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**Welcome
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Tshoot Summarization**



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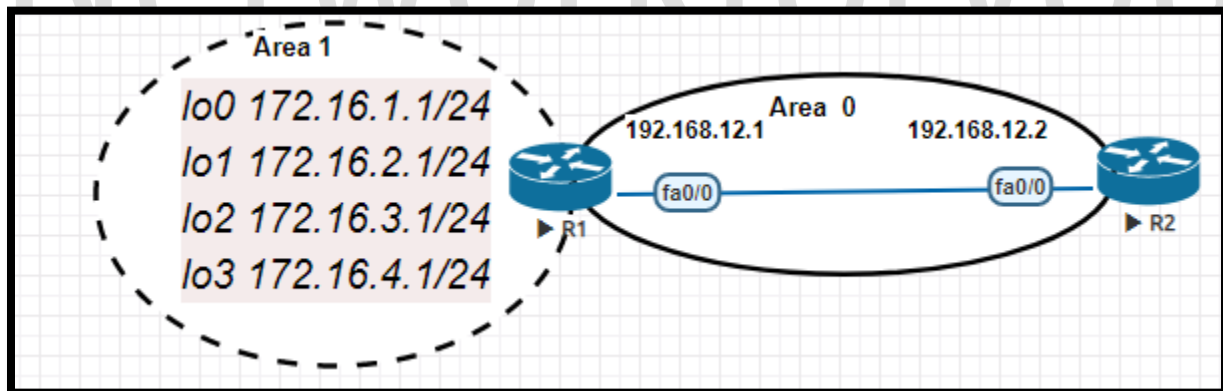
OSPF Summarization:

- Route summarization, also called route aggregation.
- It is a method of minimizing the number of routing tables in an IP (Internet Protocol) network.
- It works by consolidating selected multiple routes into a single route advertisement.
- The route summarization helps to reduce OSPF traffic and the route computation.
- OSPF support Route summarization only at ABR (Area Border Router) or ASBR (Autonomous system boundary router).

Advantages of Summarization:

- **Saves Memory** -Routing tables will be smaller which reduces memory requirements.
- **Saves Bandwidth** -There are less routes to advertise so we save some bandwidth.
- **Saves CPU Cycles** - Less packets to process and smaller routing tables to work on.
- **Stability** -Prevents routing table instability due to flapping networks.

OSPF Summarization at ABR Lab:



R1 Configuration	R2 Configuration
en config t hostname R1	en config t hostname R2

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```
int f0/0  
ip add 192.168.12.1 255.255.255.0  
no sh
```

```
int lo0  
ip add 172.16.1.1 255.255.255.0
```

```
int lo1  
ip add 172.16.2.1 255.255.255.0
```

```
int lo2  
ip add 172.16.3.1 255.255.255.0
```

```
int lo3  
ip add 172.16.4.1 255.255.255.0
```

```
router ospf 1
```

```
int f0/0  
ip ospf 1 area 0
```

```
int lo0  
ip ospf 1 area 1
```

```
int lo1
```

```
ip ospf 1 area 1
```

```
int lo2
```

```
ip ospf 1 area 1
```

```
int lo3
```

```
ip ospf 1 area 1
```

area 1 range 172.16.0.0 255.255.248.0

```
int f0/0  
ip add 192.168.12.2 255.255.255.0  
no sh
```

```
int lo0  
ip add 2.2.2.2 255.0.0.0
```

```
router ospf 1
```

```
int f0/0  
ip ospf 1 area 0
```

```
int lo0  
ip ospf 1 area 0
```

Calculating the Summarize route:

172.16.1.0

172.16.4.0

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$172.16.00000\ 001.0 = 8 + 8 + 5 = 21 \Rightarrow 255.255.248.0$

172.16.00000 100.0

So IP will be 172.16.0.0 and subnet mask is 255.255.248.0

```
R1#sh ip route
Codes: 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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, FastEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
O    2.2.2.2 [110/11] via 192.168.12.2, 00:04:46, FastEthernet0/0
     172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
C    172.16.4.0/24 is directly connected, Loopback3
O    172.16.0.0/21 is a summary, 00:04:46, Null0
C    172.16.1.0/24 is directly connected, Loopback0
C    172.16.2.0/24 is directly connected, Loopback1
C    172.16.3.0/24 is directly connected, Loopback2
```

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```
R2#sh ip route
Codes: 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

Gateway of last resort is not set

C     192.168.12.0/24 is directly connected, FastEthernet0/0
C     2.0.0.0/8 is directly connected, Loopback0
      172.16.0.0/21 is subnetted, 1 subnets
O IA  172.16.0.0 [110/11] via 192.168.12.1, 00:00:25, FastEthernet0/0
```

