.12.0/24, and 10.0.13.0/24 into OSPF area 0.

A router can run multiple OSPF processes (with the default process ID 1). The OSPF process ID is local to the router. Different routers in a routing domain can have the same or different OSPF process IDs. The wildcard mask must be specified in the **network** command.

#On R2, set the router ID of R2 to 10.0.2.2, enable OSPF process 1, and advertise network segments 10.0.12.0/24 and 10.0.2.0/24 into OSPF area 0.

If the command output contains **NeighborCurrentState=Full**, the OSPF adjacency relationship has been established.

#On R3, set the router ID to 10.0.3.3, enable OSPF process 1, and advertise network segments 10.0.3.0/24 and 10.0.13.0/24 into OSPF area 0.

Verify the OSPF configuration.

After OSPF convergence is complete, check IP routing tables on R1, R2, and R3.

<R1>display ip routing-table

Route Flags: R - relay, D - download to fib

-------------------------------------------------------------------------

Routing Tables: Public

Destinations : 15 Routes : 15

Destination/Mask Proto Pre Cost Flags NextHop Interface

10.0.1.0/24 Direct 0 0 D 10.0.1.1 LoopBack0

10.0.1.1/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.1.255/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.2.2/32 OSPF 10 1 D 10.0.12.2 GigabitEthernet0/0/1

10.0.3.3/32 OSPF 10 1 D 10.0.13.3 GigabitEthernet0/0/0

10.0.12.0/24 Direct 0 0 D 10.0.12.1 GigabitEthernet0/0/1

10.0.12.1/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.12.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.13.0/24 Direct 0 0 D 10.0.13.1 GigabitEthernet0/0/0

10.0.13.1/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

10.0.13.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

127.0.0.0/8 Direct 0 0 D 127.0.0.1 InLoopBack0

127.0.0.1/32 Direct 0 0 D 127.0.0.1 InLoopBack0

127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

<R2>display ip routing-table

Route Flags: R - relay, D - download to fib

-------------------------------------------------------------------------

Routing Tables: Public

Destinations : 13 Routes : 13

Destination/Mask Proto Pre Cost Flags NextHop Interface

10.0.1.1/32 OSPF 10 1 D 10.0.12.1 GigabitEthernet0/0/1

10.0.2.0/24 Direct 0 0 D 10.0.2.2 LoopBack0

10.0.2.2/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.2.255/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.3.3/32 OSPF 10 2 D 10.0.12.1 GigabitEthernet0/0/1

10.0.12.0/24 Direct 0 0 D 10.0.12.2 GigabitEthernet0/0/1

10.0.12.2/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.12.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.13.0/24 OSPF 10 2 D 10.0.12.1 GigabitEthernet0/0/1

127.0.0.0/8 Direct 0 0 D 127.0.0.1 InLoopBack0

127.0.0.1/32 Direct 0 0 D 127.0.0.1 InLoopBack0

127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

<R3>display ip routing-table

Route Flags: R - relay, D - download to fib

-------------------------------------------------------------------------

Routing Tables: Public

Destinations : 16 Routes : 16

Destination/Mask Proto Pre Cost Flags NextHop Interface

10.0.1.1/32 OSPF 10 1 D 10.0.13.1 GigabitEthernet0/0/0

10.0.2.2/32 OSPF 10 2 D 10.0.13.1 GigabitEthernet0/0/0

10.0.3.0/24 Direct 0 0 D 10.0.3.3 LoopBack0

10.0.3.3/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.3.255/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.12.0/24 OSPF 10 2 D 10.0.13.1 GigabitEthernet0/0/0

10.0.13.0/24 Direct 0 0 D 10.0.13.3 GigabitEthernet0/0/0

10.0.13.3/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

10.0.13.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

127.0.0.0/8 Direct 0 0 D 127.0.0.1 InLoopBack0

127.0.0.1/32 Direct 0 0 D 127.0.0.1 InLoopBack0

127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

172.16.0.0/24 Direct 0 0 D 172.16.0.1 LoopBack2

172.16.0.1/32 Direct 0 0 D 127.0.0.1 LoopBack2

172.16.0.255/32 Direct 0 0 D 127.0.0.1 LoopBack2

255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

#Check the connectivity between R2 and R1 (10.0.1.1) and between R2 and R3 (10.0.3.3).

