

OSPF Areas



- Every router learns the full picture of the network including every router, its interfaces and what they connect to
- This can cause issues in large networks:
 - Too many routes can use up too much router memory
 - Network changes cause all routers to reconverge which takes time and CPU resources

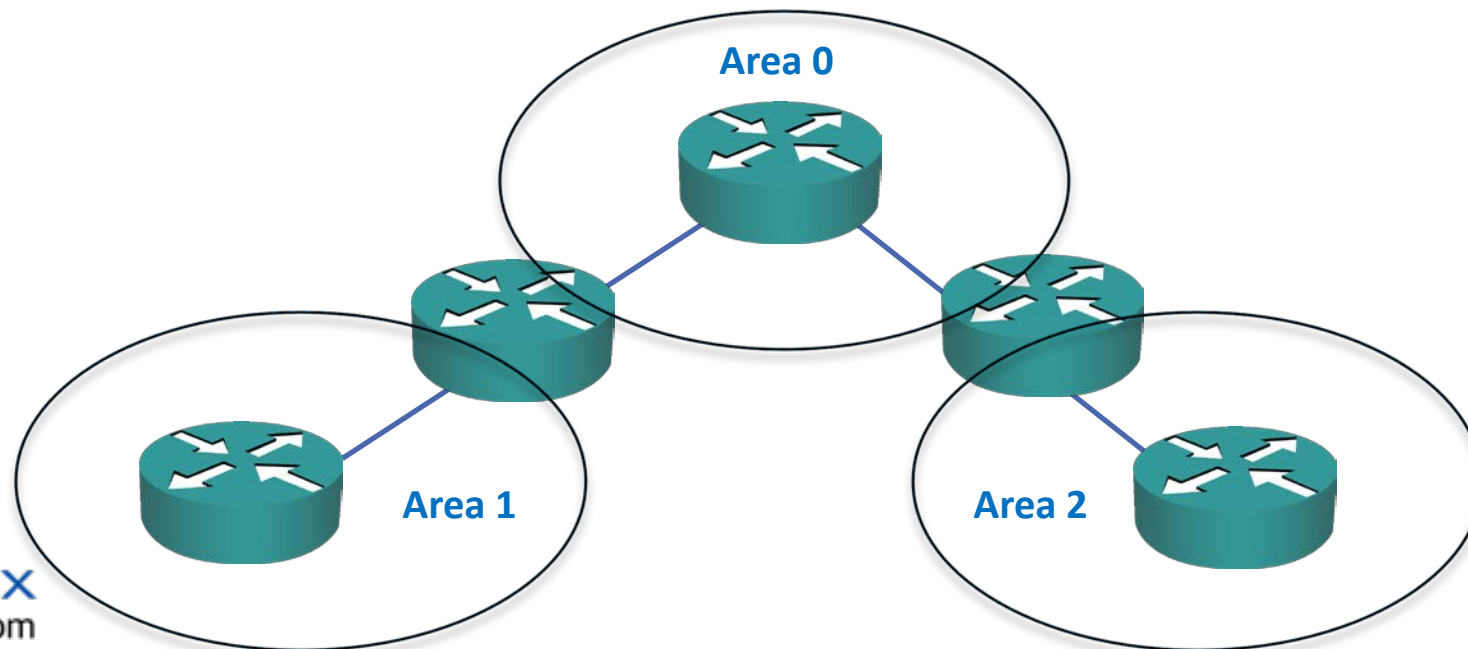
OSPF Areas



- OSPF supports a hierarchical design which segments large networks into smaller areas to solve this problem
- Each router maintains full information about its own area, but only summary information about other areas

OSPF Areas

- A two level hierarchy is used:
 - Transit area (backbone or area 0). Does not generally contain end users.
 - Regular areas (nonbackbone areas). Used to connect end users to the Transit area. By default, all transit traffic goes through the Transit area.
- Small networks do not require a hierarchical design and all routers can be in Area 0