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```

R2#ping 172.16.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/17/28 ms
R2#ping 172.16.2.1

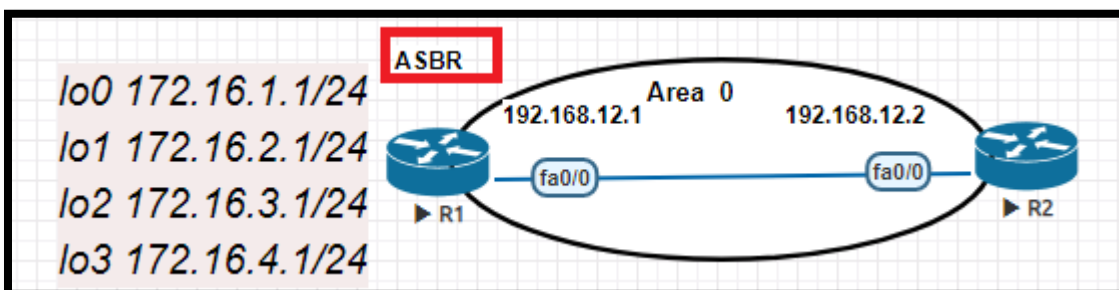
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.2.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/12/20 ms
R2#ping 172.16.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.3.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/18/24 ms
R2#ping 172.16.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.4.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/12/20 ms

```

OSPF Summarization at ASBR Lab:



R1 Configuration	R2 Configuration
<pre> en config t hostname R1 </pre>	<pre> en config t hostname R2 </pre>

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



```
int f0/0
ip add 192.168.12.1 255.255.255.0
no sh
```

```
int lo0
ip add 172.16.1.1 255.255.255.0
```

```
int lo1
ip add 172.16.2.1 255.255.255.0
```

```
int lo2
ip add 172.16.3.1 255.255.255.0
```

```
int lo3
ip add 172.16.4.1 255.255.255.0
```

```
router ospf 1
```

```
int f0/0
ip ospf 1 area 1
```

```
router ospf 1
redistribute connected subnets
summary-address 172.16.0.0 255.255.248.0
```

```
int f0/0
ip add 192.168.12.2 255.255.255.0
no sh
```

```
int lo0
ip add 2.2.2.2 255.0.0.0
```

```
router ospf 1
```

```
int f0/0
ip ospf 1 area 1
```

```
int lo0
ip ospf 1 area 1
```

Calculating the Summarize route:

172.16.1.0

172.16.4.0

172.16.00000 001.0 = 8 + 8 + 5 = 21 => 255.255.248.0

172.16.00000 100.0

So IP will be 172.16.0.0 and subnet mask is 255.255.248.0

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```
R2#sh ip route
Codes: 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

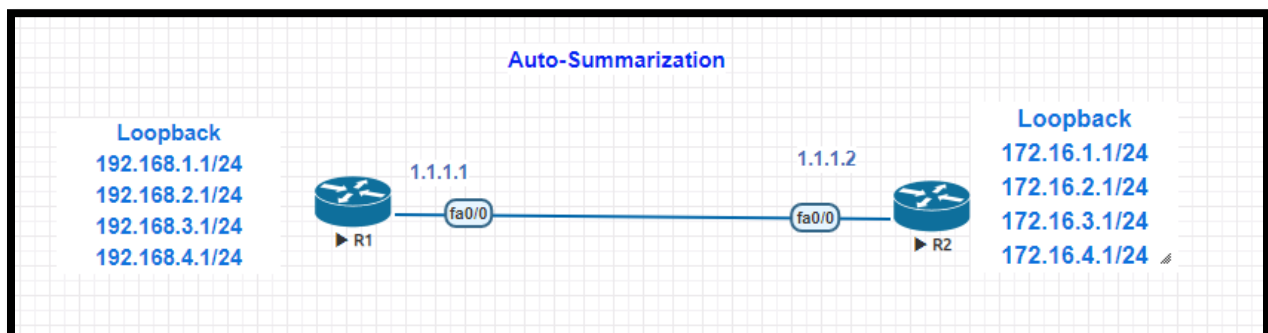
Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, FastEthernet0/0
C    2.0.0.0/8 is directly connected, Loopback0
     172.16.0.0/21 is subnetted, 1 subnets
O E2  172.16.0.0 [110/20] via 192.168.12.1, 00:00:13, FastEthernet0/0
```

EIGRP Summarization:

Auto-Summarization:

- Auto Summarization is a feature, which allows Routing Protocols to summarize its routes to their classful networks automatically.
- By default, EIGRP has auto summary feature enabled in old version but in new version v15 it is disable. Because of this, routes are summarized to classful address at network boundaries in the routing updates.
- The Auto-Summarization can be disabled with a command of no auto-summary from the router prompt.