<R2>ping 10.0.1.1

PING 10.0.1.1: 56 data bytes, press CTRL\_C to break

Reply from 10.0.1.1: bytes=56 Sequence=1 ttl=255 time=37 ms

Reply from 10.0.1.1: bytes=56 Sequence=2 ttl=255 time=42 ms

Reply from 10.0.1.1: bytes=56 Sequence=3 ttl=255 time=42 ms

Reply from 10.0.1.1: bytes=56 Sequence=4 ttl=255 time=45 ms

Reply from 10.0.1.1: bytes=56 Sequence=5 ttl=255 time=42 ms

--- 10.0.1.1 ping statistics ---

5 packet(s) transmitted

5 packet(s) received

0.00% packet loss

round-trip min/avg/max = 37/41/45 ms

<R2>ping 10.0.3.3

PING 10.0.3.3: 56 data bytes, press CTRL\_C to break

Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=254 time=37 ms

Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=254 time=42 ms

Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=254 time=42 ms

Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=254 time=42 ms

Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=254 time=42 ms

--- 10.0.3.3 ping statistics ---

5 packet(s) transmitted

5 packet(s) received

0.00% packet loss

round-trip min/avg/max = 37/41/42 ms

#Run the display ospf peer command to check the OSPF neighbor status.

<R1>display ospf peer

OSPF Process 1 with Router ID 10.0.1.1

Neighbors

Area 0.0.0.0 interface 10.0.12.1(GigabitEthernet0/0/1)'s neighbors

Router ID: 10.0.2.2 Address: 10.0.12.2

State: Full Mode:Nbr is Master Priority: 1

DR: 10.0.12.1 BDR: 10.0.12.2 MTU: 0

Dead timer due in 32 sec

Retrans timer interval: 5

Neighbor is up for 00:47:59

Authentication Sequence: [ 0 ]

Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors

Router ID: 10.0.3.3 Address: 10.0.13.3

State: Full Mode:Nbr is Master Priority: 1

DR: 10.0.13.1 BDR: 10.0.13.3 MTU: 0

Dead timer due in 34 sec

Retrans timer interval: 5

Neighbor is up for 00:41:44

Authentication Sequence: [ 0 ]

The display ospf peer command displays detailed information about all OSPF neighbors. In this task, R1 is the DR on network segment 10.0.13.0, R3 acting as the BDR, and DR election works in non-preemption mode. If the OSPF process is not restarted, R3 will not take over the DR role of R1.

#Run the **display ospf peer brief** command to check brief information about OSPF neighbors.、

<R1>display ospf peer brief

OSPF Process 1 with Router ID 10.0.1.1

Peer Statistic Information

-------------------------------------------------------------------------

Area Id Interface Neighbor id State

0.0.0.0 GigabitEthernet0/0/0 10.0.3.3 Full

0.0.0.0 GigabitEthernet0/0/1 10.0.2.2 Full

-------------------------------------------------------------------------

<R2>display ospf peer brief

OSPF Process 1 with Router ID 10.0.2.2

Peer Statistic Information

-------------------------------------------------------------------------

Area Id Interface Neighbor id State

0.0.0.0 GigabitEthernet0/0/1 10.0.1.1 Full

-------------------------------------------------------------------------

<R3>display ospf peer brief

OSPF Process 1 with Router ID 10.0.3.3

Peer Statistic Information

-------------------------------------------------------------------------

Area Id Interface Neighbor id State

0.0.0.0 GigabitEthernet0/0/0 10.0.1.1 Full

-------------------------------------------------------------------------

Set the OSPF Hello interval and Dead interval.

#Run the **display ospf interface GigabitEthernet 0/0/0** command on R1 to check the default OSPF Hello interval and Dead interval.

<R1>display ospf interface GigabitEthernet 0/0/0

OSPF Process 1 with Router ID 10.0.1.1

Interfaces

Interface: 10.0.13.1 (GigabitEthernet0/0/0)

Cost: 1 State: DR Type: Broadcast MTU: 1500

Priority: 1

Designated Router: 10.0.13.1

Backup Designated Router: 10.0.13.3

Timers: Hello 10 , Dead 40 , Poll 120 , Retransmit 5 , Transmit Delay 1

#Run the **ospf timer** command on GE0/0/0 of R1 to set the OSPF Hello interval to 15 seconds and Dead interval to 60 seconds.

<R1>display ospf interface GigabitEthernet 0/0/0

OSPF Process 1 with Router ID 10.0.1.1

Interfaces

Interface: 10.0.13.1 (GigabitEthernet0/0/0)

Cost: 1 State: DR Type: Broadcast MTU: 1500

Priority: 1

Designated Router: 10.0.13.1

Backup Designated Router: 10.0.13.3

Timers: Hello 15 , Dead 60 , Poll 120 , Retransmit 5 , Transmit Delay 1

#Check the OSPF neighbor status on R1.

