

CCNP Prep: OSPF LSAs and Special Areas

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Get OSPF-ready for ENCOR and ENARSI exams

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Session ID: CISCOU-1612

Cisco Webex App

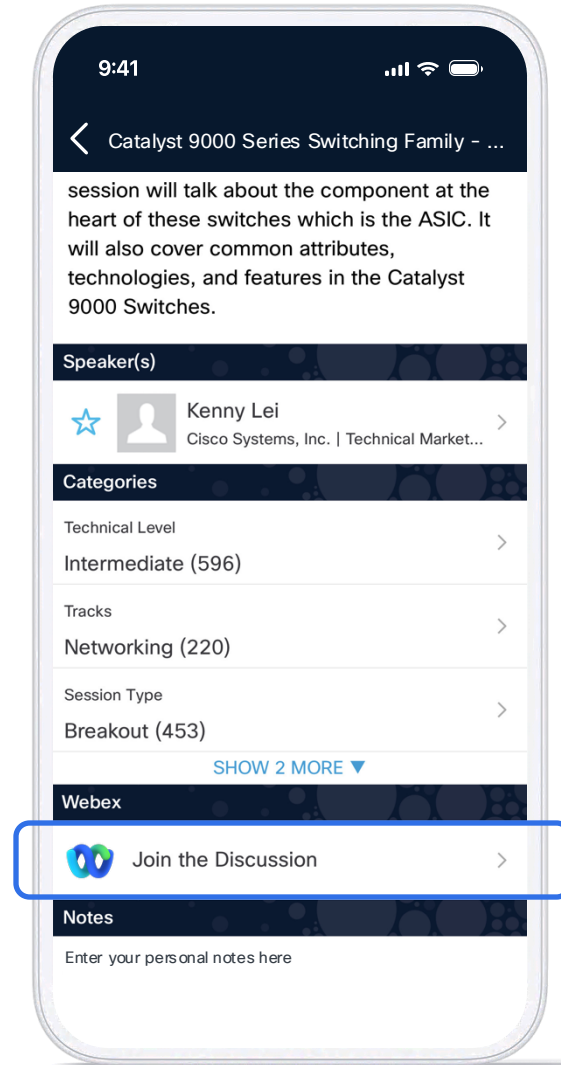
Questions?

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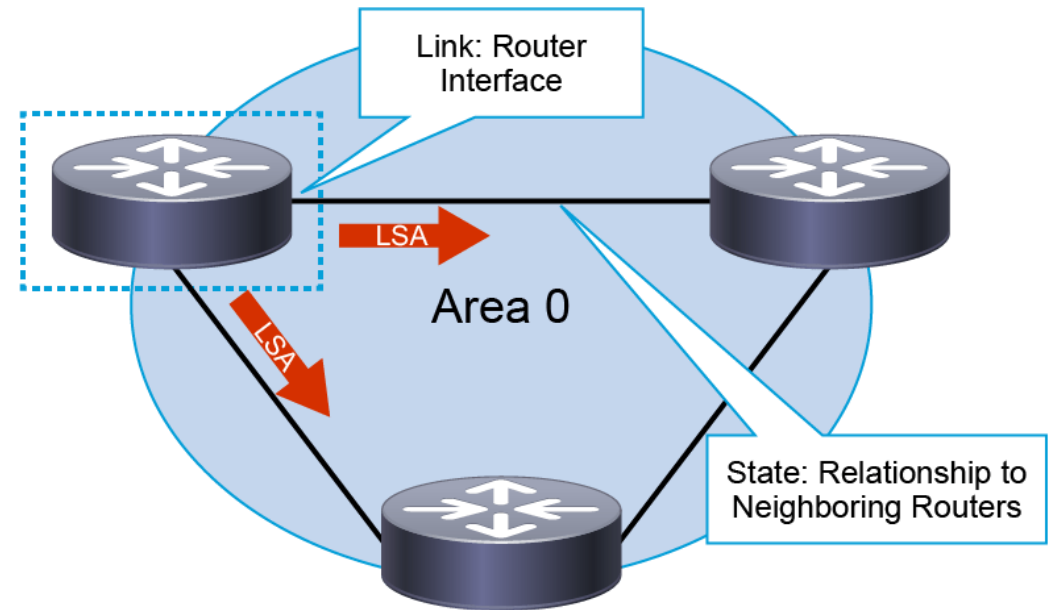
Agenda

- 01 Introduction**
- 02 OSPFv2 LSA Review**
- 03 OSPF Special Area Types**
- 04 Cisco Press Book Giveaway**

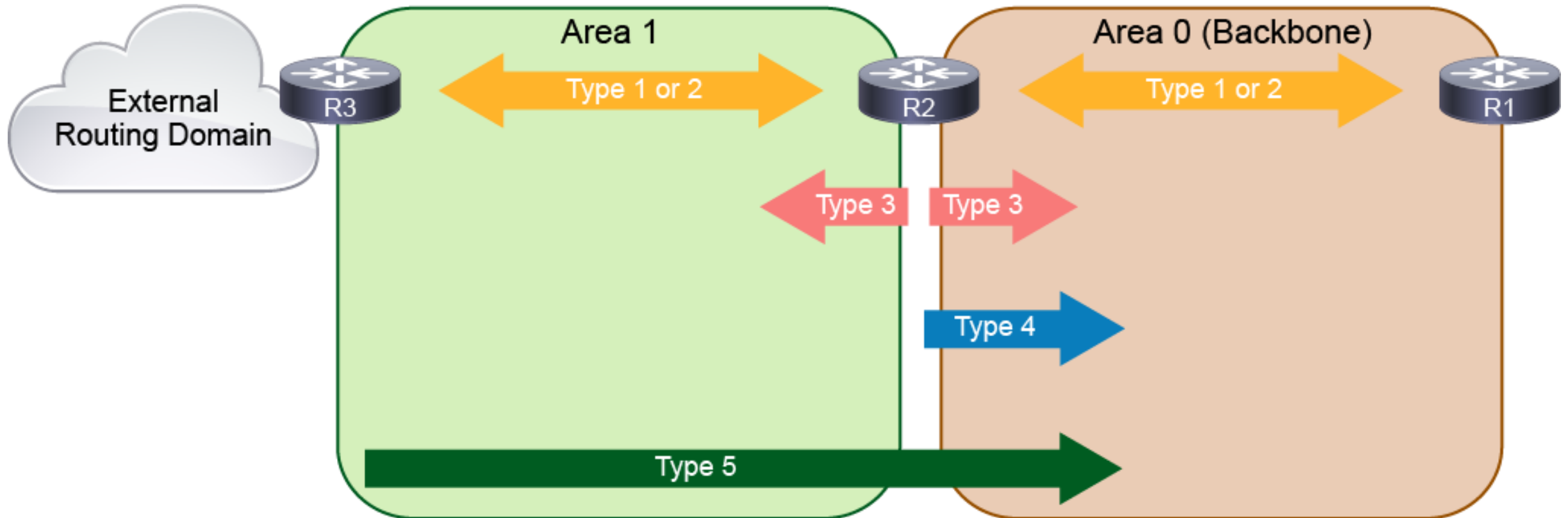
OSPFv2 LSAs

OSPFv2

- OSPF performs the following functions:
 - Creates a neighbor relationship by exchanging hello packets
 - Propagates LSAs rather than routing table updates
- Floods LSAs to all OSPF routers in the area, not just the directly connected routers
- Pieces together all the LSAs that OSPF routers generate to create the OSPF link-state database
- Uses the SPF algorithm to calculate the shortest path to each destination and places it in the routing table

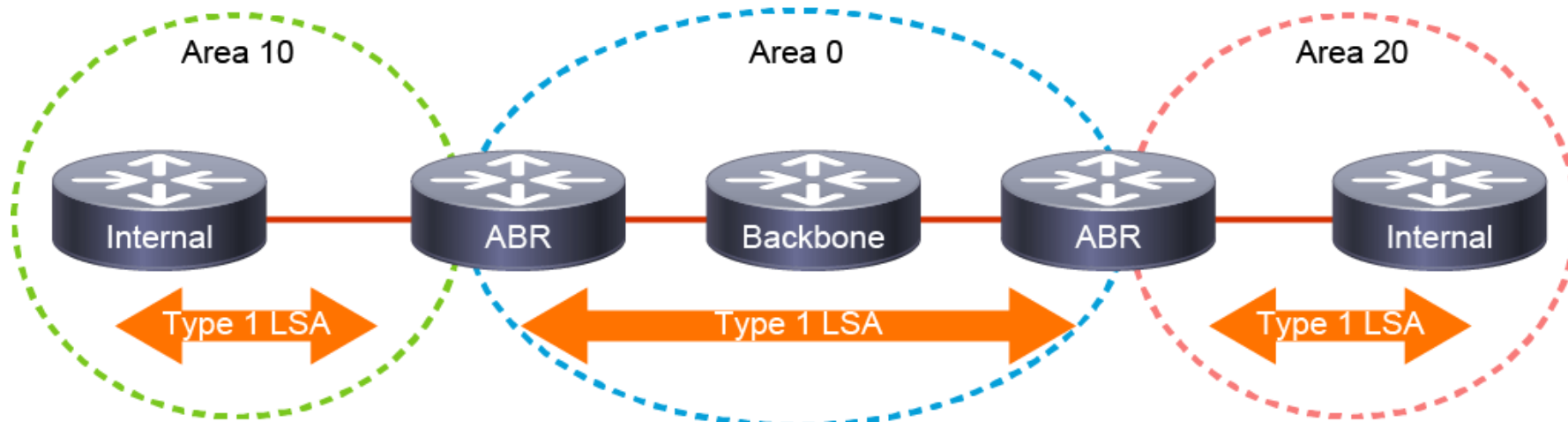


OSPFv2 LSA Types



OSPFv2 Type 1 Router-LSAs

- One Router-LSA for every router in an area
- Includes list of directly attached links/neighbors and their costs
- Identified by the Router ID of the originating router
- Floods within its area only; does not cross ABR (TIP: 1 area = Type 1)
- Carries prefix information for all directly attached networks except those on multiaccess links
- Denoted by ○ in routing table