OSPF Configuration - network

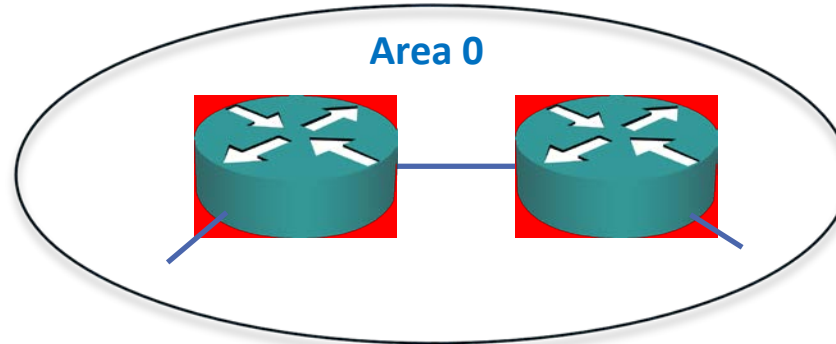


```
R1(config-router)# network 10.0.0.0 0.0.255.255 area 0
```

- The area is configured at the interface level with the 'network' command
- For a router to form an adjacency, its neighbour must be configured to be in the same area

OSPF Router Types – Backbone Routers

- Routers which have all their OSPF interfaces in Area 0 are Backbone Routers
- Routers maintain a full LSDB of other routers and links in their own area



Internal Routes

- Routes received from other routers in the same area appear as Internal OSPF routes

```
R3#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
```

```
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
```

```
10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
```

```
O          10.1.2.0/24 [110/2000] via 10.1.1.1, 00:08:53, FastEthernet0/0
```

```
O          10.1.3.0/24 [110/2500] via 10.1.1.1, 00:04:04, FastEthernet0/0
```

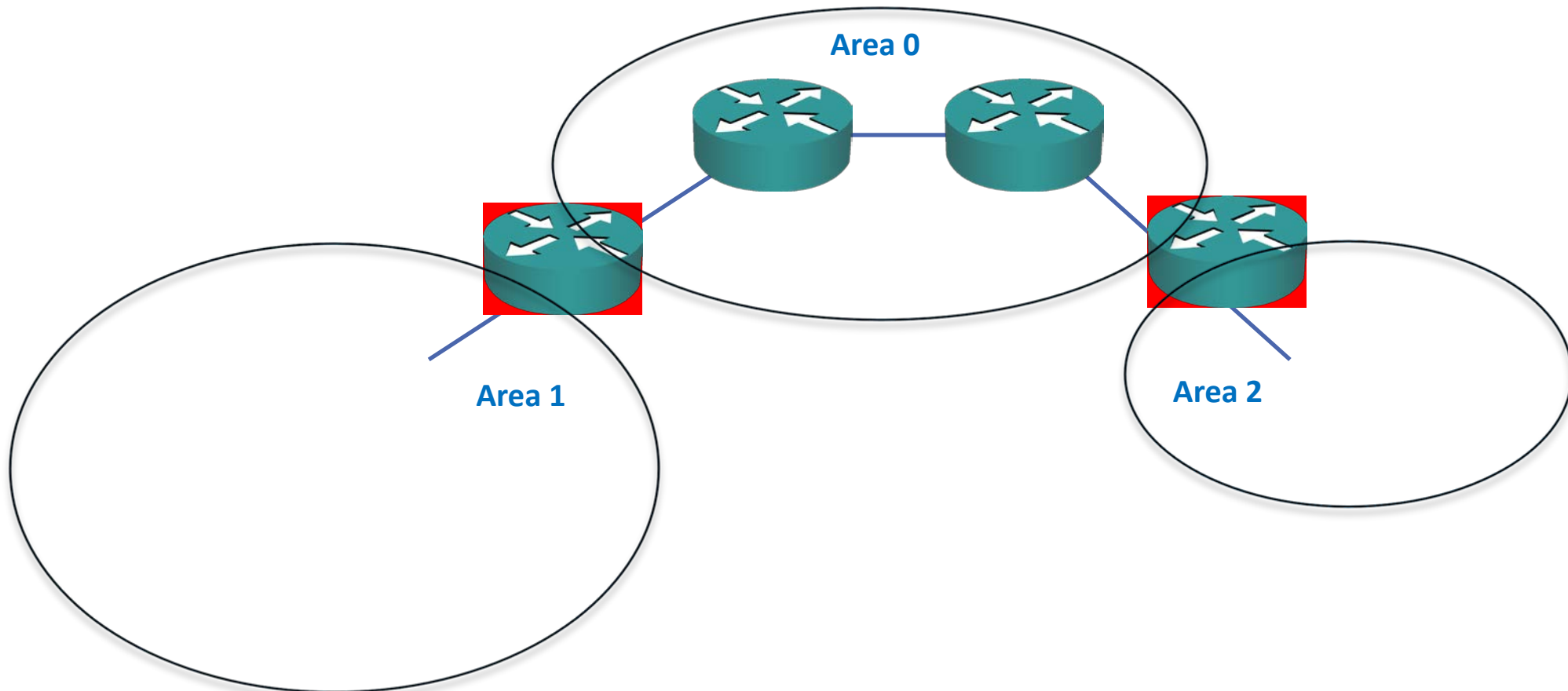
```
O          203.0.113.0/24 [110/2000] via 10.1.1.1, 00:08:43, FastEthernet0/0
```

```
! truncated
```