<R1>display ospf peer brief

OSPF Process 1 with Router ID 10.0.1.1

Peer Statistic Information

-------------------------------------------------------------------------

Area Id Interface Neighbor id State

0.0.0.0 GigabitEthernet0/0/1 10.0.2.2 Full

-------------------------------------------------------------------------

The preceding command output shows that R1 has only one neighbor, that is, R2. R1 and R3 cannot establish an OSPF neighbor relationship with each other because their OSPF Hello interval and Dead interval are different.

Run the **ospf timer** command on GE0/0/0 of R3 to set the OSPF Hello interval to 15 seconds and Dead interval to 60 seconds, which are the same as those on R1.

<R3>display ospf interface GigabitEthernet 0/0/0

OSPF Process 1 with Router ID 10.0.3.3

Interfaces

Interface: 10.0.13.3 (GigabitEthernet0/0/0)

Cost: 1 State: DR Type: Broadcast MTU: 1500

Priority: 1

Designated Router: 10.0.13.3

Backup Designated Router: 10.0.13.1

Timers: Hello 15 , Dead 60 , Poll 120 , Retransmit 5 , Transmit Delay 1

#Check the OSPF neighbor status on R1 again.

<R1>display ospf peer brief

OSPF Process 1 with Router ID 10.0.1.1

Peer Statistic Information

------------------------------------------------------------------------

Area Id Interface Neighbor id State

0.0.0.0 GigabitEthernet0/0/0 10.0.3.3 Full

0.0.0.0 GigabitEthernet0/0/1 10.0.2.2 Full

Configure OSPF to advertise default routes and verify the configuration.、

#Configure a default route on R3 and advertise it into OSPF area 0.

[R3]ip route-static 0.0.0.0 0.0.0.0 LoopBack 2

[R3]ospf 1

[R3-ospf-1]

#Check the IP routing tables on R1 and R2. The command outputs show that R1 and R2 have learned the default route advertised by R3.

<R1>display ip routing-table

Route Flags: R - relay, D - download to fib

-------------------------------------------------------------------------

Routing Tables: Public

Destinations : 16 Routes : 16

Destination/Mask Proto Pre Cost Flags NextHop Interface

0.0.0.0/0 O\_ASE 150 1 D 10.0.13.3 GigabitEthernet0/0/0

10.0.1.0/24 Direct 0 0 D 10.0.1.1 LoopBack0

10.0.1.1/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.1.255/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.2.2/32 OSPF 10 1 D 10.0.12.2 GigabitEthernet0/0/1

10.0.3.3/32 OSPF 10 1 D 10.0.13.3 GigabitEthernet0/0/0

10.0.12.0/24 Direct 0 0 D 10.0.12.1 GigabitEthernet0/0/1

10.0.12.1/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.12.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.13.0/24 Direct 0 0 D 10.0.13.1 GigabitEthernet0/0/0

10.0.13.1/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

10.0.13.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

127.0.0.0/8 Direct 0 0 D 127.0.0.1 InLoopBack0

127.0.0.1/32 Direct 0 0 D 127.0.0.1 InLoopBack0

127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

<R2>display ip routing-table

Route Flags: R - relay, D - download to fib

-------------------------------------------------------------------------

Routing Tables: Public

Destinations : 14 Routes : 14

Destination/Mask Proto Pre Cost Flags NextHop Interface

0.0.0.0/0 O\_ASE 150 1 D 10.0.12.1 GigabitEthernet0/0/1

10.0.1.1/32 OSPF 10 1 D 10.0.12.1 GigabitEthernet0/0/1

10.0.2.0/24 Direct 0 0 D 10.0.2.2 LoopBack0

10.0.2.2/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.2.255/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.3.3/32 OSPF 10 2 D 10.0.12.1 GigabitEthernet0/0/1

10.0.12.0/24 Direct 0 0 D 10.0.12.2 GigabitEthernet0/0/1

10.0.12.2/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.12.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/1