OSPFv2 Type 1 Router-LSAs (Cont.)

```
Internal2# show ip ospf database router
```

OSPF Router with ID (10.4.4.2) (Process ID 1)

Router Link States (Area 20)

LS age: 15

Options: (No TOS-capability, DC)

LS Type: Router Links

Link State ID: 10.4.4.1

Advertising Router: 10.4.4.1

LS Seq Number: 80000003

Checksum: 0x7D5D

Length: 36

Area Border Router

Number of Links: 1

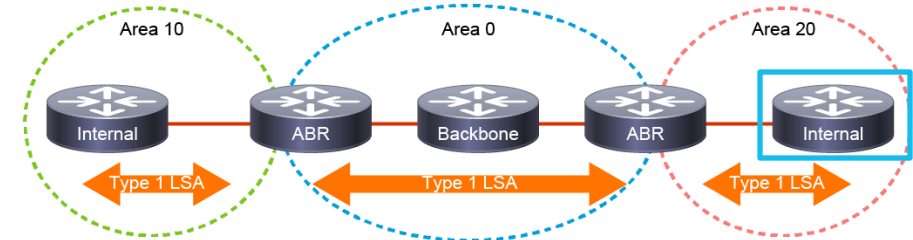
Link connected to: a Transit Network

(Link ID) Designated Router address: 10.4.4.1

(Link Data) Router Interface address: 10.4.4.1

Number of MTID metrics: 0

TOS 0 Metrics: 10



LS age: 5

Options: (No TOS-capability, DC)

LS Type: Router Links

Link State ID: 10.4.4.2

Advertising Router: 10.4.4.2

LS Seq Number: 80000003

Checksum: 0x7860

Length: 36

Number of Links: 1

Link connected to: a Transit Network

(Link ID) Designated Router address: 10.4.4.1

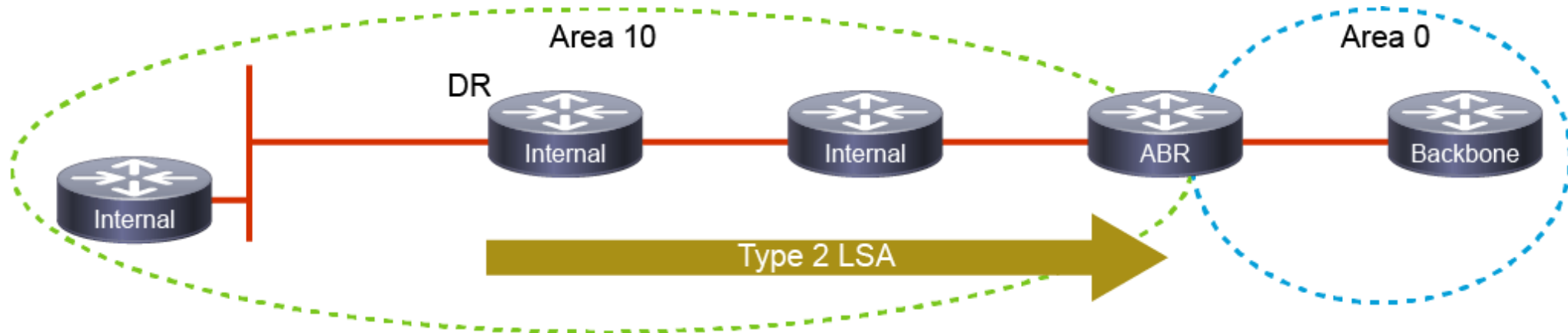
(Link Data) Router Interface address: 10.4.4.2

Number of MTID metrics: 0

TOS 0 Metrics: 10

OSPFv2 Type 2 Network-LSAs

- One Network-LSA for each transit broadcast or NBMA network in an area (intra-area)
- Advertised by the DR of the network and identified by its IP address (TIP: DR = 2 letters = Type 2 LSA)
- Includes list of attached routers on the transit link and the subnet mask of the link
- Floods within its area only, does not cross an ABR
- Denoted by ○ in routing table



OSPFv2 Type 2 Network-LSAs (Cont.)

```
Internal2# show ip ospf database network
```

```
OSPF Router with ID (10.4.4.2) (Process ID 1)
```

```
Net Link States (Area 20)
```

```
LS age: 958
```

```
Options: (No TOS-capability, DC)
```

```
LS Type: Network Links
```

```
Link State ID: 10.4.4.1 (address of Designated Router)
```

```
Advertising Router: 10.4.4.1
```

```
LS Seq Number: 80000001
```

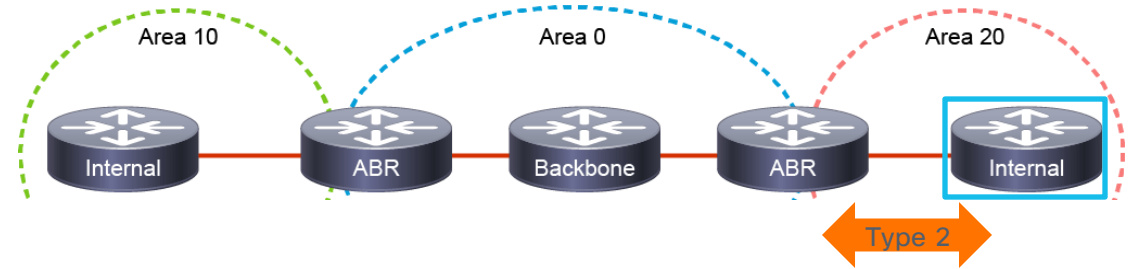
```
Checksum: 0x8B64
```

```
Length: 32
```

```
Network Mask: /30
```

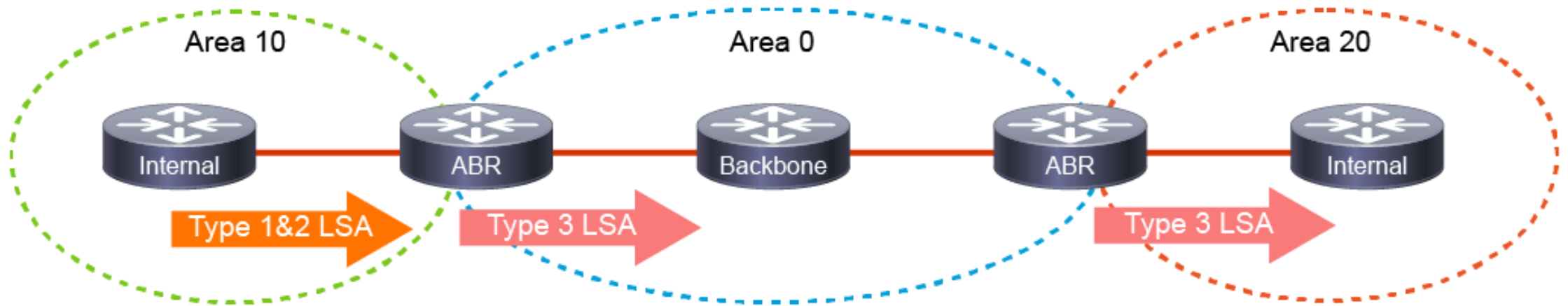
```
Attached Router: 10.4.4.1
```

```
Attached Router: 10.4.4.2
```



OSPFv2 Type 3 Summary-LSAs

- Used to flood prefix network information to areas outside the originating area (interarea)
- Describes the network address and the mask in another area
- Advertised by the ABR of the originating area; regenerated by all subsequent ABRs to flood throughout the AS (TIP: ABR = 3 letters = Type 3 LSA)
- Advertised for every subnet (denoted by **O IA** in routing table)

