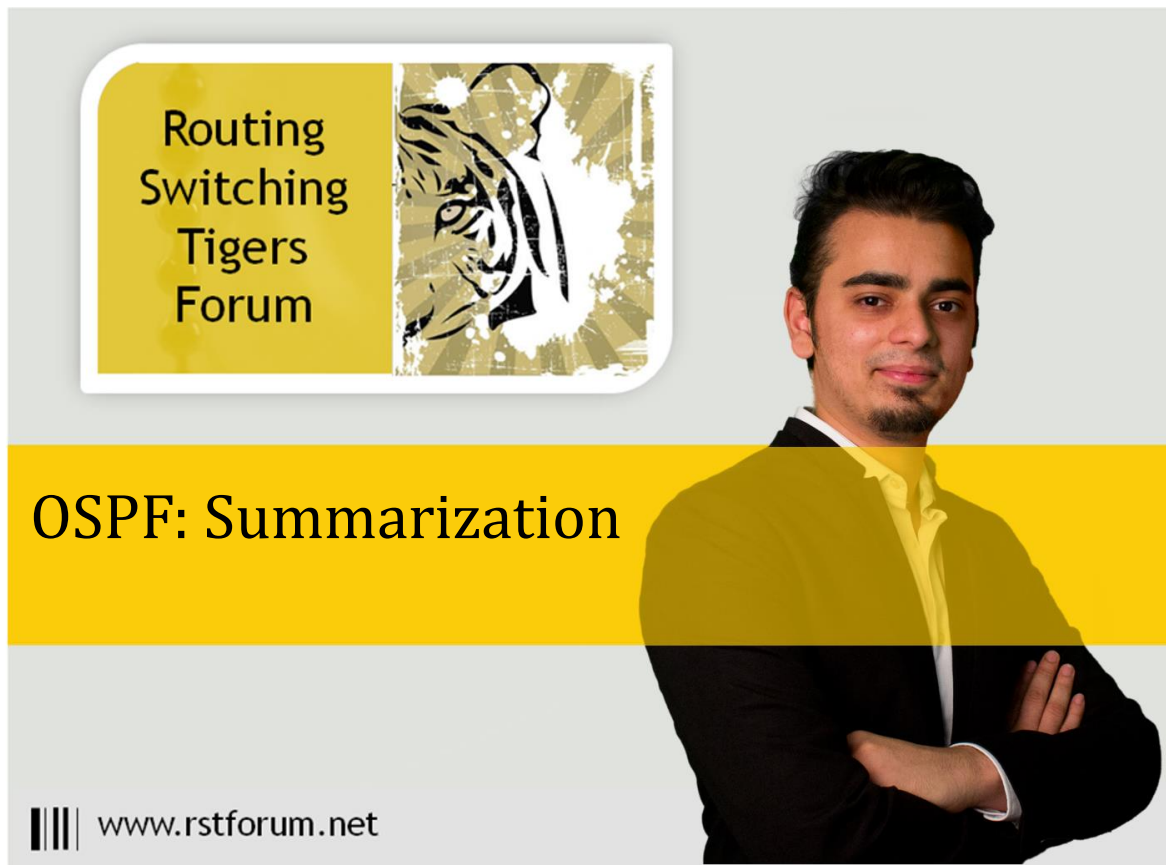


LAB3: OSPF – IPv4

Disclaimer

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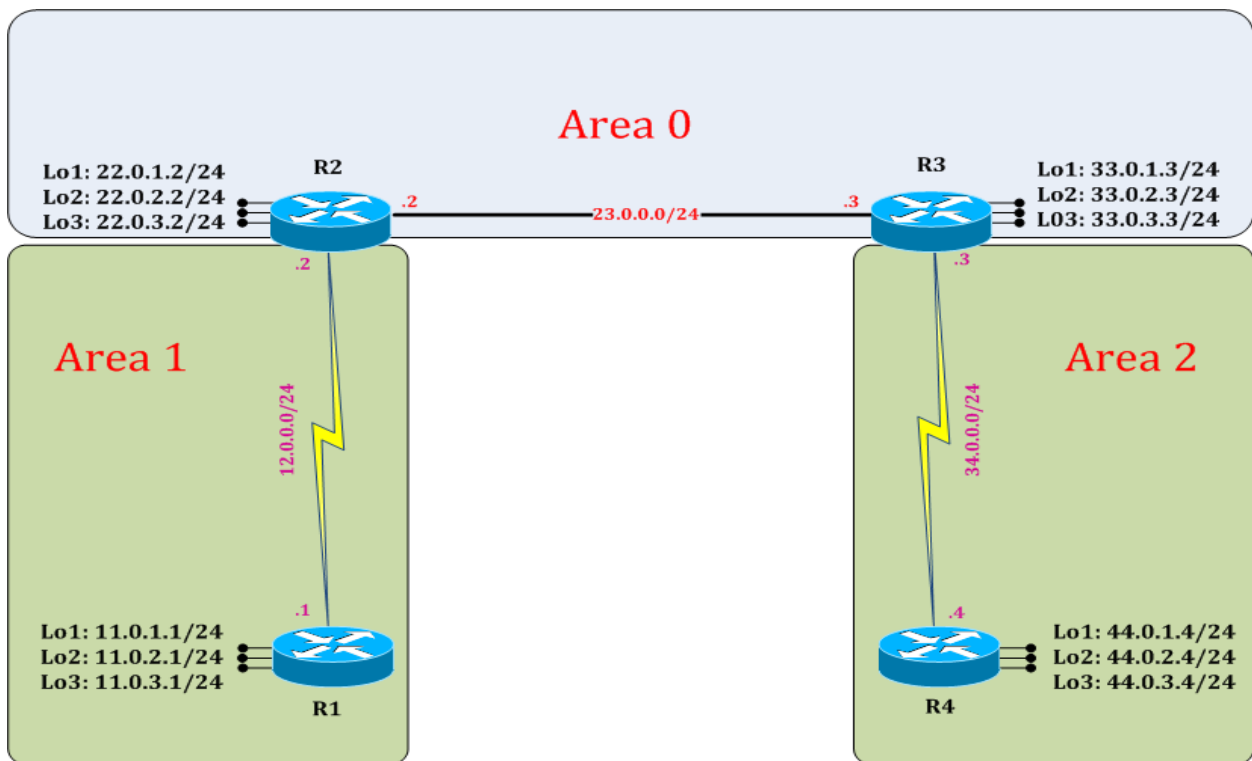
Routing
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OSPF: Summarization

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LAB 3: Diagram

Note: This Lab was developed on Cisco IOS Version 15.2(4) M1 ADVENTERPRISEK9-M.



LAB 3: OSPF Summarization:

Task 1: Configure IPv4 OSPF Summarization

Step 1 In the configuration mode of router configure 4 loopbacks with network address in sequence

```
R1:
interface loopback 0
ip address 11.0.0.1 255.255.255.0
exit
interface loopback 1
ip address 11.0.1.1 255.255.255.0
exit
interface loopback 2
ip address 11.0.2.1 255.255.255.0
exit
interface loopback 3
ip address 11.0.3.1 255.255.255.0
exit
```

Step 2 verify routes on neighbor router routing table

```
R2#show ip route
```

! (Shows router's routing table and IPv4 entries)

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - OSPF, EX - OSPF 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
i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP
+ - replicated route, % - next hop override

Gateway of last resort is not set

```
11.0.0.0/32 is subnetted, 3 subnets
O   11.0.1.1 [110/65] via 12.0.0.1, 00:20:07, Serial2/0