10.0.13.0/24 OSPF 10 2 D 10.0.12.1 GigabitEthernet0/0/1

127.0.0.0/8 Direct 0 0 D 127.0.0.1 InLoopBack0

127.0.0.1/32 Direct 0 0 D 127.0.0.1 InLoopBack0

127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

<R3>display ip routing-table

Route Flags: R - relay, D - download to fib

-------------------------------------------------------------------------

Routing Tables: Public

Destinations : 17 Routes : 17

Destination/Mask Proto Pre Cost Flags NextHop Interface

0.0.0.0/0 Static 60 0 D 172.16.0.1 LoopBack2

10.0.1.1/32 OSPF 10 1 D 10.0.13.1 GigabitEthernet0/0/0

10.0.2.2/32 OSPF 10 2 D 10.0.13.1 GigabitEthernet0/0/0

10.0.3.0/24 Direct 0 0 D 10.0.3.3 LoopBack0

10.0.3.3/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.3.255/32 Direct 0 0 D 127.0.0.1 LoopBack0

10.0.12.0/24 OSPF 10 2 D 10.0.13.1 GigabitEthernet0/0/0

10.0.13.0/24 Direct 0 0 D 10.0.13.3 GigabitEthernet0/0/0

10.0.13.3/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

10.0.13.255/32 Direct 0 0 D 127.0.0.1 GigabitEthernet0/0/0

127.0.0.0/8 Direct 0 0 D 127.0.0.1 InLoopBack0

127.0.0.1/32 Direct 0 0 D 127.0.0.1 InLoopBack0

127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

172.16.0.0/24 Direct 0 0 D 172.16.0.1 LoopBack2

172.16.0.1/32 Direct 0 0 D 127.0.0.1 LoopBack2

172.16.0.255/32 Direct 0 0 D 127.0.0.1 LoopBack2

255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

#Run the **ping** command to check the connectivity between R2 and network segment 172.16.0.1/24.

<R2>ping 172.16.0.1

PING 172.16.0.1: 56 data bytes, press CTRL\_C to break

Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=254 time=47 ms

Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=254 time=37 ms

Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=254 time=37 ms

Reply from 172.16.0.1: bytes=56 Sequence=4 ttl=254 time=37 ms

Reply from 172.16.0.1: bytes=56 Sequence=5 ttl=254 time=37 ms

--- 172.16.0.1 ping statistics ---

5 packet(s) transmitted

5 packet(s) received

0.00% packet loss

round-trip min/avg/max = 37/39/47 ms

Control OSPF DR and BDR election.

#Run the display ospf peer command to check the roles (DR or BDR) of R1 and R3.

<R1>display ospf peer 10.0.3.3

OSPF Process 1 with Router ID 10.0.1.1

Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors

Router ID: 10.0.3.3 Address: 10.0.13.3

State: Full Mode:Nbr is Master Priority: 1

DR: 10.0.13.3 BDR: 10.0.13.1 MTU: 0

Dead timer due in 49 sec

Retrans timer interval: 5

Neighbor is up for 00:17:40

Authentication Sequence: [ 0 ]

The preceding command output shows that R3 is the DR and R1 is the BDR. This is because R1 and R3 use the same default DR priority of 1 and R3 has a larger router ID (10.0.3.3) than R1 with the router ID 10.0.1.1.

#Run the ospf dr-priority command to change the DR priorities of R1 and R3.

By default, DR and BDR election works in non-preemption mode. After the DR priority of a router is changed, DR election is not automatically performed again. To make the DR priority settings take effect, you need to reset the OSPF neighbor relationship between R1 and R3.

#Shut down and then enable GigabitEthernet0/0/0 on R1 and R3 to reset the OSPF neighbor relationship between R1 and R3.

[R3]interface GigabitEthernet0/0/0

[R3-GigabitEthernet0/0/0]shutdown

[R1]interface GigabitEthernet0/0/0

[R1-GigabitEthernet0/0/0]shutdown

[R1-GigabitEthernet0/0/0]undo shutdown

[R3-GigabitEthernet0/0/0]undo shutdown

Run the display ospf peer command to check the roles (DR or BDR) of R1 and R3.

[R1]display ospf peer 10.0.3.3

OSPF Process 1 with Router ID 10.0.1.1

Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors

Router ID: 10.0.3.3 Address: 10.0.13.3

State: Full Mode:Nbr is Master Priority: 100

DR: 10.0.13.1 BDR: 10.0.13.3 MTU: 0

Dead timer due in 52 sec

Retrans timer interval: 5

Neighbor is up for 00:00:25

Authentication Sequence: [ 0 ]

The command output shows that R1 is elected as the DR, and R3 becomes the BDR. This is because the DR priority of R1 is higher than that of R3.

----**End**