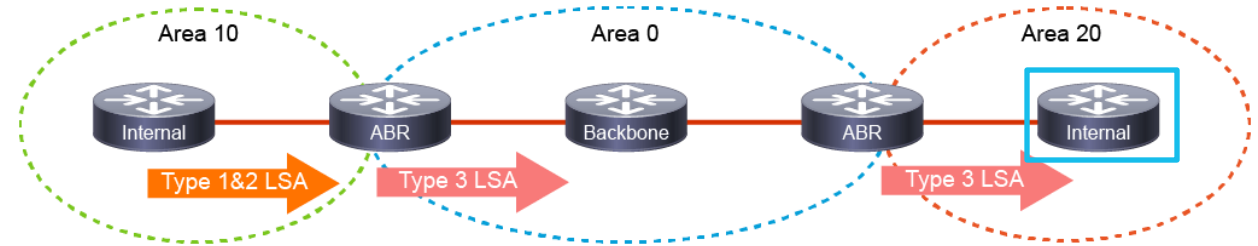


OSPFv2 Type 3 Summary-LSAs (Cont.)

```
Internal2# show ip ospf database summary
      OSPF Router with ID (10.4.4.2) (Process ID 1)
      Summary Net Link States (Area 20)
```

```
LS age: 1263
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 10.1.1.0 (summary Network Number)
Advertising Router: 10.4.4.1
LS Seq Number: 80000001
Checksum: 0x6E94
Length: 28
Network Mask: /30
      MTID: 0      Metric: 30
```

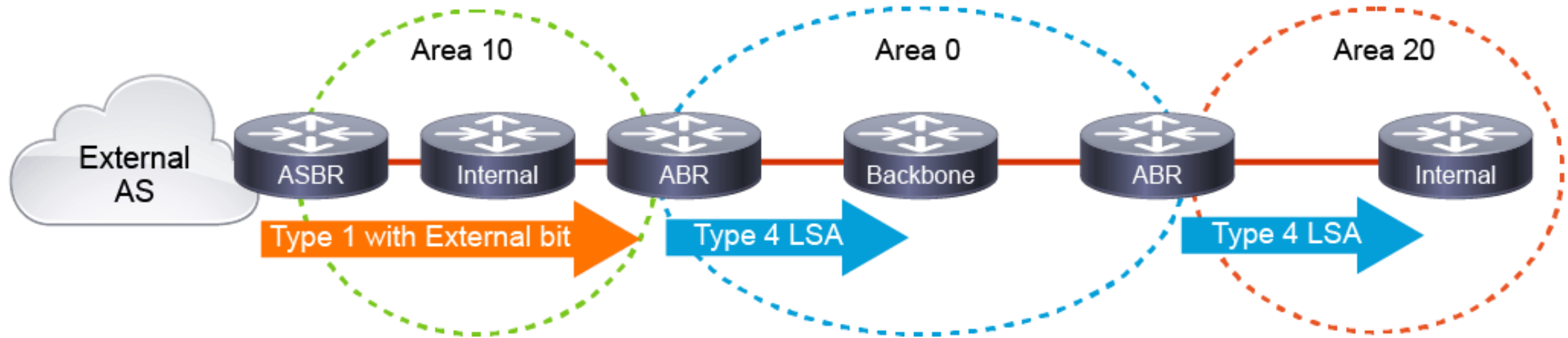
```
LS age: 1263
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 10.2.2.0 (summary Network Number)
Advertising Router: 10.4.4.1
LS Seq Number: 80000001
Checksum: 0xF218
Length: 28
Network Mask: /30
      MTID: 0      Metric: 20
```



```
LS age: 1263
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 10.3.3.0 (summary Network Number)
Advertising Router: 10.4.4.1
LS Seq Number: 80000001
Checksum: 0x779B
Length: 28
Network Mask: /30
      MTID: 0      Metric: 10
```

OSPFv2 Type 4 ASBR-Summary-LSAs

- Used to advertise the RID and metric to the ASBR, which is used for path selection
- Generated by the ABR of the originating area
- Regenerated by all subsequent ABRs to flood throughout the AS
- TIP: ASBR = 4 letters = Type 4 LSA



OSPFv2 Type 4 ASBR-Summary-LSAs (Cont.)

```
Internal2# show ip ospf database asbr-summary
```

```
OSPF Router with ID (10.4.4.2) (Process ID 1)
```

```
Summary ASB Link States (Area 20)
```

```
LS age: 77
```

```
Options: (No TOS-capability, DC, Upward)
```

```
LS Type: Summary Links(AS Boundary Router)
```

```
Link State ID: 8.8.8.8 (AS Boundary Router address)
```

```
Advertising Router: 10.4.4.1
```

```
LS Seq Number: 80000001
```

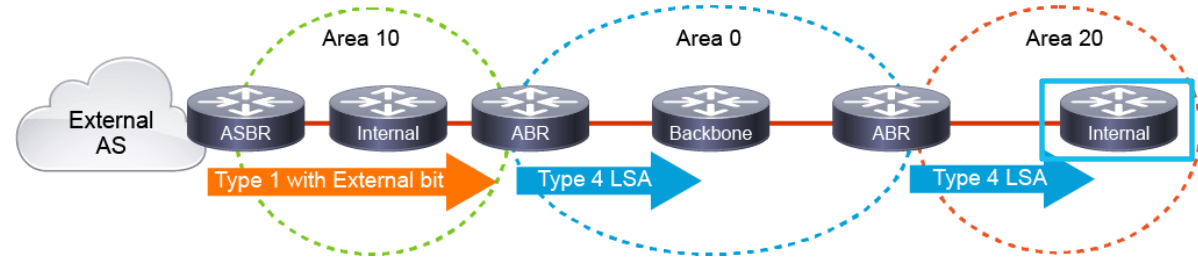
```
Checksum: 0xFEE1
```

```
Length: 28
```

```
Network Mask: /0
```

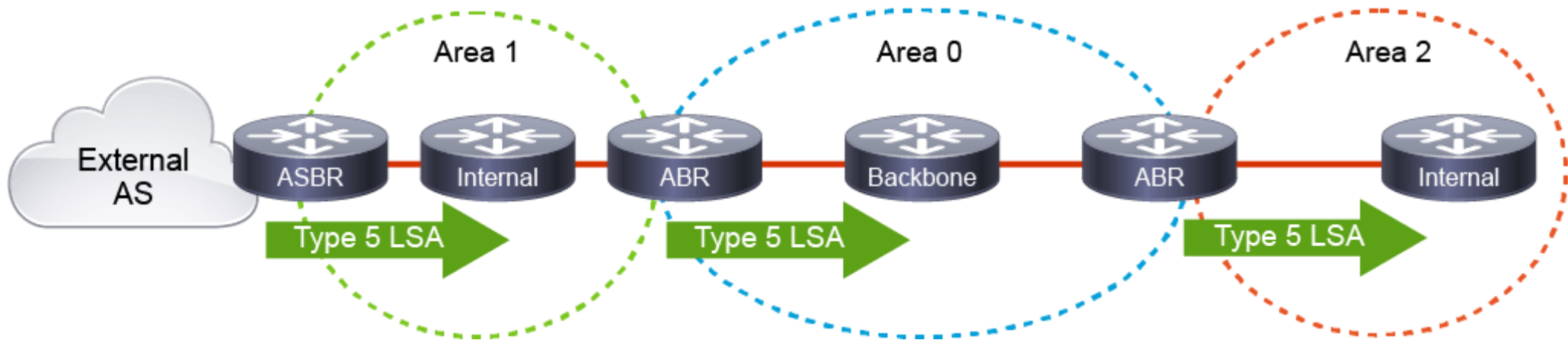
```
MTID: 0
```

```
Metric: 40
```



OSPFv2 Type 5 External-LSAs

- Used to advertise networks from other routing processes (using redistribute command)
- Advertised and owned by the originating ASBR
- Flooded throughout the entire AS
- The advertising router ID (ASBR) is unchanged throughout the AS
- Type 4 LSA used to find the ASBR outside its own area
- Denoted by **O E1** or **O E2** in routing table



OSPFv2 Type 5 External-LSAs (Cont.)

```
Internal2# show ip ospf database external
```

OSPF Router with ID (10.4.4.2) (Process ID 1)

Type-5 AS External Link States

LS age: 609

Options: (No TOS-capability, DC, Upward)

LS Type: AS External Link

Link State ID: 8.8.8.8 (External Network Number)

Advertising Router: 8.8.8.8

LS Seq Number: 80000001

Checksum: 0x85DA

Length: 36

Network Mask: /32

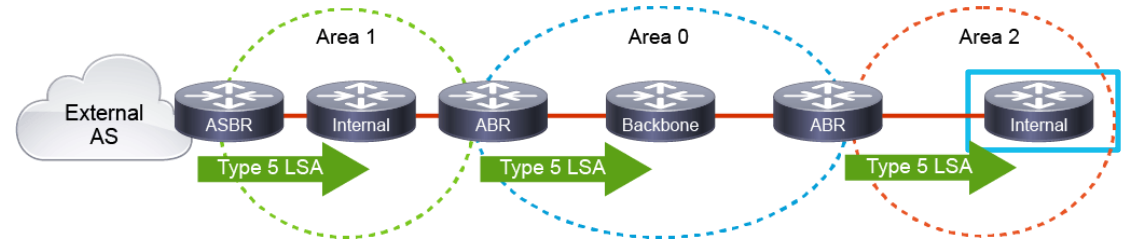
Metric Type: 2 (Larger than any link state path)