O   11.0.2.1 [110/65] via 12.0.0.1, 00:20:07, Serial2/0
O   11.0.3.1 [110/65] via 12.0.0.1, 00:20:07, Serial2/0
12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C   12.0.0.0/24 is directly connected, Serial2/0
L   12.0.0.2/32 is directly connected, Serial2/0
22.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C   22.0.1.0/24 is directly connected, Loopback1
L   22.0.1.2/32 is directly connected, Loopback1
C   22.0.2.0/24 is directly connected, Loopback2
L   22.0.2.2/32 is directly connected, Loopback2
```

```

C    22.0.3.0/24 is directly connected, Loopback3
L    22.0.3.2/32 is directly connected, Loopback3
     23.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    23.0.0.0/24 is directly connected, Ethernet0/0
L    23.0.0.2/32 is directly connected, Ethernet0/0
     33.0.0.0/32 is subnetted, 3 subnets
O    33.0.1.3 [110/11] via 23.0.0.3, 00:20:17, Ethernet0/0
O    33.0.2.3 [110/11] via 23.0.0.3, 00:20:17, Ethernet0/0
O    33.0.3.3 [110/11] via 23.0.0.3, 00:20:17, Ethernet0/0
     34.0.0.0/24 is subnetted, 1 subnets
O IA 34.0.0.0 [110/74] via 23.0.0.3, 00:20:17, Ethernet0/0
     44.0.0.0/32 is subnetted, 3 subnets
O IA 44.0.1.4 [110/75] via 23.0.0.3, 00:19:32, Ethernet0/0
O IA 44.0.2.4 [110/75] via 23.0.0.3, 00:19:21, Ethernet0/0
O IA 44.0.3.4 [110/75] via 23.0.0.3, 00:19:11, Ethernet0/0

