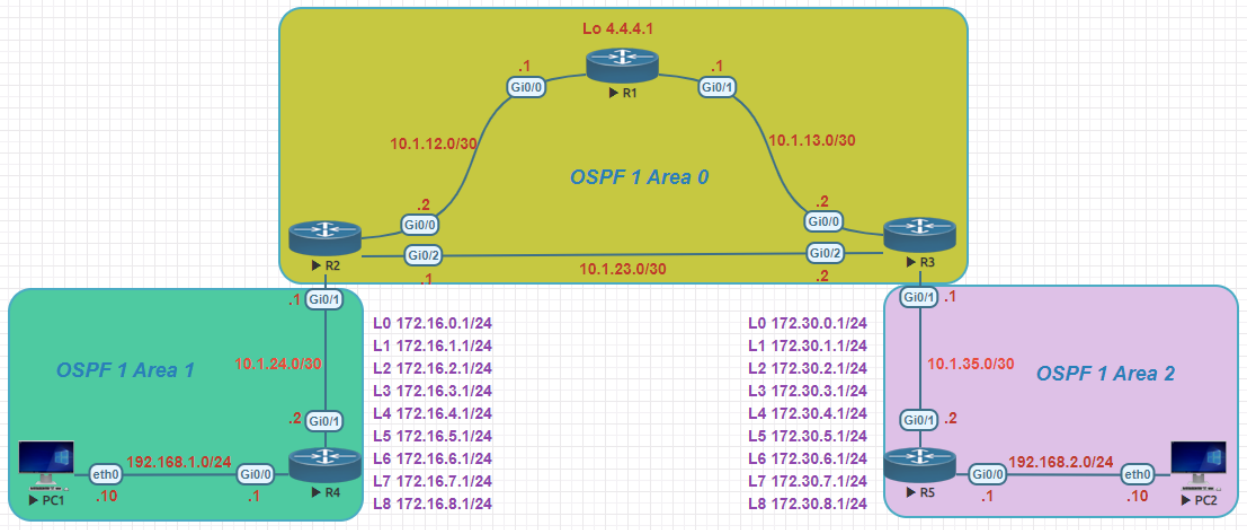
OSPF Summarization Lab:



Router Images	vios-adventerprisek9-m.spa.159-3.m2
Client PC	VPCS
Testing	OSPF
OSPF Process ID	1

R1 Basic Configuration
R1(config)#hostname R1 R1(config)#no ip domain lookup R1(config)#line con 0 R1(config-line)#exec-timeout 0 0 R1(config-line)#logging synchronous R1(config-line)#exit R1(config)#interface Loopback0 R1(config-if)#ip address 4.4.4.1 255.255.255.255 R1(config-if)#exit R1(config)#interface GigabitEthernet0/0 R1(config-if)#ip address 10.1.12.1 255.255.255.252 R1(config-if)#no shutdown R1(config-if)#exit R1(config)#interface GigabitEthernet0/1 R1(config-if)#ip address 10.1.13.1 255.255.255.252 R1(config-if)#no shutdown R1(config-if)#exit

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R2 Basic Configuration
R2(config)#hostname R2 R2(config)#no ip domain lookup R2(config)#line con 0 R2(config-line)#exec-timeout 0 0 R2(config-line)#logging synchronous R2(config-line)#exit R2(config)#interface GigabitEthernet0/0 R2(config-if)#ip address 10.1.12.2 255.255.255.252 R2(config-if)#no shutdown R2(config-if)#exit R2(config)#interface GigabitEthernet0/1 R2(config-if)#ip address 10.1.24.1 255.255.255.252 R2(config-if)#no shutdown R2(config-if)#exit R2(config)#interface GigabitEthernet0/2 R2(config-if)#ip address 10.1.23.1 255.255.255.252 R2(config-if)#no shutdown R2(config-if)#exit