OSPF Router Types - ABRs



- Routers which have interfaces in multiple areas are Area Border Routers (ABRs)



OSPF Router Types - ABRs



An ABR has the following characteristics:

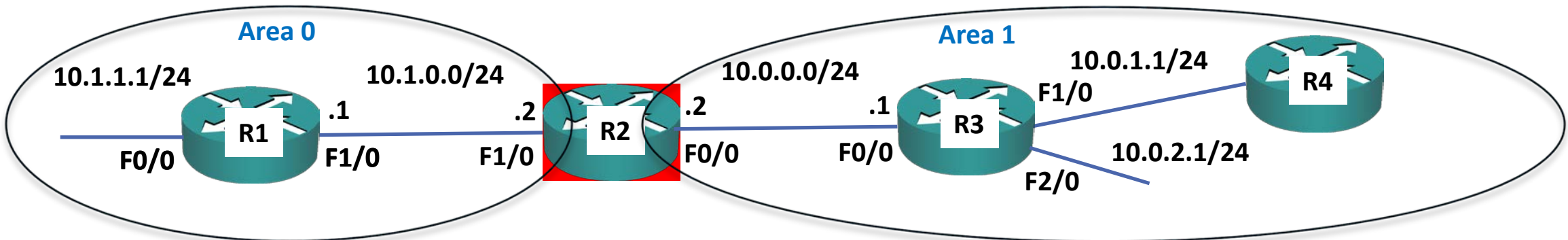
- It separates LSA flooding zones.
- It becomes the primary point for area address summarization.
- It functions regularly as the source for default routes.
- It maintains the LSDB for each area with which it is connected.

- The ideal design is to have each ABR connected to two areas only, the backbone and another area, with three areas being the upper limit.