```

Step 3 Summarize OSPF routes on ABR router

! (In OSPF Summary is always done on Area Border Router (ABR))

R1:

telnet 12.0.0.2

password: cisco

R2>enable

password: cisco

R2#show ip ospf database

OSPF Router with ID (22.0.3.2) (Process ID 1)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
22.0.3.2	22.0.3.2	308	0x80000005	0x00BA7F	4
33.0.3.3	33.0.3.3	325	0x80000004	0x00A35A	4

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
23.0.0.3	33.0.3.3	325	0x80000002	0x00595C

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
11.0.1.1	22.0.3.2	303	0x80000001	0x00894A
11.0.2.1	22.0.3.2	303	0x80000001	0x007E54
11.0.3.1	22.0.3.2	120	0x80000001	0x00735E
12.0.0.0	22.0.3.2	303	0x80000001	0x00874E
34.0.0.0	33.0.3.3	325	0x80000002	0x00FCB5

```

44.0.1.4 33.0.3.3 325 0x80000002 0x005151
44.0.2.4 33.0.3.3 325 0x80000002 0x00465B
44.0.3.4 33.0.3.3 325 0x80000002 0x003B65

```

Router Link States (Area 1)

```

Link ID    ADV Router  Age    Seq#    Checksum Link count
11.0.3.1  11.0.3.1   126    0x80000009 0x002FBD 5
22.0.3.2  22.0.3.2   308    0x80000007 0x00F845 2

```

Summary Net Link States (Area 1)

```

Link ID    ADV Router  Age    Seq#    Checksum
22.0.1.2  22.0.3.2   303    0x80000001 0x006D9A
22.0.2.2  22.0.3.2   303    0x80000001 0x0062A4
22.0.3.2  22.0.3.2   303    0x80000001 0x0057AE
23.0.0.0  22.0.3.2   303    0x80000001 0x00D927
33.0.1.3  22.0.3.2   303    0x80000001 0x0038B9
33.0.2.3  22.0.3.2   303    0x80000001 0x002DC3
33.0.3.3  22.0.3.2   303    0x80000001 0x0022CD
34.0.0.0  22.0.3.2   303    0x80000001 0x00CCE8
44.0.1.4  22.0.3.2   303    0x80000001 0x002184
44.0.2.4  22.0.3.2   303    0x80000001 0x00168E
44.0.3.4  22.0.3.2   303    0x80000001 0x000B98

```

R2:

```

router ospf 1
area 1 range 11.0.0.0 255.255.252.0
area 0 range 22.0.0.0 255.255.252.0
exit

```

telnet 23.0.0.3

```

password: cisco
R3>enable
password: cisco

```

R3# show ip ospf database

OSPF Router with ID (33.0.3.3) (Process ID 3)

Router Link States (Area 0)

```

Link ID    ADV Router  Age    Seq#    Checksum Link count
22.0.3.2  22.0.3.2   1941   0x80000008 0x00B482 4
33.0.3.3  33.0.3.3   1627   0x8000000D 0x009163 4

```

R3:

```

router ospf 1
area 0 range 22.0.0.0 255.255.252.0
exit

```

[Connection to 23.0.0.3 closed by foreign host]

Task 2: Verification:

Step 1 Verify receipt of summary route in neighbor routing table & verify creation of null interface in routing table by following command:

```
R2#show ip route
```