R3 Basic Configuration
R3(config)#hostname R3 R3(config)#no ip domain lookup R3(config)#line con 0 R3(config-line)#exec-timeout 0 0 R3(config-line)#logging synchronous R3(config-line)#exit R3(config)#interface GigabitEthernet0/0 R3(config-if)#ip address 10.1.13.2 255.255.255.252 R3(config-if)#no shutdown R3(config-if)#exit R3(config)#interface GigabitEthernet0/1 R3(config-if)#ip address 10.1.35.1 255.255.255.252 R3(config-if)#no shutdown R3(config-if)#exit R3(config)#interface GigabitEthernet0/2 R3(config-if)#ip address 10.1.23.2 255.255.255.252 R3(config-if)#no shutdown R3(config-if)#exit

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R4 Basic Configuration

```
R4(config)#hostname R4
R4(config)#no ip domain lookup
R4(config)#line con 0
R4(config-line)#exec-timeout 0 0
R4(config-line)#logging synchronous
R4(config-line)#exit
R4(config)#interface Loopback0
R4(config-if)#ip address 172.16.0.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback1
R4(config-if)#ip address 172.16.1.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback2
R4(config-if)#ip address 172.16.2.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback3
R4(config-if)#ip address 172.16.3.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback4
R4(config-if)#ip address 172.16.4.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback5
R4(config-if)#ip address 172.16.5.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback6
R4(config-if)#ip address 172.16.6.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback7
R4(config-if)#ip address 172.16.7.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface Loopback8
R4(config-if)#ip address 172.16.8.1 255.255.255.0
R4(config-if)#exit
R4(config)#interface GigabitEthernet0/0
R4(config-if)#ip address 192.168.1.1 255.255.255.0
R4(config-if)#no shutdown
R4(config-if)#exit
R4(config)#interface GigabitEthernet0/1
R4(config-if)#ip address 10.1.24.2 255.255.255.252
R4(config-if)#no shutdown
R4(config-if)#exit
```


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R5 Basic Configuration

```
R5(config)#hostname R5
R5(config)#no ip domain lookup
R5(config)#line con 0
R5(config-line)#exec-timeout 0 0
R5(config-line)#logging synchronous
R5(config-line)#exit
R5(config)#interface Loopback0
R5(config-if)#ip address 172.30.0.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback1
R5(config-if)#ip address 172.30.1.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback2
R5(config-if)#ip address 172.30.2.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback3
R5(config-if)#ip address 172.30.3.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback4
R5(config-if)#ip address 172.30.4.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback5
R5(config-if)#ip address 172.30.5.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback6
R5(config-if)#ip address 172.30.6.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback7
R5(config-if)#ip address 172.30.7.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface Loopback8
R5(config-if)#ip address 172.30.8.1 255.255.255.0
R5(config-if)#exit
R5(config)#interface GigabitEthernet0/0
R5(config-if)#ip address 192.168.2.1 255.255.255.0
R5(config-if)#no shutdown
R5(config-if)#exit
R5(config)#interface GigabitEthernet0/1
R5(config-if)#ip address 10.1.35.2 255.255.255.252
R5(config-if)#no shutdown
R5(config-if)#exit
```


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PC1 Basic Configuration
VPCS> set pcname PC1 PC1> ip 192.168.1.10 /24 192.168.1.1

PC2 Basic Configuration
VPCS> set pcname PC2 PC2> ip 192.168.2.10 /24 192.168.2.10

R1 OSPF Configuration
R1(config)#router ospf 1 R1(config-router)#router-id 1.1.1.1 R1(config-router)#network 10.1.12.0 0.0.0.3 area 0 R1(config-router)#network 10.1.13.0 0.0.0.3 area 0 R1(config-router)#network 4.4.4.4 0.0.0.0 area 0

R2 OSPF Configuration
R2(config)#router ospf 1 R2(config-router)#router-id 2.2.2.2 R2(config-router)#network 10.1.12.0 0.0.0.3 area 0 R2(config-router)#network 10.1.23.0 0.0.0.3 area 0 R2(config-router)#network 10.1.24.0 0.0.0.3 area 1

R3 OSPF Configuration
R3(config)#router ospf 1 R3(config-router)#router-id 3.3.3.3 R3(config-router)#network 10.1.13.0 0.0.0.3 area 0 R3(config-router)#network 10.1.23.0 0.0.0.3 area 0 R3(config-router)#network 10.1.35.0 0.0.0.3 area 2