MTID: 0

Metric: 20

Forward Address: 0.0.0.0

External Route Tag: 0



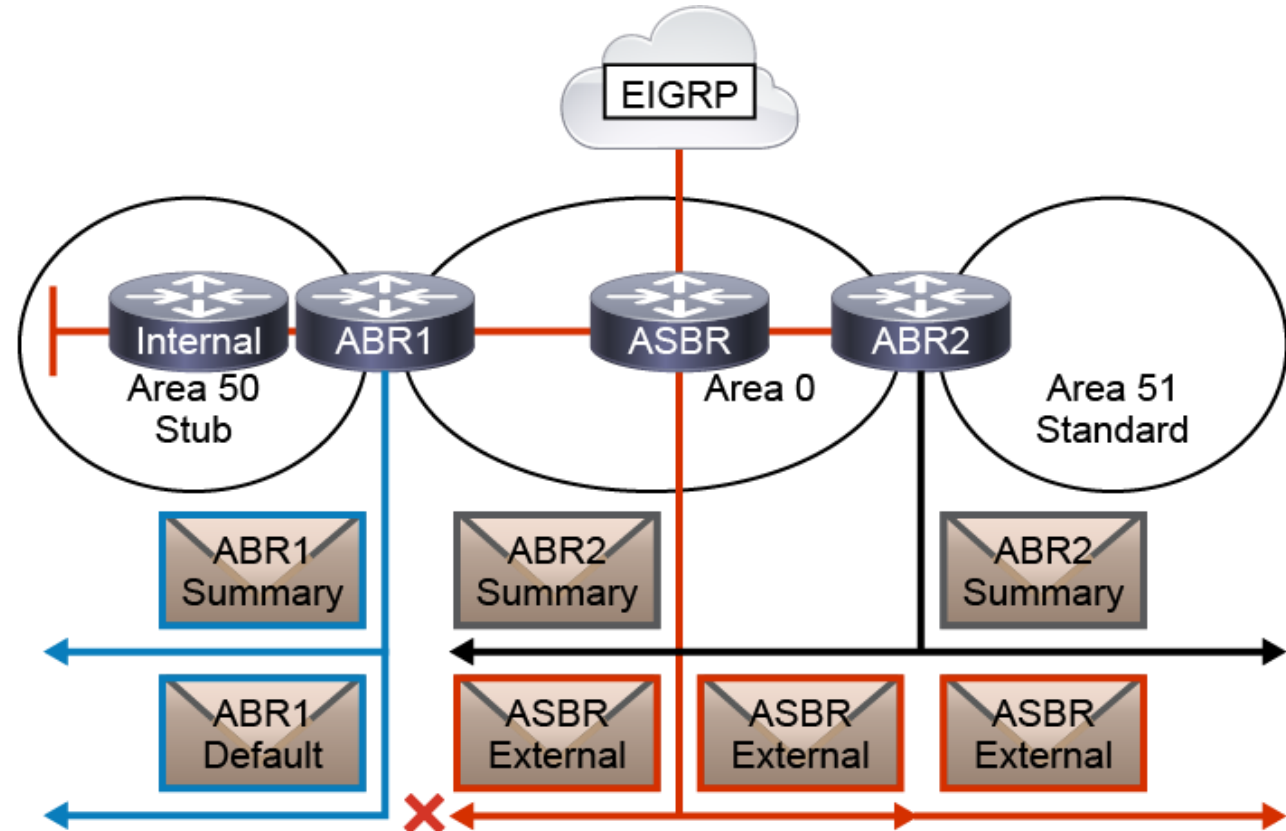
OSPF Special Area Types

OSPF Special Area Types

- OSPF Stub Area
- OSPF Totally Stub Area (Cisco)
- OSPF NSSA (Not So Stubby Area)
- OSPF NSSA Totally Stub (Cisco)

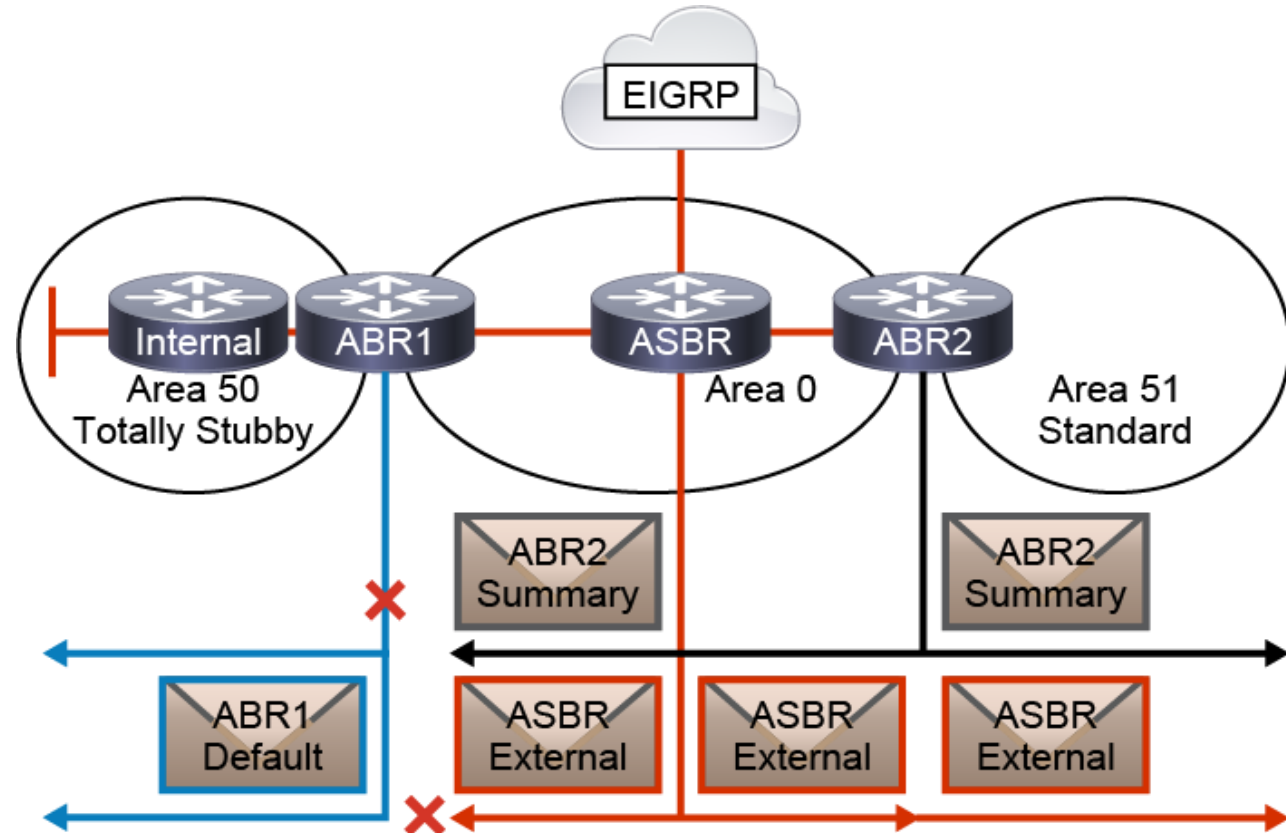
OSPF Stub Area

- Type 4 and Type 5 External LSAs are blocked
- Default route advertised into stub area by ABR