Manual Summarization

- ABRs do not automatically summarise
- If you do not configure summarisation, all routes are flooded everywhere

```
R2(config)#router ospf 1
R2(config-router)#network 10.1.0.0 0.0.255.255 area 0
R2(config-router)#network 10.0.0.0 0.0.255.255 area 1
R2(config-router)#area 0 range 10.1.0.0 255.255.0.0
R2(config-router)#area 1 range 10.0.0.0 255.255.0.0
```



Inter Area Routes

- Routes to other areas appear as Inter Area IA routes

```
R1#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
```

```
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
```

```
10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
```

```
O IA      10.0.0.0/16 [110/2000] via 10.1.0.2, 00:06:15, FastEthernet1/0
```

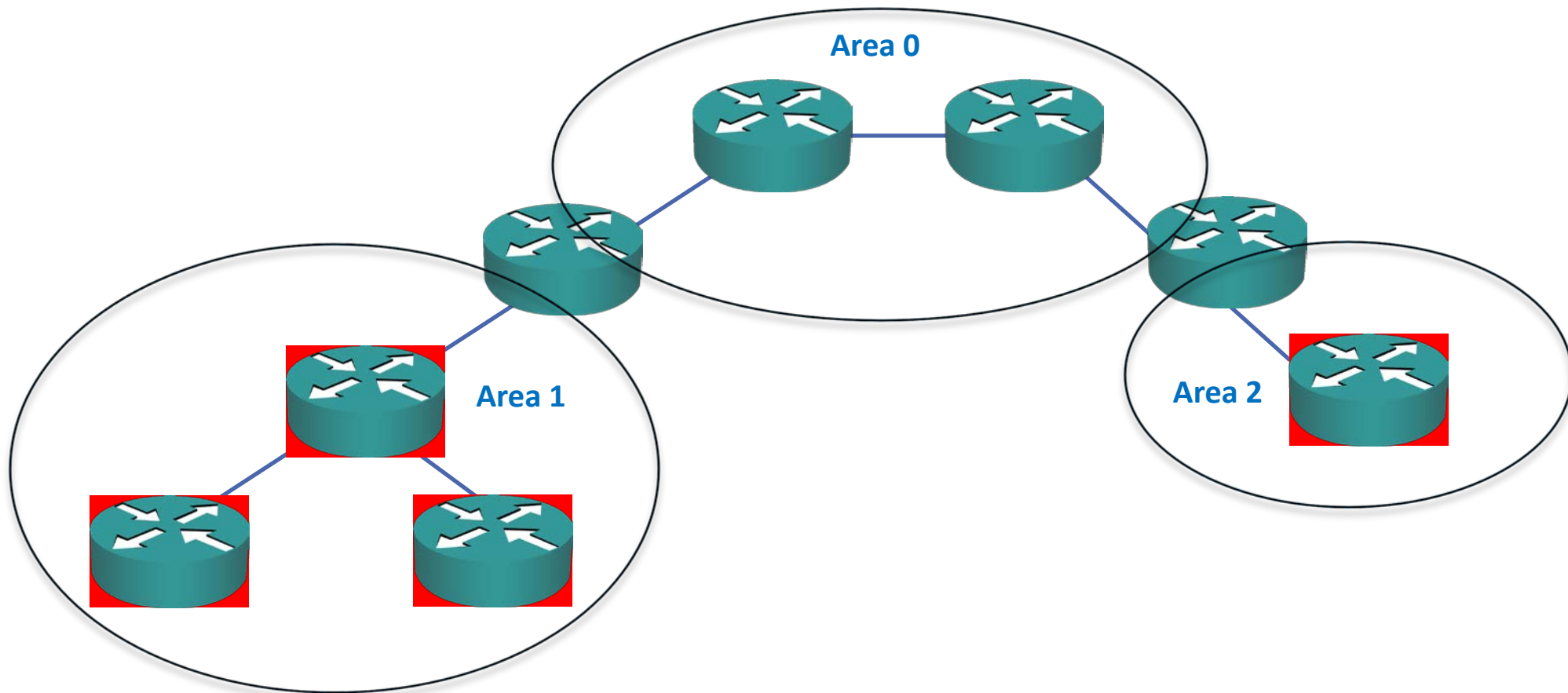
```
O          192.168.0.4 [110/1001] via 10.1.1.1, 00:08:53, FastEthernet0/0
```

```
O          203.0.113.0/24 [110/2000] via 10.1.1.1, 00:08:43, FastEthernet0/0
```

```
! truncated
```

