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**Welcome  
To  
Network for you  
OSPF Virtual Link**



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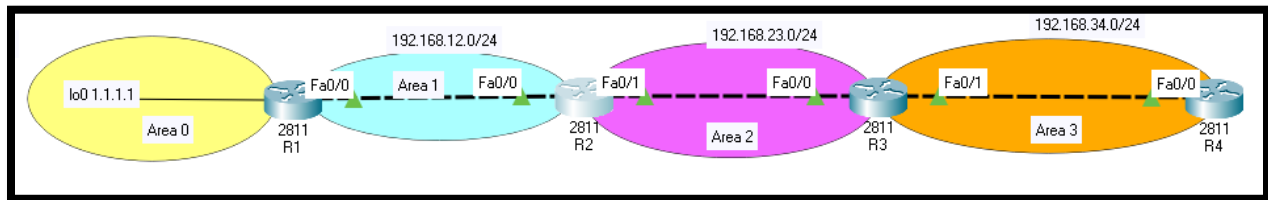
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## OSPF Virtual Link:

- If you studied Cisco's CCNA you have learned that when you use OSPF all the areas have to be directly connected to the backbone area.
- Areas have to be connected to the backbone area but if they aren't How we can fix this ? We will fix with a virtual link.

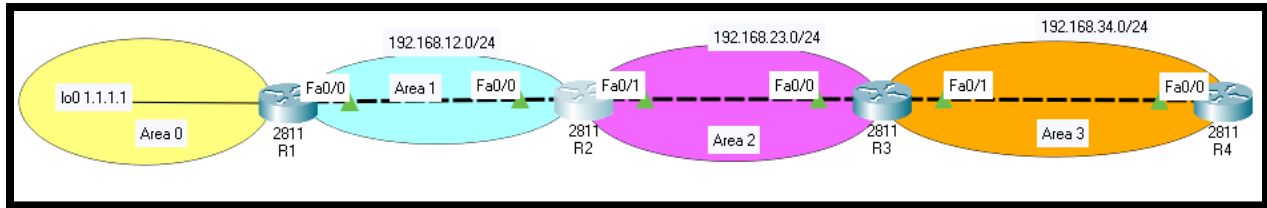


- We have four areas and on the left side is area 0. Area 2 is behind area 1 and Area 3 is behind area 2.
- Normally this is not going to work since area 2 has to be directly connected to area 0.
- We can make this work by using a virtual link.
- By using a virtual link we can extend area 0 through area 1 so area 2 will be "directly connected" to area 0 and through area 2 so area 3 will be "directly connected". To area 0. Let's take a look at how a virtual link can solve this problem:
- It's like a tunnel through area 1 to reach area 2. This way area 2 will be directly connected. Then we will do same thing for Area 2 to Area 3.
- In the example above area 2 is not directly connected to area 0 so we'll have to use a virtual link between routers R1 and R2, here's how we do it: (Later we will do R2 and R3 also)
- We configure the virtual-link between ABRs and we use the area virtual-link command.
- First we need to specify the area 1 where we need the virtual-link which is area 1 in my example (Then we will extend to other Area).
- Second step is to configure the OSPF router ID of the other ABR. Keep this in mind...you need to configure the OSPF router ID and NOT the IP address of the ABR.
- If everything is OK area 2 will have be directly connected to area 0 through our virtual-link. Then we will do make R2 as ABR and we will do virtual link between R2 and R3 so R4 have the all routers. Let see lab now.

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R1 Configuration:	R2 Configuration:
<pre>en config t hostname R1  int f0/0 ip add 192.168.12.1 255.255.255.0 no sh  int lo0 ip add 1.1.1.1 255.0.0.0  router ospf 1 router-id 1.1.1.1  int f0/0 ip ospf 1 area 1  int lo0 ip ospf 1 area 0  router ospf 1 area 1 virtual-link 2.2.2.2</pre>	<pre>en config t hostname R2  int f0/0 ip add 192.168.12.2 255.255.255.0 no sh  int f0/1 ip add 192.168.23.1 255.255.255.0 no sh  router ospf 1 router-id 2.2.2.2  int f0/0 ip ospf 1 area 1  int f0/1 ip ospf 1 area 2  router ospf 1 area 1 virtual-link 1.1.1.1  router ospf 1 area 2 virtual-link 3.3.3.3</pre>
R3 Configuration:	R4 Configuration:
<pre>en config t hostname R3</pre>	<pre>en config t hostname R4</pre>

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```
int f0/0
ip add 192.168.23.2 255.255.255.0
no sh
```

```
int f0/1
ip add 192.168.34.1 255.255.255.0
no sh
```

```
router ospf 1
router-id 3.3.3.3
```

```
int f0/0
ip ospf 1 area 2
```

```
int f0/1
ip ospf 1 area 3
```

```
router ospf 1
area 2 virtual-link 2.2.2.2
```

```
int f0/0
ip add 192.168.34.2 255.255.255.0
no sh
```

```
router ospf 1
router-id 4.4.4.4
```

```
int f0/0
ip ospf 1 area 3
```

R4 is now having all routers.

```
R4>sh 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

    1.0.0.0/32 is subnetted, 1 subnets
O IA   1.1.1.1/32 [110/4] via 192.168.34.1, 00:41:33, FastEthernet0/0
O IA  192.168.12.0/24 [110/3] via 192.168.34.1, 00:06:57, FastEthernet0/0
O IA  192.168.23.0/24 [110/2] via 192.168.34.1, 00:41:53, FastEthernet0/0
    192.168.34.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.34.0/24 is directly connected, FastEthernet0/0
L       192.168.34.2/32 is directly connected, FastEthernet0/0
```

Now let see R2 and R3 it is ABR or not let see

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Sh ip ospf

```
R2#sh ip ospf
Routing Process "ospf 1" with ID 2.2.2.2
Supports only single TOS(TOS0) routes
Supports opaque LSA
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 3. 3 normal 0 stub 0 nssa
External flood list length 0
```

```
R3#sh ip ospf
Routing Process "ospf 1" with ID 3.3.3.3
Supports only single TOS(TOS0) routes
Supports opaque LSA
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 3. 3 normal 0 stub 0 nssa
External flood list length 0
```

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```
R3#sh ip ospf virtual-links
Virtual Link OSPF_VL0 to router 2.2.2.2 is up
  Run as demand circuit
  Transit area 2, via interface FastEthernet0/0, Cost of using 1
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  Hello due in 00:00:03
  Adjacency State FULL
  Index 1/2, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
  Last retransmission scan length is 0, maximum is 0
  Last retransmission scan time is 0 msec, maximum is 0 msec
```

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