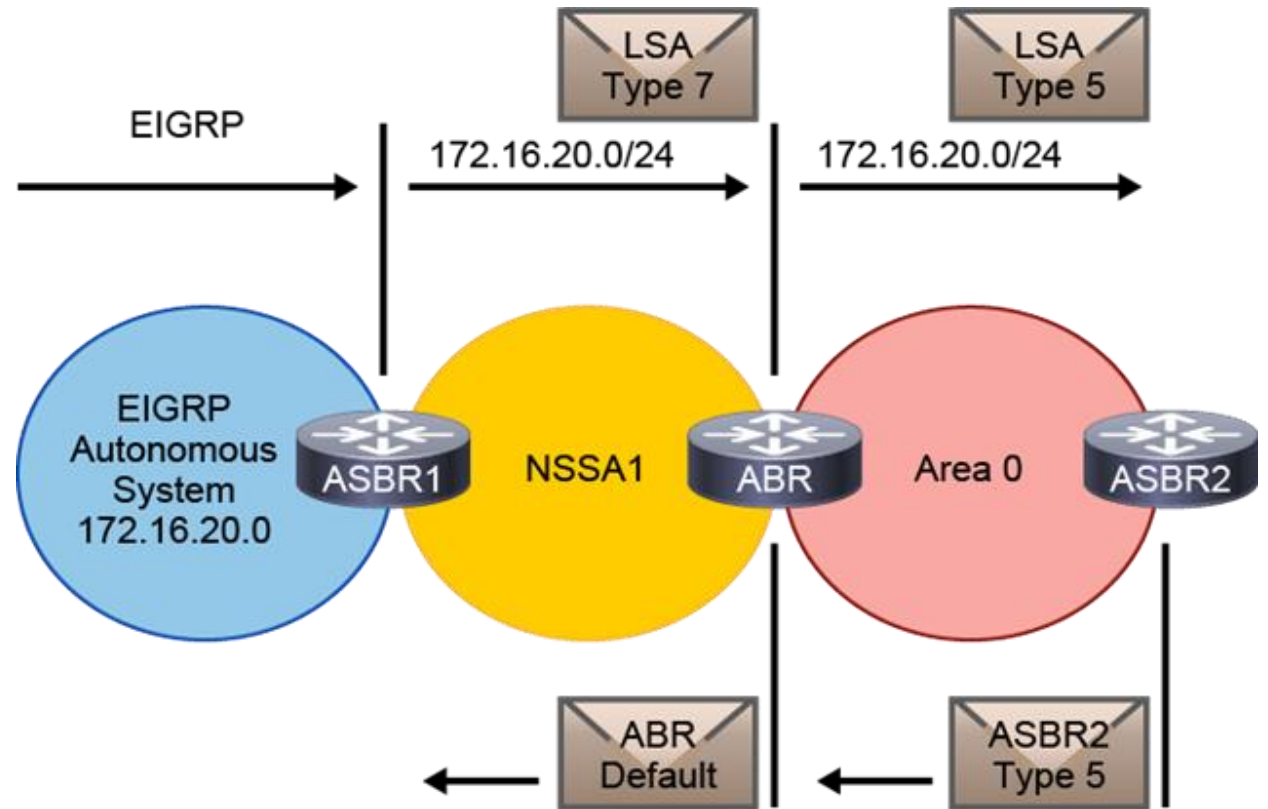
OSPF Totally Stubby Area

- Type 4, Type 5 External LSAs are blocked, and Type 3 Summary LSAs are replaced by default route
- Default route advertised into totally stub area by ABR
- Cisco extension feature



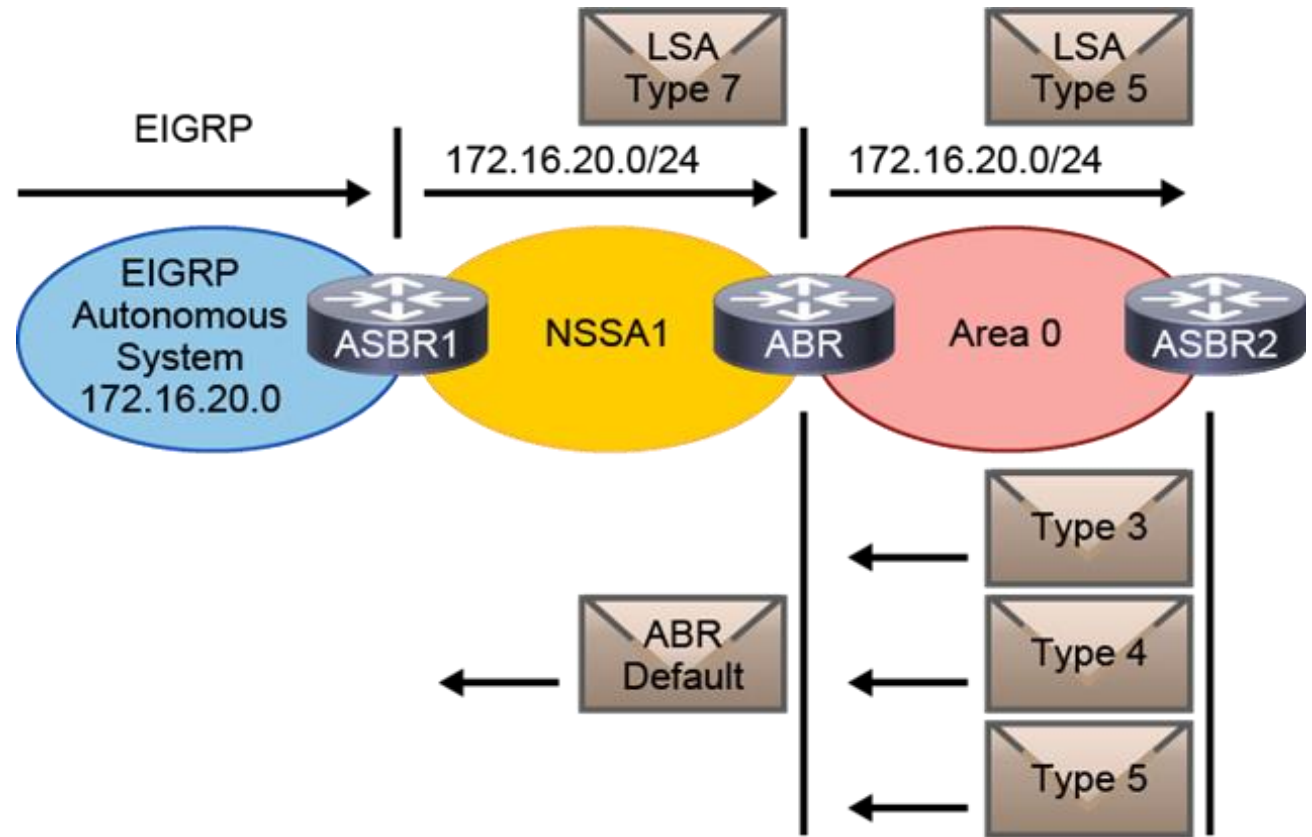
OSPF NSSA (Not-So-Stubby Area)

- Supports ASBR
- Type 7 AS-External-LSA
- ABR converts Type 7 to Type 5
- ABR/ASBR can send a default route into NSSA (blocks Type 5 External LSAs)



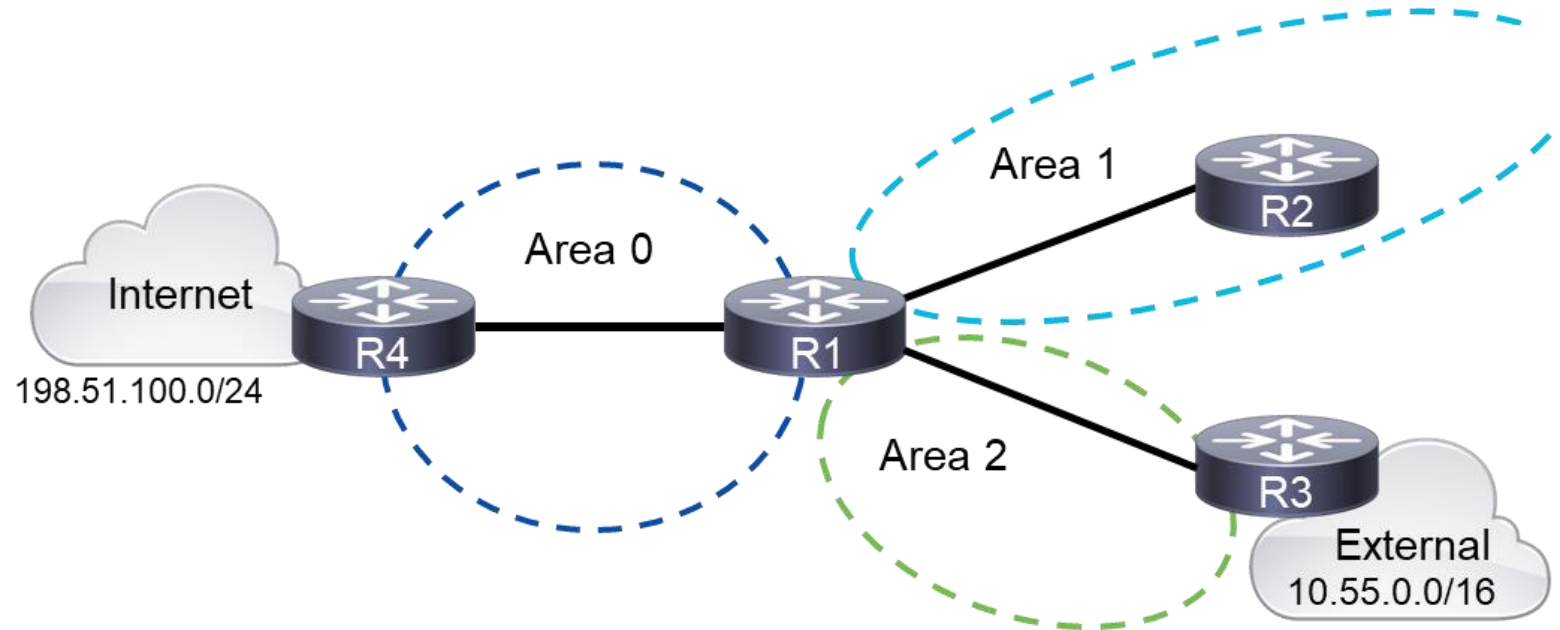
OSPF NSSA Totally Stub

- ABR blocks Type 3, Type 4, and Type 5 LSAs
- ABR sends default route into the NSSA
- Cisco extension feature