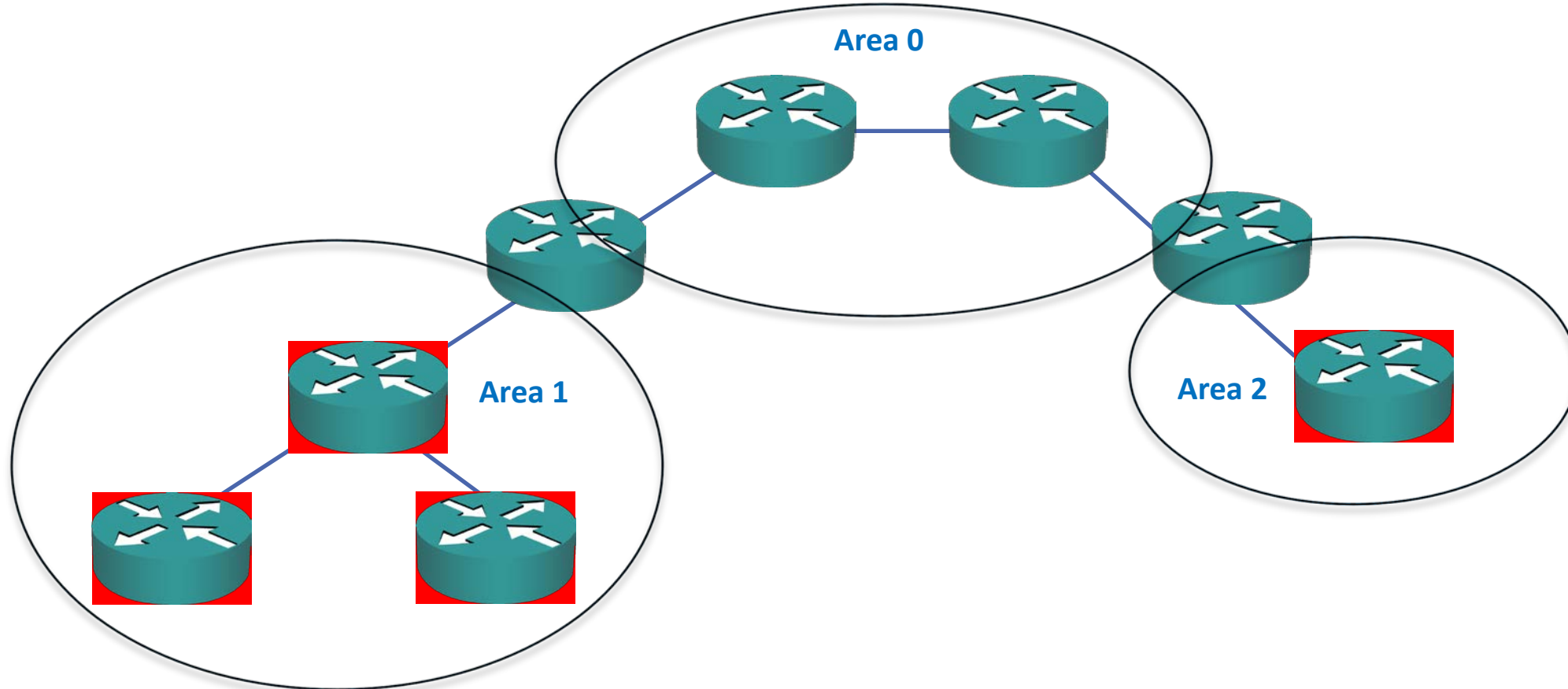
OSPF Router Types – Normal Area Routers

- Routers which have all their OSPF interfaces in a normal area are normal internal routers



