# Configuring Multiarea OSPFv2

Отчет по лабораторной работе № 6

по дисциплине «Компьютерные сети»

студента 2 курса группы ИВТ-б-о-202(1)

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Device	Interface	IP Address	Subnet Mask	OSPFv2 Area
R1	G0/0	10.1.1.1	255.255.255.0	1
	G0/1	10.1.2.1	255.255.255.0	1
	S0/0/0	192.168.10.2	255.255.255.252	0
R2	G0/0	10.2.1.1	255.255.255.0	0
	S0/0/0	192.168.10.1	255.255.255.252	0
	S0/0/1	192.168.10.5	255.255.255.252	0
R3	G0/0	192.168.2.1	255.255.255.0	2
	G0/1	192.168.1.1	255.255.255.0	2
	S0/0/1	192.168.10.6	255.255.255.252	0
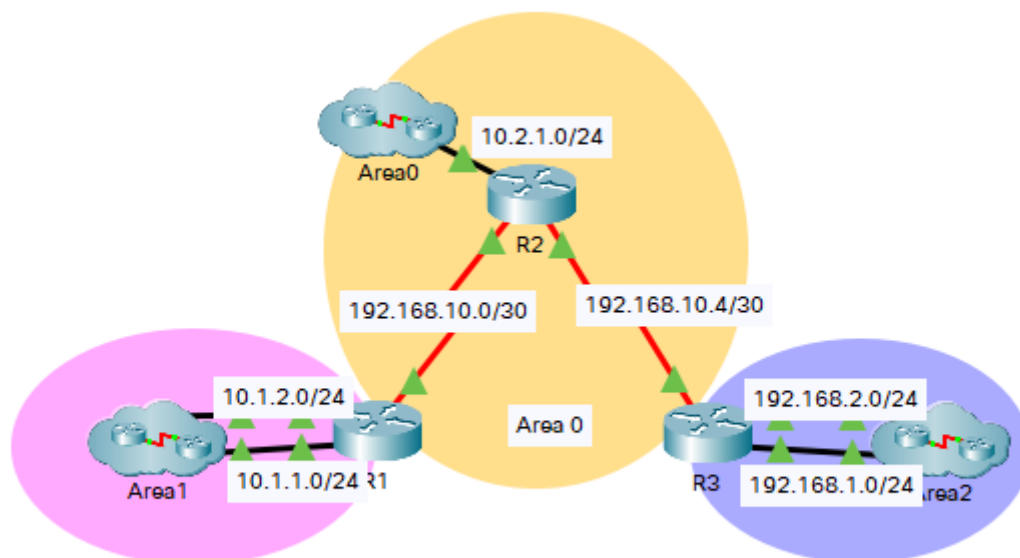
Part 1: Configure OSPFv2

Step 1: Configure OSPFv2 on R1.

Configure OSPFv2 on R1 with a process ID of 1 and a router ID of 1.1.1.1.

Step 2: Advertise each directly connected network in OSPFv2 on R1.

Configure each network in OSPFv2 assigning areas according to the **Addressing Table**.

```
R1(config-router)# network 10.1.1.0 0.0.0.255 area 1
R1(config-router)# network 10.1.2.0 0.0.0.255 area 1
R1(config-router)# network 192.168.10.0 0.0.0.3 area 0
```

R1

```
R1>ena
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1
R1(config-router)#network 10.1.1.0 0.0.0.255 area 1
R1(config-router)#network
23:08:43: %OSPF-5-ADJCHG: Process 1, Nbr 9.9.9.9 on GigabitEthernet0/0 from LOADING to
FULL, Loadi
R1(config-router)#network 10.1.2.0 0.0.0.255 area 1
R1(config-router)#
23:10:27: %OSPF-5-ADJCHG: Process 1, Nbr 5.5.5.5 on GigabitEthernet0/1 from LOADING to
FULL, Loading Done

R1(config-router)#network 192.168.10.0 0.0.0.3 area 0
```

Step 3: Configure OSPFv2 on R2 and R3.

Repeat the steps above for **R2** and **R3** using a router ID of 2.2.2.2 and 3.3.3.3, respectively.