R4 OSPF Configuration
R4(config)#router ospf 1 R4(config-router)#router-id 4.4.4.4 R4(config-router)#network 10.1.24.0 0.0.0.3 area 1 R4(config-router)#network 192.168.1.0 0.0.0.255 area 1 R4(config-router)#network 172.16.0.0 0.0.255.255 area 1

R5 OSPF Configuration
R5(config)#router ospf 1 R5(config-router)#router-id 5.5.5.5 R5(config-router)#network 10.1.35.0 0.0.0.3 area 2 R5(config-router)#network 192.168.2.0 0.0.0.255 area 2 R5(config-router)#network 172.30.0.0 0.0.255.255 area 2

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Show Commands
R1#show ip route ospf R1#show ip ospf neighbor
R2#show ip ospf neighbor R2#show ip route ospf
R3#show ip ospf neighbor
R4#show ip ospf neighbor R5#show ip ospf neighbor
R5#show ip ospf neighbor R5#show ip route ospf
PC1> ping 192.168.2.10
PC2> ping 192.168.1.10

R1 Routing Table before summarization, routes coming from R4 and R5 loopbacks interfaces.

```
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
O        10.1.23.0/30 [110/2] via 10.1.13.2, 00:44:15, GigabitEthernet0/1
                      [110/2] via 10.1.12.2, 00:44:15, GigabitEthernet0/0
O IA     10.1.24.0/30 [110/2] via 10.1.12.2, 00:44:25, GigabitEthernet0/0
O IA     10.1.35.0/30 [110/2] via 10.1.13.2, 00:44:15, GigabitEthernet0/1
      172.16.0.0/32 is subnetted, 9 subnets
O IA     172.16.0.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.1.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.2.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.3.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.4.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.5.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.6.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.7.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
O IA     172.16.8.1 [110/3] via 10.1.12.2, 00:00:15, GigabitEthernet0/0
      172.30.0.0/32 is subnetted, 9 subnets
O IA     172.30.0.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.1.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.2.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.3.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.4.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.5.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.6.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.7.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA     172.30.8.1 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA  192.168.1.0/24 [110/3] via 10.1.12.2, 00:09:24, GigabitEthernet0/0
O IA  192.168.2.0/24 [110/3] via 10.1.13.2, 00:43:59, GigabitEthernet0/1
R1#
```


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R2 ABR Summarization
R2(config)#router ospf 1 R2(config-router)#area 1 range 172.16.0.0 255.255.240.0 R2(config-router)#exit

R3 ABR Summarization
R3(config)#router ospf 1 R3(config-router)#area 2 range 172.30.0.0 255.255.240.0 R3(config-router)#exit

After apply the summarization on both ABR Routers R2 and R3 let's check R1 table now.

```
R1#show ip route ospf
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
       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
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
O        10.1.23.0/30 [110/2] via 10.1.13.2, 00:45:52, GigabitEthernet0/1
                      [110/2] via 10.1.12.2, 00:45:52, GigabitEthernet0/0
O IA     10.1.24.0/30 [110/2] via 10.1.12.2, 00:46:02, GigabitEthernet0/0
O IA     10.1.35.0/30 [110/2] via 10.1.13.2, 00:45:52, GigabitEthernet0/1
      172.16.0.0/20 is subnetted, 1 subnets
O IA     172.16.0.0 [110/3] via 10.1.12.2, 00:00:11, GigabitEthernet0/0
      172.30.0.0/20 is subnetted, 1 subnets
O IA     172.30.0.0 [110/3] via 10.1.13.2, 00:00:04, GigabitEthernet0/1
O IA  192.168.1.0/24 [110/3] via 10.1.12.2, 00:11:01, GigabitEthernet0/0
O IA  192.168.2.0/24 [110/3] via 10.1.13.2, 00:45:36, GigabitEthernet0/1
R1#


R2#show ip route ospf
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
       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
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O        10.1.13.0/30 [110/2] via 10.1.23.2, 00:02:22, GigabitEthernet0/2
                      [110/2] via 10.1.12.1, 00:02:22, GigabitEthernet0/0
O IA     10.1.35.0/30 [110/2] via 10.1.23.2, 00:02:22, GigabitEthernet0/2
      172.16.0.0/16 is variably subnetted, 10 subnets, 2 masks
O        172.16.0.0/20 is a summary, 00:02:22, Null0
```