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R1 Configuration	R2 Configuration
en config t hostname R1 int f0/0 ip add 1.1.1.1 255.0.0.0 no sh int lo 0 ip add 192.168.1.1 255.255.255.0 int lo 1 ip add 192.168.2.1 255.255.255.0 int lo 2 ip add 192.168.3.1 255.255.255.0 int lo 3 ip add 192.168.4.1 255.255.255.0 router eigrp 1 network 0.0.0.0 no auto-summary auto-summary	en config t hostname R2 int f0/0 ip add 1.1.1.2 255.0.0.0 no sh int lo 0 ip add 172.16.1.1 255.255.255.0 int lo 1 ip add 172.16.2.1 255.255.255.0 int lo 2 ip add 172.16.3.1 255.255.255.0 int lo 3 ip add 172.16.4.1 255.255.255.0 router eigrp 1 network 0.0.0.0 no auto-summary auto-summary

```
R2#sh ip route eigrp
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
       + - replicated route, % - next hop override

Gateway of last resort is not set

D      192.168.1.0/24 [90/156160] via 1.1.1.1, 00:08:19, FastEthernet0/0
D      192.168.2.0/24 [90/156160] via 1.1.1.1, 00:08:19, FastEthernet0/0
D      192.168.3.0/24 [90/156160] via 1.1.1.1, 00:08:19, FastEthernet0/0
D      192.168.4.0/24 [90/156160] via 1.1.1.1, 00:08:19, FastEthernet0/0
```

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Commands	Description
R1(config)#router eigrp 1 R1(config-router)#network 0.0.0.0 R1(config-router)#no auto-summary	Enter EIGRP mode Advertise all networks Disable auto summary feature
R2(config)#router eigrp 1 R2(config-router)#network 0.0.0.0 R2(config-router)#no auto-summary	Enter EIGRP mode Advertise all network Disable auto summary feature
R1#show ip route eigrp	View routing table for EIGRP all four networks of 172 present in table
R2(config)#router eigrp 1 R2(config-router)#auto-summary	Enter EIGRP mode Enable auto summary feature
R1#show ip route eigrp	Again, view routing table for EIGRP Only summary route 172.16.0.0/16

```
R1#sh ip route eigrp
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
       + - replicated route, % - next hop override

Gateway of last resort is not set

D   _ 172.16.0.0/16 [90/156160] via 1.1.1.2, 00:01:57, FastEthernet0/0
```

Manual Summarization:

- The manual summarization is a process of creating a summary route that will be used to represent multiple routes and can be used to reduce the sizes of routing tables in a network.
- Manual summarization is configured differently on different protocols.
- The syntax of the command is (config-if) ip summary-address eigrp ASN SUMMARY_ADDRESS SUBNET_MASK.

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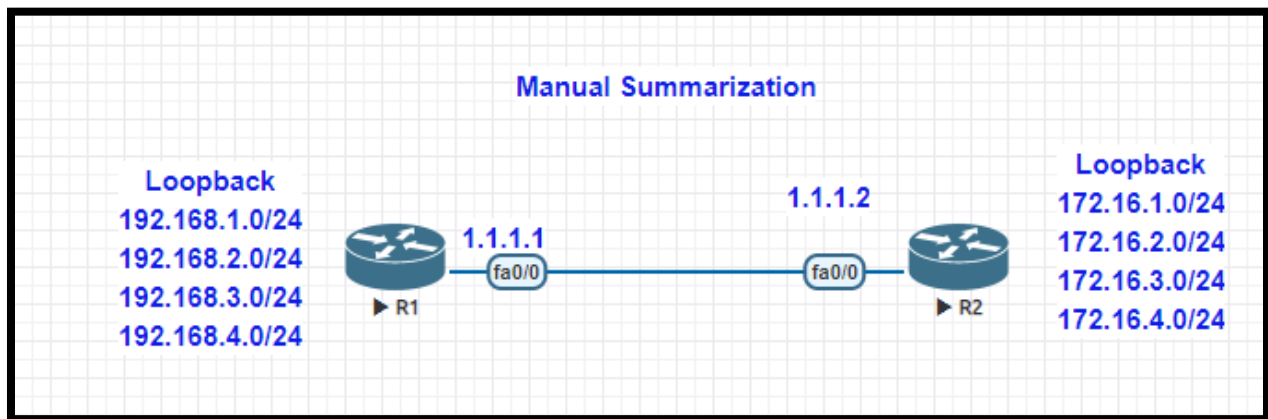
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Advantages of Summarization:

- Saves Memory: Routing tables will be smaller which reduces memory requirements.
- Saves Bandwidth: There are less routes to advertise so we save some bandwidth.
- Saves CPU Cycles: Less packets to process and smaller routing tables to work on.
- Stability: Prevents routing table instability due to flapping networks.

Lab-Manual Summarization:



Calculating the Summarize route:

192.168.1.0

192.168.4.0

192.168.00000 001. 0 = 8 + 8 + 5 = 21 => 255.255.248.0

192.168.00000 100. 0

So IP will be 192.168.0.0 and subnet mask is 255.255.248.0

Commands	Description
R1(config)#router eigrp 1	Enter EIGRP mode
R1(config-router)#network 0.0.0.0	Advertise all networks
R1(config-router)#no auto-summary	Disable auto summary feature
R2(config)#router eigrp 1	Enter EIGRP mode

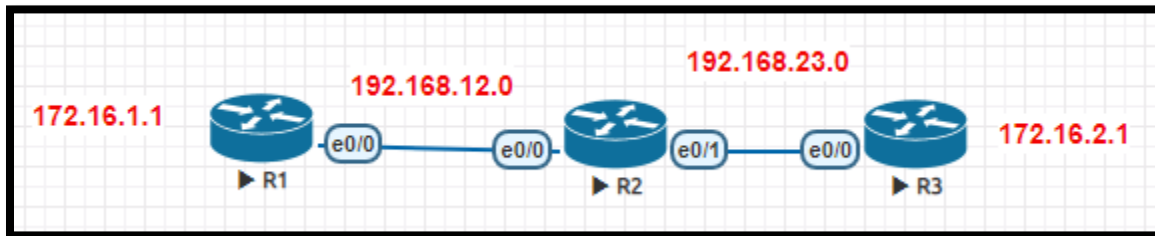
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R2(config-router)#network 1.0.0.0 R2(config-router)#no auto-summary	Advertise only 1 network Disable auto summary feature
R2#show ip route eigrp	View routing table for EIGRP all four networks of 192.168. present
R1(config)#interface f0/0 R1(config-if)#ip summary-address eigrp 1 192.168.0.0 255.255.248.0	Enter interface mode facing R2 Enter summary route to send
R2#show ip route eigrp	Check again routing table only summary route 192.168.0.0/21 only
R1#show ip route eigrp	Checking summary route in R1 192.168.0.0/21 is a summary, Null0

Auto Summarization Issue:



R1 Configuration	R2 Configuration	R3 Configuration
<pre> en config t hostname R1 interface e0/0 ip add 192.168.12.1 255.255.255.0 no shut interface loopback 1 ip add 172.16.1.1 255.255.255.0 router eigrp 1 network 0.0.0.0 auto-summary </pre>	<pre> en config t hostname R2 interface e0/0 ip add 192.168.12.2 255.255.255.0 no shut interface e0/1 ip add 192.168.23.2 255.255.255.0 no shut router eigrp 1 network 0.0.0.0 auto-summary </pre>	<pre> en config t hostname R3 interface e0/0 ip add 192.168.23.3 255.255.255.0 no shut interface loopback 1 ip add 172.16.2.1 255.255.255.0 router eigrp 1 network 0.0.0.0 auto-summary </pre>

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```
R2#sh ip route eigrp
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

Gateway of last resort is not set

D     172.16.0.0/16 [90/409600] via 192.168.23.3, 00:00:20, Ethernet0/1
      [90/409600] via 192.168.12.1, 00:00:20, Ethernet0/0
```

```
R2#ping 172.16.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
U.U.U
Success rate is 0 percent (0/5)
```

```
R1#sh ip route eigrp
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

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
D     172.16.0.0/16 is a summary, 00:01:54, Null0
D     192.168.23.0/24 [90/307200] via 192.168.12.2, 00:01:33, Ethernet0/0
```

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```
R1#ping 172.16.2.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.2.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

```
R3#ping 172.16.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

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