**Lab 15**

**Single Area OSPFv2 Routing Between Routers**

**🧠 Real-Time Scenario:**

You're a network engineer for a **multi-branch company**. Each branch has its own router, and all routers need to communicate **using OSPF (in Area 0)**.

* **3 Routers**: R1 (HQ), R2 (Branch1), R3 (Branch2)
* **Each router connects to 1 PC network**
* Use **OSPFv2** for dynamic routing across all routers.

**🖥️ Devices Needed (in Packet Tracer or Real Lab):**

* 3 Routers (e.g., 2911)
* 3 Switches
* 3 PCs
* Cables

**🌐 IP Addressing Plan:**

| **Device** | **Interface** | **IP Address** | **Connected To** |
| --- | --- | --- | --- |
| R1 | G0/0 | 192.168.1.1/24 | PC1 via Switch1 |
| R1 | G0/1 | 10.0.0.1/30 | R2 (G0/1) |
| R1 | G0/2 | 10.0.0.5/30 | R3 (G0/1) |
| R2 | G0/0 | 192.168.2.1/24 | PC2 via Switch2 |
| R2 | G0/1 | 10.0.0.2/30 | R1 (G0/1) |
| R3 | G0/0 | 192.168.3.1/24 | PC3 via Switch3 |
| R3 | G0/1 | 10.0.0.6/30 | R1 (G0/2) |

**🔧 Configuration Steps**

**👉 Step 1: Assign IPs and enable interfaces**

On all routers:

bash

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interface g0/x

ip address <IP> <Subnet Mask>

no shutdown

**👉 Step 2: Enable OSPF on all routers**

On **R2**:

bash

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router ospf 1

network 192.168.10.0 0.0.0.255 area 0

network 10.0.0.0 0.0.0.3 area 0

network 192.168.30.0 0.0.0.255 area 0

network 10.0.0.4 0.0.0.3 area 0

On **R0**:

bash

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router ospf 1

network 10.0.0.0 0.0.0.3 area 0

network 192.168.20.0 0.0.0.255 area 0

network 192.168.30.0 0.0.0.255 area 0

network 10.0.0.4 0.0.0.3 area 0

On **R1:**

bash

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router ospf 1

network 10.0.0.0 0.0.0.3 area 0

network 192.168.30.0 0.0.0.255 area 0

network 10.0.0.4 0.0.0.3 area 0

network 192.168.20.0 0.0.0.255 area 0

network 192.168.10.0 0.0.0.255 area 0

**👉 Step 3: Test Routing**

On all routers:

bash

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show ip route ospf

ping 192.168.2.1 ← from R1 to PC2 gateway

ping 192.168.3.1 ← from R1 to PC3 gateway

**🚨 Common Troubleshooting Issues & Solutions**

| **🔎 Issue** | **🛠️ Troubleshooting Command** | **💡 Solution** |
| --- | --- | --- |
| OSPF neighbor not forming | show ip ospf neighbor | Check if IPs are in same subnet and OSPF enabled on interfaces |
| Interface down | show ip interface brief | Use no shutdown |
| Missing OSPF routes | show ip route | Check if the network commands include correct interfaces |
| Incorrect wildcard mask | Check OSPF config | Use correct wildcard mask: /24 = 0.0.0.255, /30 = 0.0.0.3 |
| OSPF not enabled on right interface | show running-config or use debug ip ospf | Add missing interface using proper network command |
| PC can't ping remote PC | Check PC IP/gateway + router routes | Ensure PCs have correct default gateway and routers have OSPF routes |
| OSPF process ID mismatch? | ✅ No issue. Process ID (e.g., 1) is local to the router only |  |

**🧪 Useful Show Commands:**

bash

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show ip route ospf

show ip ospf neighbor

show ip protocols

show ip interface brief

show running-config

**🎯 Goal Success When:**

* All routers can ping each other
* PC1 ↔ PC2 ↔ PC3 communication works via OSPF
* OSPF neighbor relationships are up

**✅ Optional: Add Loopbacks for OSPF Testing**

bash

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interface loopback0

ip address 1.1.1.1 255.255.255.255

Advertise it in OSPF:

bash

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router ospf 1

network 1.1.1.1 0.0.0.0 area 0

**Output:**

Router2#sh ip ro

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks

C 10.0.0.0/30 is directly connected, GigabitEthernet0/0

L 10.0.0.1/32 is directly connected, GigabitEthernet0/0

O 10.0.0.4/30 [110/2] via 10.0.0.2, 00:03:07, GigabitEthernet0/0

192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.10.0/24 is directly connected, GigabitEthernet0/1

L 192.168.10.1/32 is directly connected, GigabitEthernet0/1

O 192.168.20.0/24 [110/2] via 10.0.0.2, 01:13:26, GigabitEthernet0/0

O 192.168.30.0/24 [110/3] via 10.0.0.2, 00:02:57, GigabitEthernet0/0

Router#ping 192.168.10.10

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.10.10, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

Router#ping 192.168.20.10

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.20.10, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

Router#ping 192.168.30.10

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.30.10, timeout is 2 seconds:

.!!!!

Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

Router1#sh ip ro

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks

O 10.0.0.0/30 [110/2] via 10.0.0.5, 00:00:55, GigabitEthernet0/0

C 10.0.0.4/30 is directly connected, GigabitEthernet0/0

L 10.0.0.6/32 is directly connected, GigabitEthernet0/0

O 192.168.10.0/24 [110/3] via 10.0.0.5, 00:00:55, GigabitEthernet0/0

O 192.168.20.0/24 [110/2] via 10.0.0.5, 00:00:55, GigabitEthernet0/0

192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.30.0/24 is directly connected, GigabitEthernet0/1

L 192.168.30.1/32 is directly connected, GigabitEthernet0/1

Router0#sh ip ro

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.0.0.0/30 is directly connected, GigabitEthernet0/0

L 10.0.0.2/32 is directly connected, GigabitEthernet0/0

C 10.0.0.4/30 is directly connected, GigabitEthernet0/1

L 10.0.0.5/32 is directly connected, GigabitEthernet0/1

O 192.168.10.0/24 [110/2] via 10.0.0.1, 01:12:44, GigabitEthernet0/0

192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.20.0/24 is directly connected, GigabitEthernet0/2

L 192.168.20.1/32 is directly connected, GigabitEthernet0/2

O 192.168.30.0/24 [110/2] via 10.0.0.6, 00:01:12, GigabitEthernet0/1