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```
R3#show ip route ospf
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
       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
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O        10.1.12.0/30 [110/2] via 10.1.23.1, 00:03:24, GigabitEthernet0/2
                      [110/2] via 10.1.13.1, 00:03:24, GigabitEthernet0/0
O IA     10.1.24.0/30 [110/2] via 10.1.23.1, 00:03:24, GigabitEthernet0/2
      172.16.0.0/20 is subnetted, 1 subnets
O IA     172.16.0.0 [110/3] via 10.1.23.1, 00:03:24, GigabitEthernet0/2
      172.30.0.0/16 is variably subnetted, 10 subnets, 2 masks
O        172.30.0.0/20 is a summary, 00:03:24, Null0
```

Verification
PC1> ping 172.30.0.1
PC1> ping 172.30.1.1
PC1> ping 172.30.2.1
PC1> ping 172.30.3.1
PC1> ping 172.30.4.1
PC1> ping 172.30.5.1
PC1> ping 172.30.6.1
PC1> ping 172.30.7.1
PC1> ping 172.30.8.1

Verification
PC2> ping 172.16.0.1
PC2> ping 172.16.1.1
PC2> ping 172.16.2.1
PC2> ping 172.16.3.1
PC2> ping 172.16.4.1
PC2> ping 172.16.5.1
PC2> ping 172.16.6.1
PC2> ping 172.16.7.1
PC2> ping 172.16.8.1

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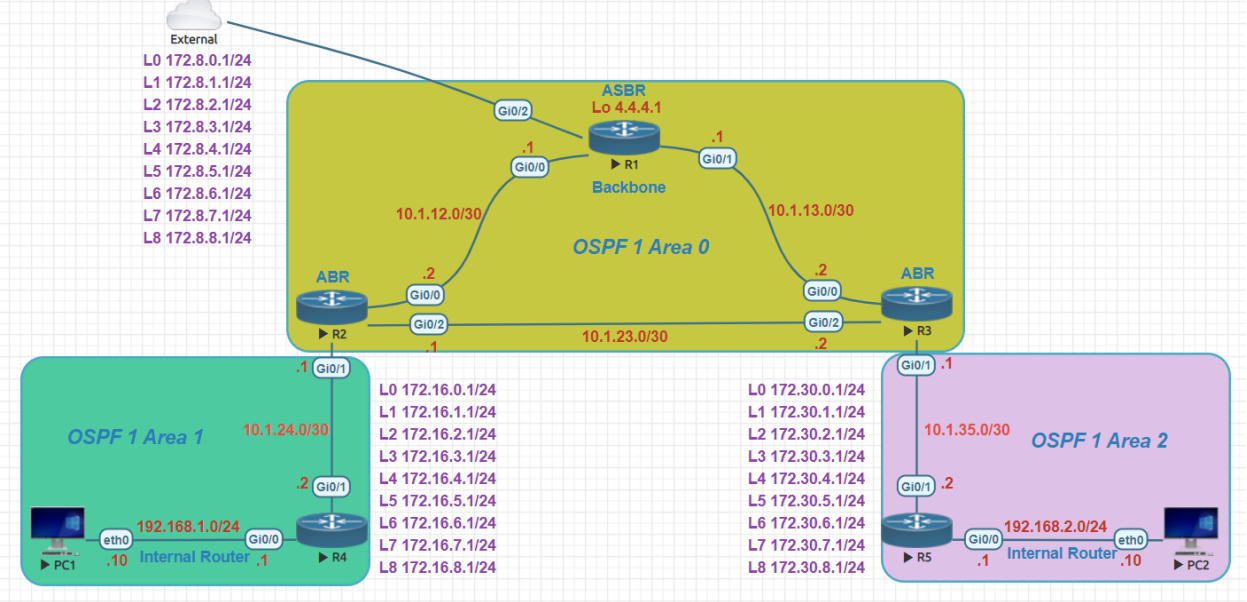

R1 Loopback Configuration
R1(config)#interface Loopback1 R1(config-if)#ip address 172.8.0.1 255.255.255.0 R1(config)#interface Loopback2 R1(config-if)#ip address 172.8.1.1 255.255.255.0 R1(config)#interface Loopback3 R1(config-if)#ip address 172.8.2.1 255.255.255.0 R1(config)#interface Loopback4 R1(config-if)#ip address 172.8.3.1 255.255.255.0 R1(config-if)#exit R1(config)#interface Loopback5 R1(config-if)#ip address 172.8.4.1 255.255.255.0 R1(config-if)#exit R1(config)#interface Loopback6 R1(config-if)#ip address 172.8.5.1 255.255.255.0 R1(config-if)#exit R1(config)#interface Loopback7 R1(config-if)#ip address 172.8.6.1 255.255.255.0 R1(config-if)#exit R1(config)#interface Loopback8 R1(config-if)#ip address 172.8.7.1 255.255.255.0 R1(config-if)#exit R1(config)#interface Loopback9 R1(config-if)#ip address 172.16.8.1 255.255.255.0

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R1 OSPF Configuration
R1(config)#router ospf 1 R1(config-router)#redistribute connected subnets

R2 Routing Table Before Summarization.