Putting it all together

Area 1 - Standard

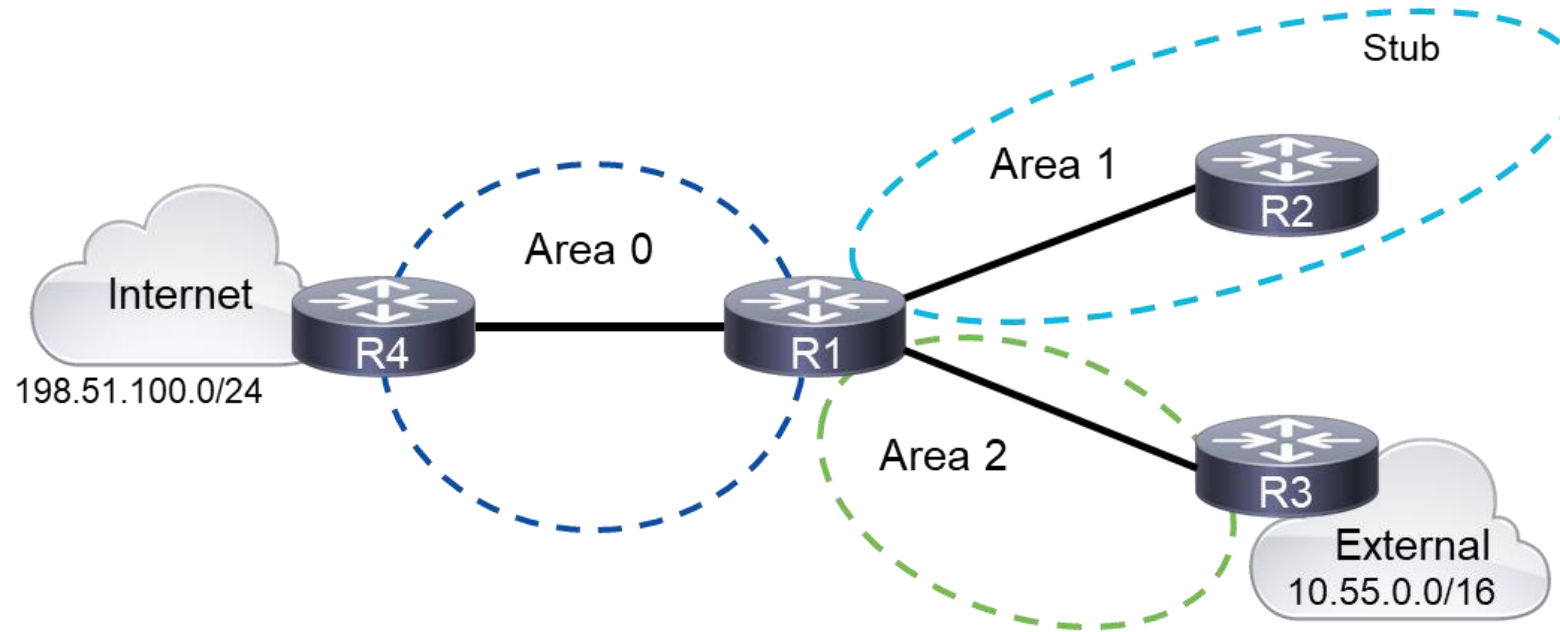


```
R2# show ip route ospf
```

```
Gateway of last resort is not set
```

```
0 E2 10.55.0.0/16 [110/20] via 172.16.12.1, 02:20:13, Ethernet0/0
0 IA 172.16.13.0/30 [110/20] via 172.16.12.1, 02:21:01, Ethernet0/0
0 IA 172.16.14.0/25 [110/20] via 172.16.12.1, 02:21:01, Ethernet0/0
0 IA 192.168.1.0/24 [110/11] via 172.16.12.1, 02:21:01, Ethernet0/0
0 IA 192.168.3.0/24 [110/21] via 172.16.12.1, 02:20:18, Ethernet0/0
0 IA 192.168.4.0/24 [110/21] via 172.16.12.1, 00:01:48, Ethernet0/0
0 E2 198.51.100.0/24 [110/20] via 172.16.12.1, 00:04:02, Ethernet0/0
```

Area 1 - Stub

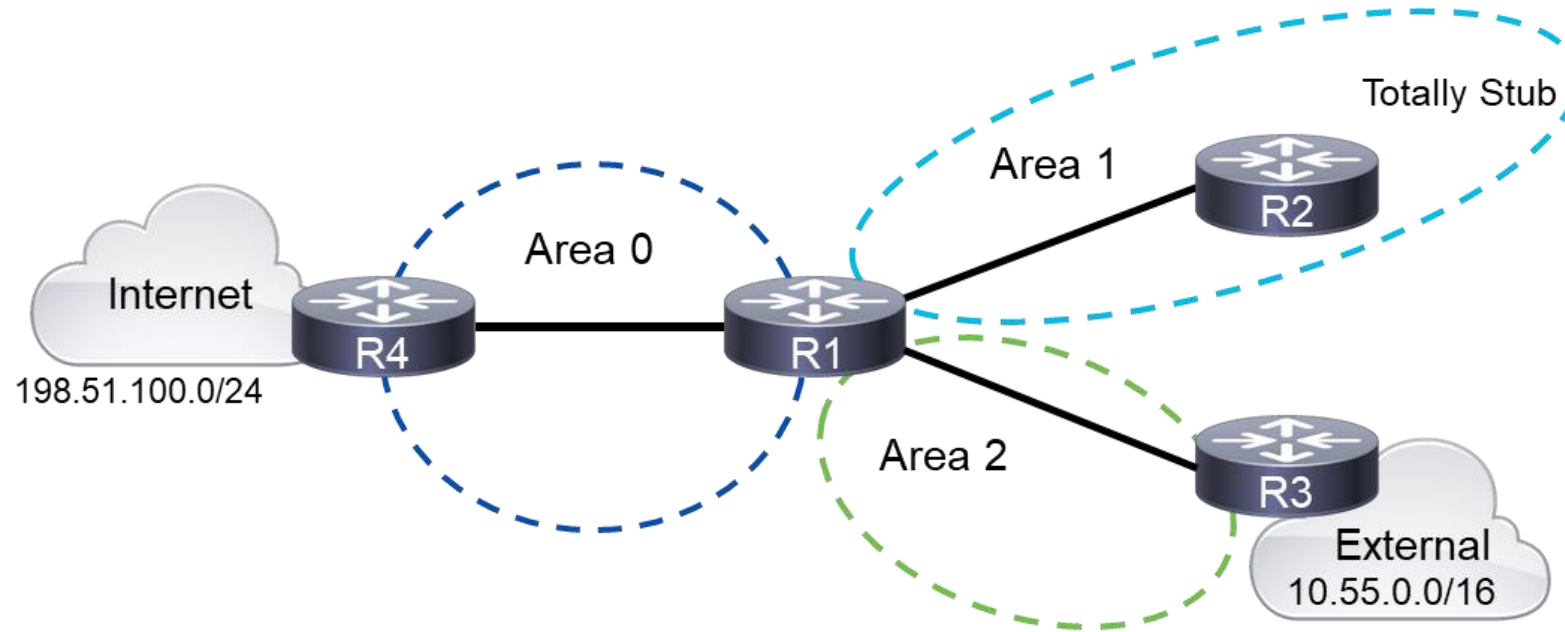


```
R2# show ip route ospf
```

```
Gateway of last resort is 172.16.12.1 to network 0.0.0.0
```

```
0*IA 0.0.0.0/0 [110/11] via 172.16.12.1, 00:23:14, Ethernet0/0
0 IA 172.16.13.0/30 [110/20] via 172.16.12.1, 02:21:01, Ethernet0/0
0 IA 172.16.14.0/25 [110/20] via 172.16.12.1, 02:21:01, Ethernet0/0
0 IA 192.168.1.0/24 [110/11] via 172.16.12.1, 02:21:01, Ethernet0/0
0 IA 192.168.3.0/24 [110/21] via 172.16.12.1, 02:20:18, Ethernet0/0
0 IA 192.168.4.0/24 [110/21] via 172.16.12.1, 00:01:48, Ethernet0/0
```