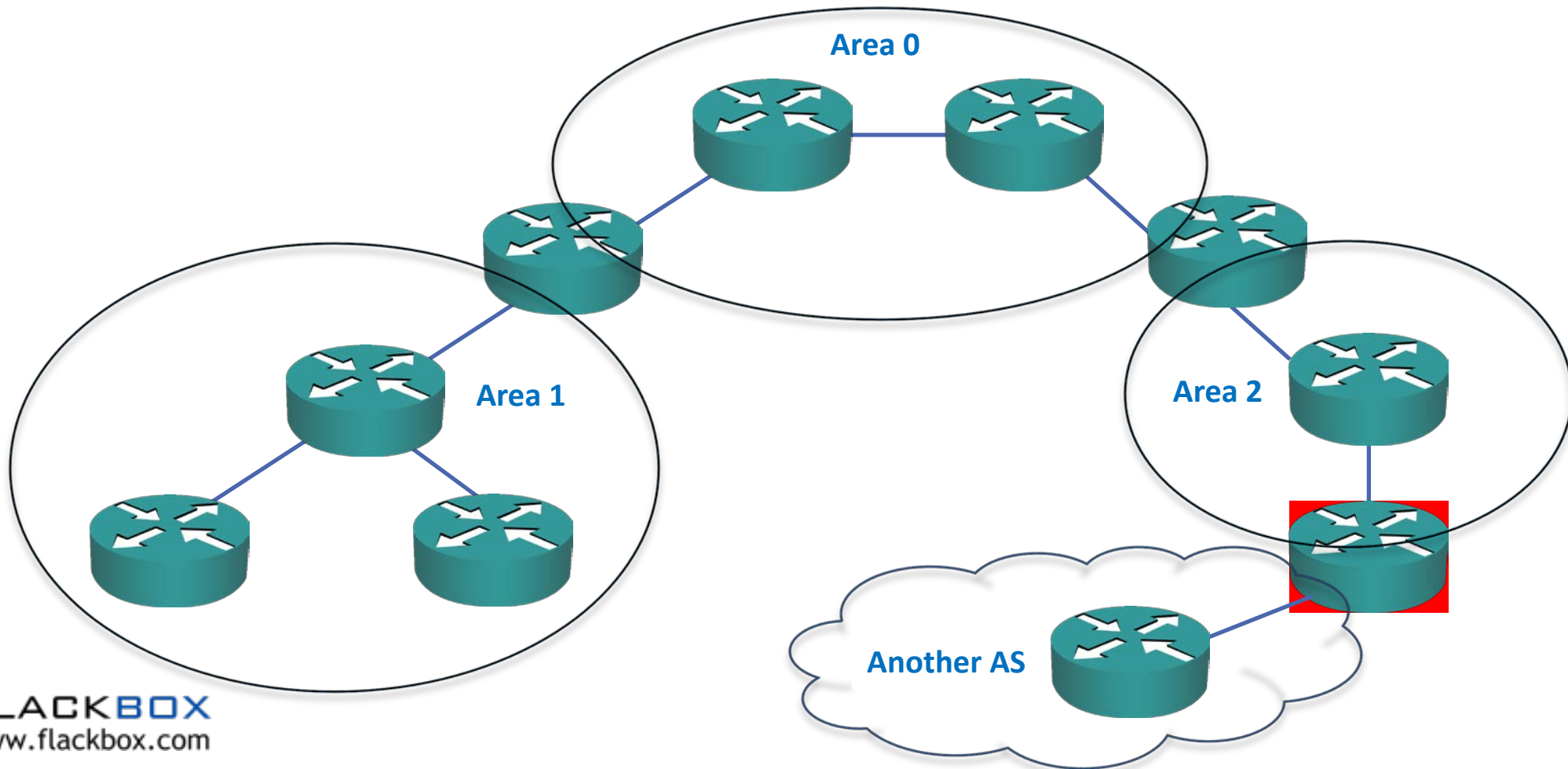
OSPF Router Types – Normal Area Routers

- Routers maintain a full LSDB of other routers and links in their own area
- They learn Inter Area routes to other areas from their ABRs