! (Shows router's routing table and IPv4 entries)

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

Gateway of last resort is not set

```
11.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O 11.0.0.0/22 is a summary, 00:10:01, Null0
O 11.0.1.1/32 [110/65] via 12.0.0.1, 00:10:01, Serial2/0
O 11.0.2.1/32 [110/65] via 12.0.0.1, 00:10:01, Serial2/0
O 11.0.3.1/32 [110/65] via 12.0.0.1, 00:10:01, Serial2/0
12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 12.0.0.0/24 is directly connected, Serial2/0
L 12.0.0.2/32 is directly connected, Serial2/0
22.0.0.0/8 is variably subnetted, 7 subnets, 3 masks
O 22.0.0.0/22 is a summary, 00:10:01, Null0
C 22.0.1.0/24 is directly connected, Loopback1
L 22.0.1.2/32 is directly connected, Loopback1
C 22.0.2.0/24 is directly connected, Loopback2
L 22.0.2.2/32 is directly connected, Loopback2
C 22.0.3.0/24 is directly connected, Loopback3
L 22.0.3.2/32 is directly connected, Loopback3
23.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 23.0.0.0/24 is directly connected, Ethernet0/0
L 23.0.0.2/32 is directly connected, Ethernet0/0
33.0.0.0/32 is subnetted, 3 subnets
O 33.0.1.3 [110/11] via 23.0.0.3, 00:10:01, Ethernet0/0
O 33.0.2.3 [110/11] via 23.0.0.3, 00:10:01, Ethernet0/0
O 33.0.3.3 [110/11] via 23.0.0.3, 00:10:01, Ethernet0/0
34.0.0.0/24 is subnetted, 1 subnets
O IA 34.0.0.0 [110/74] via 23.0.0.3, 00:10:01, Ethernet0/0
44.0.0.0/32 is subnetted, 3 subnets
O IA 44.0.1.4 [110/75] via 23.0.0.3, 00:10:01, Ethernet0/0
O IA 44.0.2.4 [110/75] via 23.0.0.3, 00:10:01, Ethernet0/0
O IA 44.0.3.4 [110/75] via 23.0.0.3, 00:10:01, Ethernet0/0
```

(ABR Router will send summary routes from one area to other areas. When summarization is configured on a router, same router immediately created a routing point to Null 0 for loop prevention. Hence Null 0 will be created only on ABR routers in OSPF.)

```
R4#show ip route
```

! (Shows router's routing table and IPv4 entries)

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - OSPF, EX - OSPF external, O - OSPF, IA - OSPF inter ar
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP
+ - replicated route, % - next hop override

Gateway of last resort is not set

```
11.0.0.0/22 is subnetted, 1 subnets
O IA 11.0.0.0 [110/139] via 34.0.0.3, 01:31:00, Serial2/0
12.0.0.0/24 is subnetted, 1 subnets
O IA 12.0.0.0 [110/138] via 34.0.0.3, 01:44:50, Serial2/0
22.0.0.0/22 is subnetted, 1 subnets
O IA 22.0.0.0 [110/75] via 34.0.0.3, 00:04:28, Serial2/0
23.0.0.0/24 is subnetted, 1 subnets
O IA 23.0.0.0 [110/74] via 34.0.0.3, 02:42:59, Serial2/0
33.0.0.0/32 is subnetted, 3 subnets
O IA 33.0.1.3 [110/65] via 34.0.0.3, 02:42:59, Serial2/0
O IA 33.0.2.3 [110/65] via 34.0.0.3, 02:42:59, Serial2/0
O IA 33.0.3.3 [110/65] via 34.0.0.3, 02:42:59, Serial2/0
34.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 34.0.0.0/24 is directly connected, Serial2/0
L 34.0.0.4/32 is directly connected, Serial2/0
44.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 44.0.1.0/24 is directly connected, Loopback1
L 44.0.1.4/32 is directly connected, Loopback1
C 44.0.2.0/24 is directly connected, Loopback2
L 44.0.2.4/32 is directly connected, Loopback2
C 44.0.3.0/24 is directly connected, Loopback3
L 44.0.3.4/32 is directly connected, Loopback3
```

(Summarized routes are received from inter-area)