Area 1 – Totally Stub

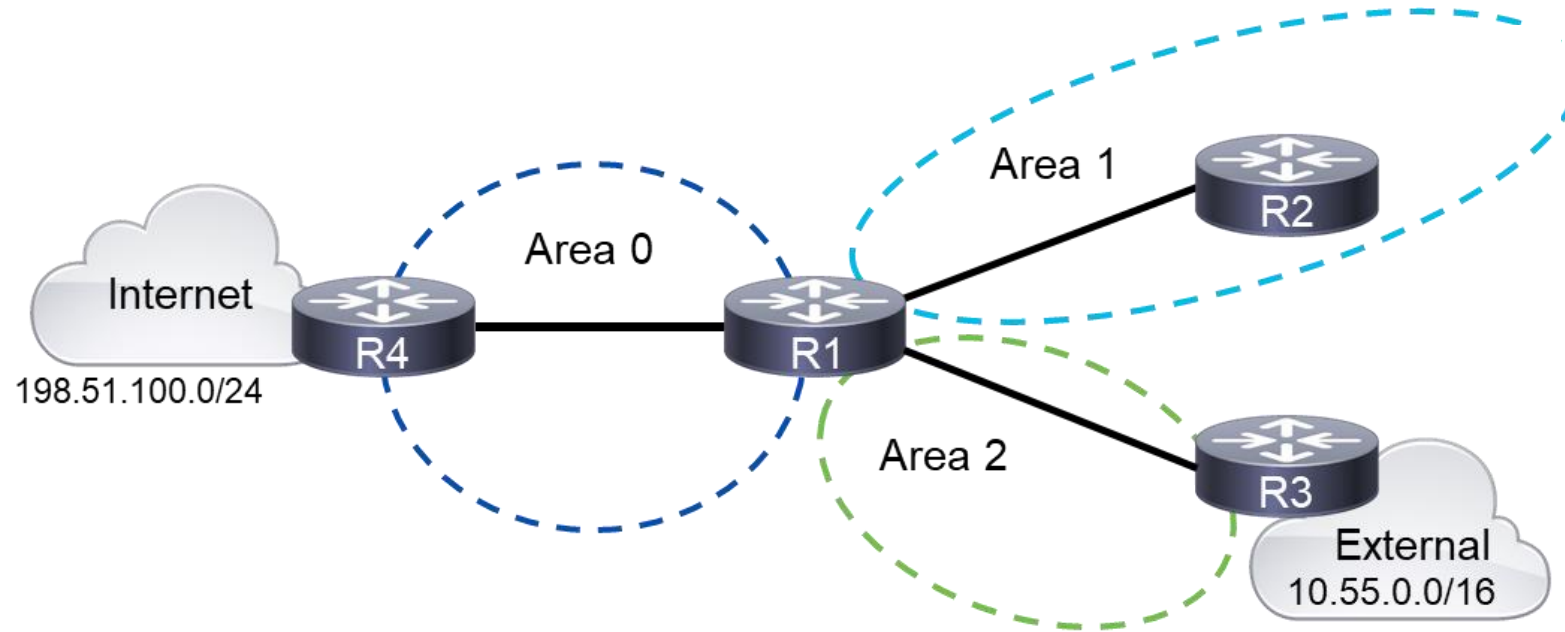


```
R2# show ip route ospf
```

```
Gateway of last resort is 172.16.12.1 to network 0.0.0.0
```

```
O*IA 0.0.0.0/0 [110/11] via 172.16.12.1, 00:23:14, Ethernet0/0
```

Area 2 – Standard



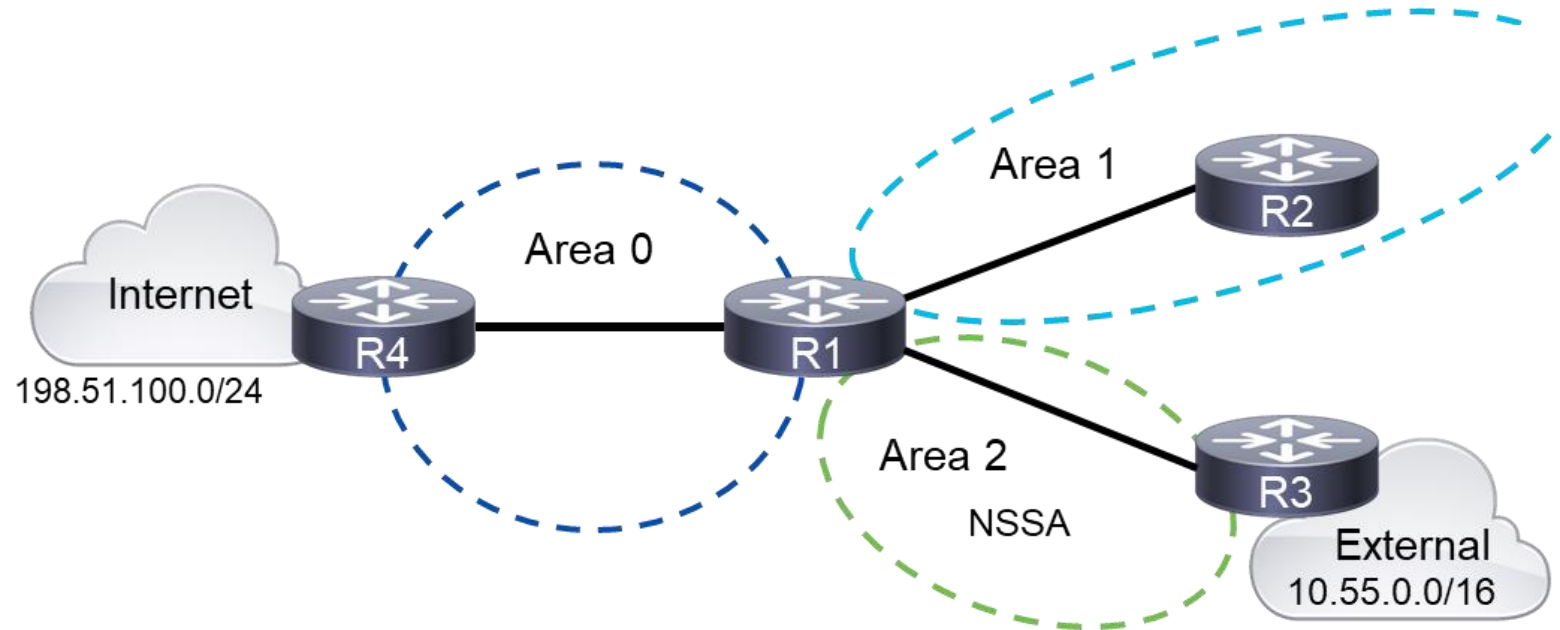
R3# show ip route ospf

```
O IA 172.16.12.0/30 [110/20] via 172.16.13.1
O IA 172.16.14.0/25 [110/20] via 172.16.13.1
O IA 192.168.1.0/24 [110/11] via 172.16.13.1
O IA 192.168.2.0/24 [110/21] via 172.16.13.1
O IA 192.168.4.0/24 [110/21] via 172.16.13.1
O E2 198.51.100.0/24 [110/20] via 172.16.13.1
```

R1# show ip route ospf

```
O E2 10.55.0.0/16 [110/20] via 172.16.13.2
O    192.168.2.0/24 [110/11] via 172.16.12.2
O    192.168.3.0/24 [110/11] via 172.16.13.2
O    192.168.4.0/24 [110/11] via 172.16.14.2
O E2 198.51.100.0/24 [110/20] via 172.16.14.2
```

Area 2 – NSSA



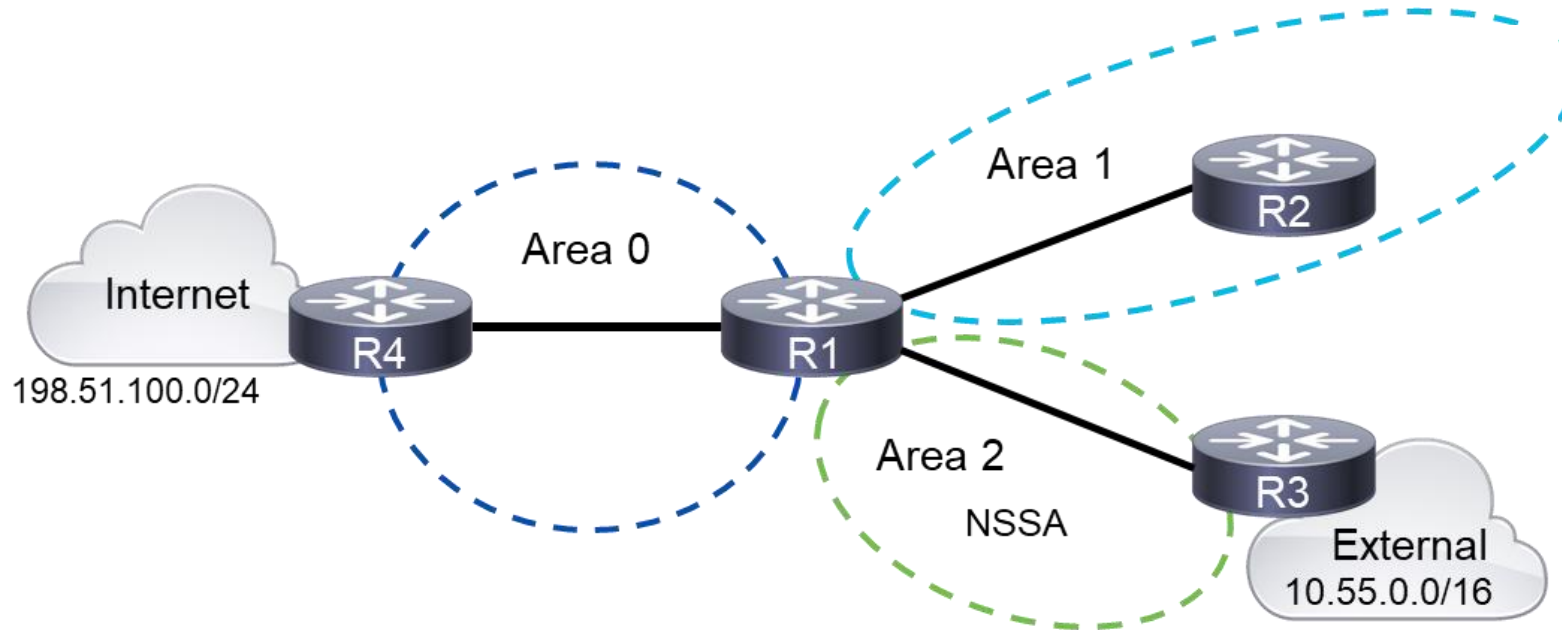
R3# show ip route ospf

```
O IA 172.16.12.0/30 [110/20] via 172.16.13.1
O IA 172.16.14.0/25 [110/20] via 172.16.13.1
O IA 192.168.1.0/24 [110/11] via 172.16.13.1
O IA 192.168.2.0/24 [110/21] via 172.16.13.1
O IA 192.168.4.0/24 [110/21] via 172.16.13.1
```