R2

```
R2>ena
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#router ospf 1
R2(config-router)#router-id 2.2.2.2
R2(config-router)#network 10.2.1.0 0.0.0.255
% Incomplete command.
R2(config-router)#network 10.2.1.0 0.0.0.255 area 0
R2(config-router)#
00:02:40: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on GigabitEthernet0/0 from LOADING to
FULL, Loading Done

R2(config-router)#network 192.168.10.4 0.0.0.3 area 0
R2(config-router)#network 192.168.10.0 0.0.0.3 area 0
R2(config-router)#
00:03:58: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Serial0/0/0 from LOADING to FULL,
Loading Done
```

R3

```
R3>ena
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#router ospf 1
R3(config-router)#router-id 3.3.3.3
R3(config-router)#network 192.168.2.0 0.0.0.255 area 2
R3(config-router)#network 192.16
00:05:45: %OSPF-5-ADJCHG: Process 1, Nbr 6.6.6.6 on GigabitEthernet0/0 from LOADING to
FULL, Loadin
% Incomplete command.
R3(config-router)#network 192.168.1.0 0.0.0.255 area 2
R3(config-router)#
00:06:22: %OSPF-5-ADJCHG: Process 1, Nbr 7.7.7.7 on GigabitEthernet0/1 from LOADING to
FULL, Loading Done

R3(config-router)#network 192.168.10.4 0.0.0.3 area 0
R3(config-router)#
00:06:47: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial0/0/1 from LOADING to FULL,
Loading Done
```

Part 2: Verify and Examine Multiarea OSPFv2

Step 1: Verify connectivity to each of the OSPFv2 areas.

From R1, ping each of the following remote devices in area 0 and area 2: 192.168.1.2,
192.168.2.2, and 10.2.1.2.

```
R1(config)#
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#ping 192.168.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/12/23 ms

R1#ping 192.168.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/17/23 ms

R1#ping 10.2.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 9/10/12 ms
```

Step 2: Use show commands to examine the current OSPFv2 operations.

Use the following commands to gather information about your OSPFv2 multiarea implementation.

```
show ip protocols
show ip route
show ip ospf database
show ip ospf interface
show ip ospf neighbor
```

Protocols

```
R1#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.1
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.1.1.0 0.0.0.255 area 1
    10.1.2.0 0.0.0.255 area 1
    192.168.10.0 0.0.0.3 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.1              110      00:15:11
    2.2.2.2              110      00:12:22
    3.3.3.3              110      00:12:19
    4.4.4.4              110      00:16:29
    5.5.5.5              110      00:18:23
    9.9.9.9              110      00:18:28
  Distance: (default is 110)
```

Route

```
R1#show ip route
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, 5 subnets, 2 masks
C        10.1.1.0/24 is directly connected, GigabitEthernet0/0
L        10.1.1.1/32 is directly connected, GigabitEthernet0/0
C        10.1.2.0/24 is directly connected, GigabitEthernet0/1
L        10.1.2.1/32 is directly connected, GigabitEthernet0/1
O        10.2.1.0/24 [110/65] via 192.168.10.1, 00:15:32, Serial0/0/0
O IA 192.168.1.0/24 [110/129] via 192.168.10.1, 00:12:34, Serial0/0/0
O IA 192.168.2.0/24 [110/129] via 192.168.10.1, 00:12:34, Serial0/0/0
      192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks
C        192.168.10.0/30 is directly connected, Serial0/0/0
L        192.168.10.2/32 is directly connected, Serial0/0/0
O        192.168.10.4/30 [110/128] via 192.168.10.1, 00:15:32, Serial0/0/0
```

Database

```
R1# show ip ospf database
            OSPF Router with ID (1.1.1.1) (Process ID 1)

                Router Link States (Area 0)

Link ID          ADV Router       Age         Seq#         Checksum Link count
4.4.4.4          4.4.4.4          1074        0x80000002 0x00db3a 1
1.1.1.1          1.1.1.1          996         0x80000002 0x000ec0 2
2.2.2.2          2.2.2.2          827         0x80000006 0x008f74 5
3.3.3.3          3.3.3.3          824         0x80000002 0x0006b0 2

                Net Link States (Area 0)
Link ID          ADV Router       Age         Seq#         Checksum
10.2.1.2         4.4.4.4          1074        0x80000001 0x00961b

                Summary Net Link States (Area 0)
Link ID          ADV Router       Age         Seq#         Checksum
10.1.1.0         1.1.1.1          1229        0x80000001 0x00db72
10.1.2.0         1.1.1.1          1229        0x80000002 0x00ce7d
192.168.2.0      3.3.3.3          824         0x80000001 0x007175
192.168.1.0      3.3.3.3          824         0x80000002 0x007a6c

                Router Link States (Area 1)

Link ID          ADV Router       Age         Seq#         Checksum Link count
9.9.9.9          9.9.9.9          1193        0x80000002 0x004aa5 1
1.1.1.1          1.1.1.1          1188        0x80000006 0x00817d 2
5.5.5.5          5.5.5.5          1188        0x80000002 0x00917c 1

                Net Link States (Area 1)
Link ID          ADV Router       Age         Seq#         Checksum
10.1.1.2         9.9.9.9          1193        0x80000001 0x006b26
10.1.2.2         5.5.5.5          1188        0x80000001 0x0001b6

                Summary Net Link States (Area 1)
Link ID          ADV Router       Age         Seq#         Checksum
192.168.10.0     1.1.1.1          1219        0x80000001 0x00bbee
10.2.1.0         1.1.1.1          990         0x80000002 0x0050bb
192.168.10.4     1.1.1.1          990         0x80000003 0x001252
192.168.2.0      1.1.1.1          813         0x80000004 0x00acbe
192.168.1.0      1.1.1.1          813         0x80000005 0x00b5b5
R1#
```