```
Gateway of last resort is not set

      4.0.0.0/32 is subnetted, 1 subnets
O E2     4.4.4.1 [110/20] via 10.1.12.1, 00:15:34, GigabitEthernet0/0
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O        10.1.13.0/30 [110/2] via 10.1.23.2, 00:22:37, GigabitEthernet0/2
                      [110/2] via 10.1.12.1, 00:22:37, GigabitEthernet0/0
O IA     10.1.35.0/30 [110/2] via 10.1.23.2, 00:22:37, GigabitEthernet0/2
      172.8.0.0/24 is subnetted, 7 subnets
O E2     172.8.1.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
O E2     172.8.2.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
O E2     172.8.3.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
O E2     172.8.4.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
O E2     172.8.5.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
O E2     172.8.6.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
O E2     172.8.7.0 [110/20] via 10.1.12.1, 00:00:05, GigabitEthernet0/0
      172.16.0.0/16 is variably subnetted, 11 subnets, 3 masks
O        172.16.0.0/20 is a summary, 00:22:47, Null0
O        172.16.0.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.1.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.2.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.3.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.4.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.5.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.6.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O        172.16.7.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O E2     172.16.8.0/24 [110/20] via 10.1.12.1, 00:10:40, GigabitEthernet0/0
O        172.16.8.1/32 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
      172.30.0.0/20 is subnetted, 1 subnets
O IA     172.30.0.0 [110/3] via 10.1.23.2, 00:22:37, GigabitEthernet0/2
O     192.168.1.0/24 [110/2] via 10.1.24.2, 00:22:47, GigabitEthernet0/1
O IA  192.168.2.0/24 [110/3] via 10.1.23.2, 00:22:37, GigabitEthernet0/2
R2#
```

R1 OSPF Configuration
R1(config)#router ospf 1 R1(config-router)# summary-address 172.8.0.0 255.255.240.0

R2 Routing Table after Summarization on ASBR R1 Router.

```
      4.0.0.0/32 is subnetted, 1 subnets
O E2     4.4.4.1 [110/20] via 10.1.12.1, 00:17:34, GigabitEthernet0/0
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O        10.1.13.0/30 [110/2] via 10.1.23.2, 00:24:37, GigabitEthernet0/2
                      [110/2] via 10.1.12.1, 00:24:37, GigabitEthernet0/0
O IA     10.1.35.0/30 [110/2] via 10.1.23.2, 00:24:37, GigabitEthernet0/2
      172.8.0.0/20 is subnetted, 1 subnets
O E2     172.8.0.0 [110/20] via 10.1.12.1, 00:00:04, GigabitEthernet0/0
```


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