R1# show ip route ospf

```
O N2 10.55.0.0/16 [110/20] via 172.16.13.2
O    192.168.2.0/24 [110/11] via 172.16.12.2
O    192.168.3.0/24 [110/11] via 172.16.13.2
O    192.168.4.0/24 [110/11] via 172.16.14.2
O E2 198.51.100.0/24 [110/20] via 172.16.14.2
```

Area 2 – NSSA (with default route option enabled)

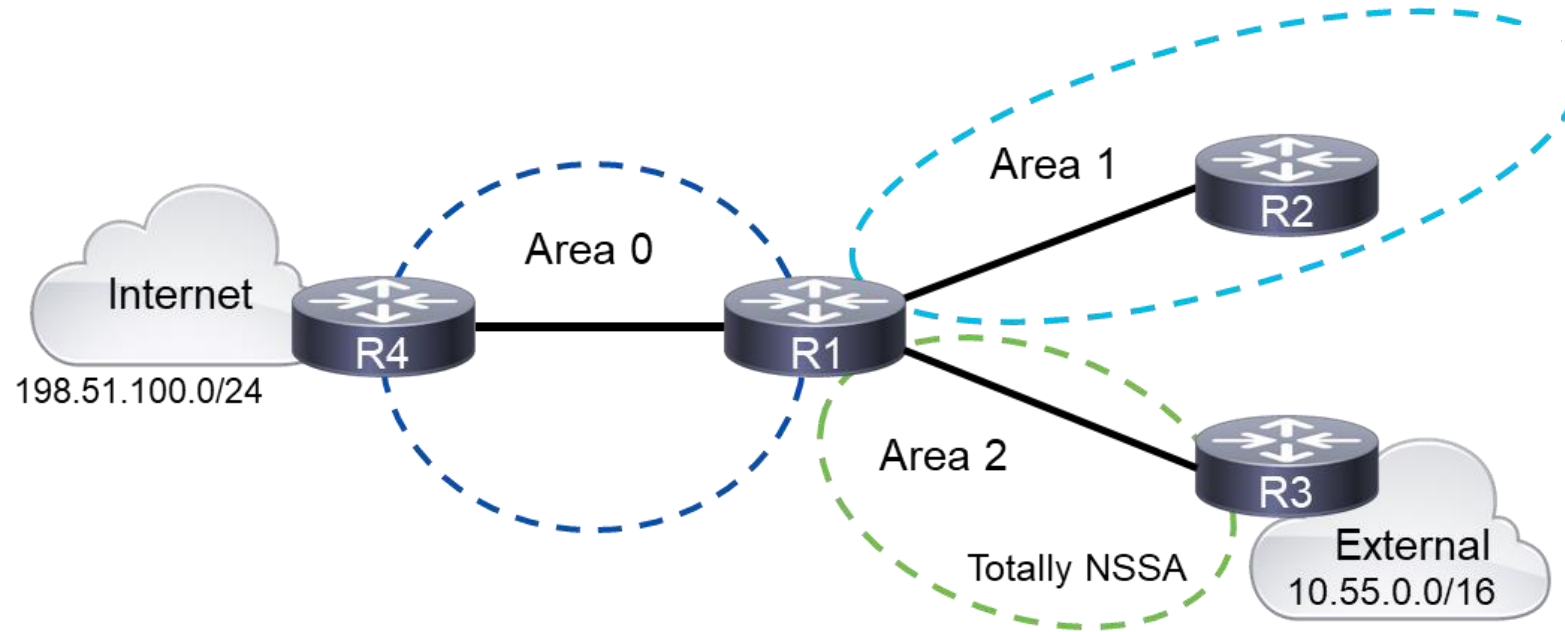


```
R3# show ip route ospf
Gateway of last resort is 172.16.13.1 to network 0.0.0.0
```

```
O*N2  0.0.0.0/0 [110/1] via 172.16.13.1
O IA  172.16.12.0/30 [110/20] via 172.16.13.1
O IA  172.16.14.0/25 [110/20] via 172.16.13.1
O IA  192.168.1.0/24 [110/11] via 172.16.13.1
O IA  192.168.2.0/24 [110/21] via 172.16.13.1
O IA  192.168.4.0/24 [110/21] via 172.16.13.1
```

```
R1# show ip route ospf
O N2  10.55.0.0/16 [110/20] via 172.16.13.2
O     192.168.2.0/24 [110/11] via 172.16.12.2
O     192.168.3.0/24 [110/11] via 172.16.13.2
O     192.168.4.0/24 [110/11] via 172.16.14.2
O E2  198.51.100.0/24 [110/20] via 172.16.14.2
```

Area 2 – Totally NSSA



```
R3# show ip route ospf
```

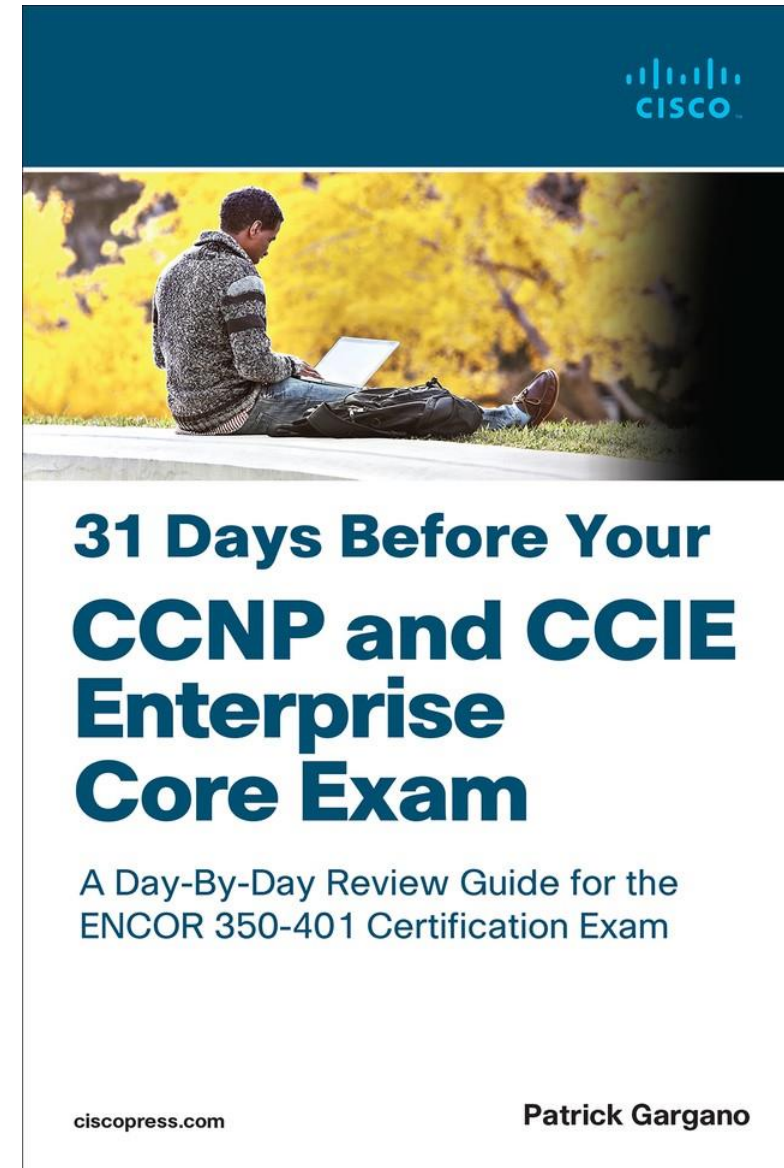
```
0*IA 0.0.0.0/0 [110/11] via 172.16.13.1, 00:55:18, Ethernet0/0
```

```
R1# show ip route ospf
```

```
O N2 10.55.0.0/16 [110/20] via 172.16.13.2
O    192.168.2.0/24 [110/11] via 172.16.12.2
O    192.168.3.0/24 [110/11] via 172.16.13.2
O    192.168.4.0/24 [110/11] via 172.16.14.2
O E2 198.51.100.0/24 [110/20] via 172.16.14.2
```

Cisco Press Book Giveaway

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The Cisco Live! logo is displayed in a bold, black, sans-serif font. The word "CISCO" is in all caps, followed by the word "Live" in title case, and a large exclamation mark. The logo is positioned on the right side of a white rectangular area, which is centered vertically on the page. The background of the entire slide consists of dynamic, flowing blue and white lines that create a sense of motion and energy.

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