Interface

```
R1#show ip ospf interface

Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.2/30, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:04
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 2.2.2.2
  Suppress hello for 0 neighbor(s)
GigabitEthernet0/0 is up, line protocol is up
  Internet address is 10.1.1.1/24, Area 1
  Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 9.9.9.9, Interface address 10.1.1.2
  Backup Designated Router (ID) 1.1.1.1, Interface address 10.1.1.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:06
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 9.9.9.9  (Designated Router)
  Suppress hello for 0 neighbor(s)
GigabitEthernet0/1 is up, line protocol is up
  Internet address is 10.1.2.1/24, Area 1
  Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 5.5.5.5, Interface address 10.1.2.2
  Backup Designated Router (ID) 1.1.1.1, Interface address 10.1.2.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:06
  Index 3/3, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 5.5.5.5  (Designated Router)
  Suppress hello for 0 neighbor(s)
```

Neighbor

```
Neighbor ID     Pri   State         Dead Time   Address        Interface
2.2.2.2          0    FULL/  -      00:00:39    192.168.10.1   Serial0/0/0
5.5.5.5          1    FULL/DR       00:00:38    10.1.2.2       GigabitEthernet0/1
9.9.9.9          1    FULL/DR       00:00:38    10.1.1.2       GigabitEthernet0/0
```

Reflection Questions

1. Which router(s) are internal routers?
2. Which router(s) are backbone routers?
3. Which router(s) are area border routers?
4. Which router(s) are autonomous system routers?
5. Which routers are generating Type 1 LSAs?
6. Which routers are generating Type 2 LSAs?
7. Which routers are generating Type 3 LSAs?
8. Which routers are generating Type 4 and 5 LSAs?
9. How many inter area routes does each router have?
10. Why would there usually be an ASBR in this type of network?

1. Двойные
2. R1/R2/R3
3. R1/R3
4. Нету
5. Все
6. Скрытые
7. R1/R3
8. Никто
9. 1
10. Для подключения доменов внешней маршрутизации

Suggested Scoring Rubric

Packet Tracer scores 80 points. Each of the Reflection Questions is worth 2 points.

1. Всегда должна присутствовать Area 0 так как она магистральная – является связующей остальных area.
2. Area нужны для оптимизации маршрутизации трафика
3. DR – управляет процессов рассылки LSA, каждый маршрутизатор подключается к DR, а он уже в свою очередь передаёт информацию LSA всем бродкастом.
4. BDR – на случай если DR выйдет из строя.

5. Выбираться DR и BDR по трём критериям:
   1) С самым высоким ID маршрутизатора
   2) По приоритету loopback
   3) С самым большим IP адресом
6. Типы LSA:
   1) **Router LSA -** содержится описание всех каналов маршрутизатора и стоимость (cost) каждого канала. Распространяются только в пределах одной зоны.
   2) **Network LSA** - содержится описание всех маршрутизаторов присоединенных к сети, включая DR. Распространяются только в пределах одной зоны.
   3) **Network Summary LSA**
   4) **ASBR Summary LSA** – содержит информации о пограничном маршрутизаторе
   5) **AS External LSA -** описывает маршруты по умолчанию
   6) **Multicast OSPF LSA** – описывает мультикаст маршруты
   7) **AS External LSA for NSSA -** объявления о состоянии внешних каналов автономной системы
   8) **Link LSA -** анонсирует link-local адрес
   9) **Intra-Area-Prefix LSA** – соответствие между префиксов IPv6 и Router LSA