OSPF Router Types - ASBRs

- Routers which redistribute into OSPF are Autonomous System Boundary Routers



External Routes

- Routes which are redistributed into OSPF appear as External Routes

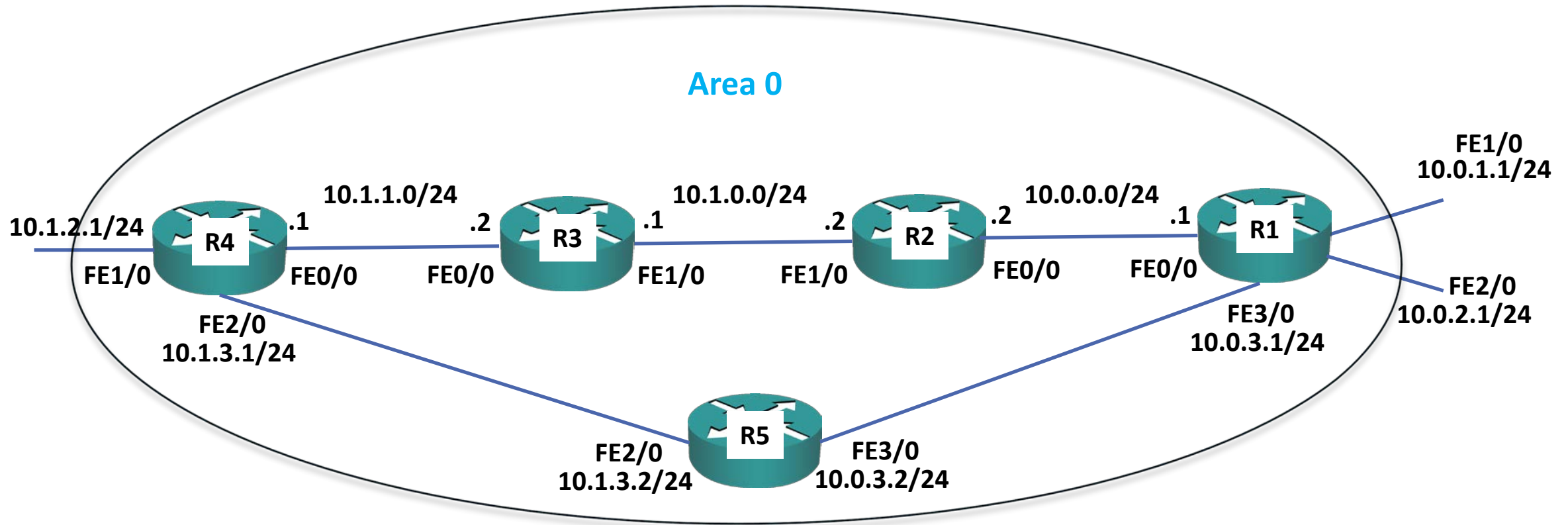
```
R1#sh ip route
```

```
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  
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 10.1.1.1 to network 0.0.0.0
```

```
O*E2 0.0.0.0/0 [110/1] via 10.1.1.1, 00:19:35, FastEthernet0/0  
      10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks  
O IA   10.0.0.0/16 [110/2000] via 10.1.0.2, 00:18:18, FastEthernet1/0  
O      10.1.2.0/24 [110/2000] via 10.1.1.1, 00:20:56, FastEthernet0/0  
O      10.1.3.0/24 [110/2500] via 10.1.1.1, 00:16:07, FastEthernet0/0  
      192.168.0.0/32 is subnetted, 3 subnets  
O IA   192.168.0.1 [110/2001] via 10.1.0.2, 00:18:18, FastEthernet1/0
```

Single Area OSPF Lab



Multi Area OSPF Lab

