



Chapter 9: Multiarea OSPF



Scaling Networks

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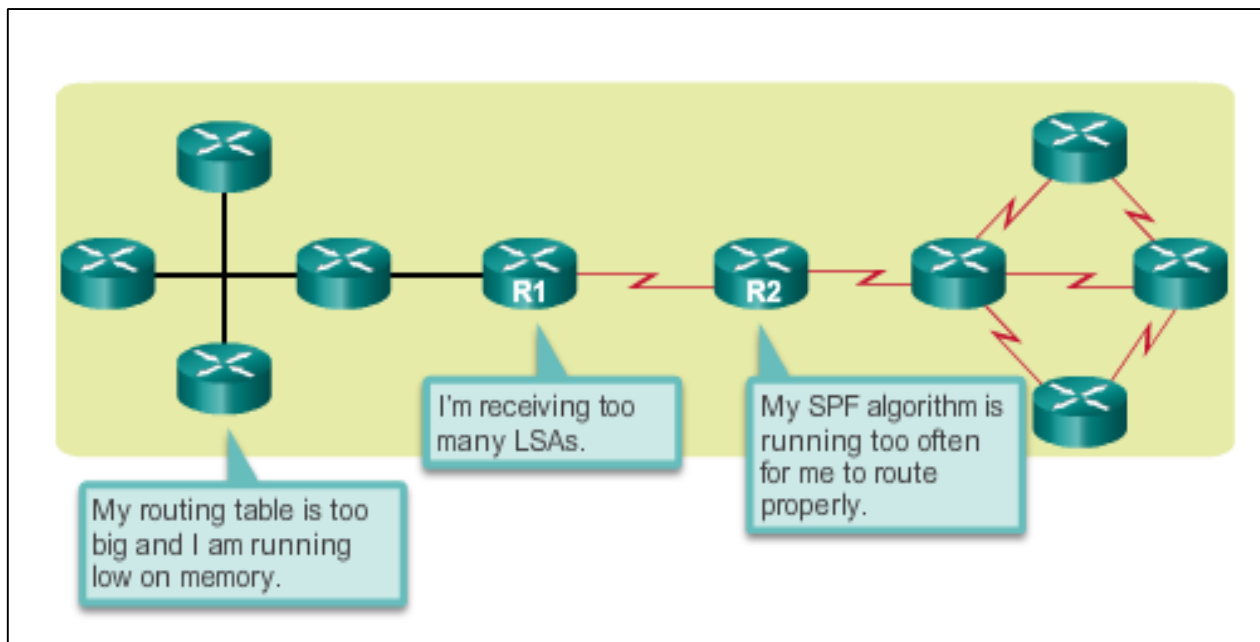


Why Multiarea OSPF?

Single-Area OSPF

Single-area OSPF is useful in smaller networks. If an area becomes too big, the following issues must be addressed:

- Large routing table (no summarization by default)
- Large link-state database (LSDB)
- Frequent SPF algorithm calculations

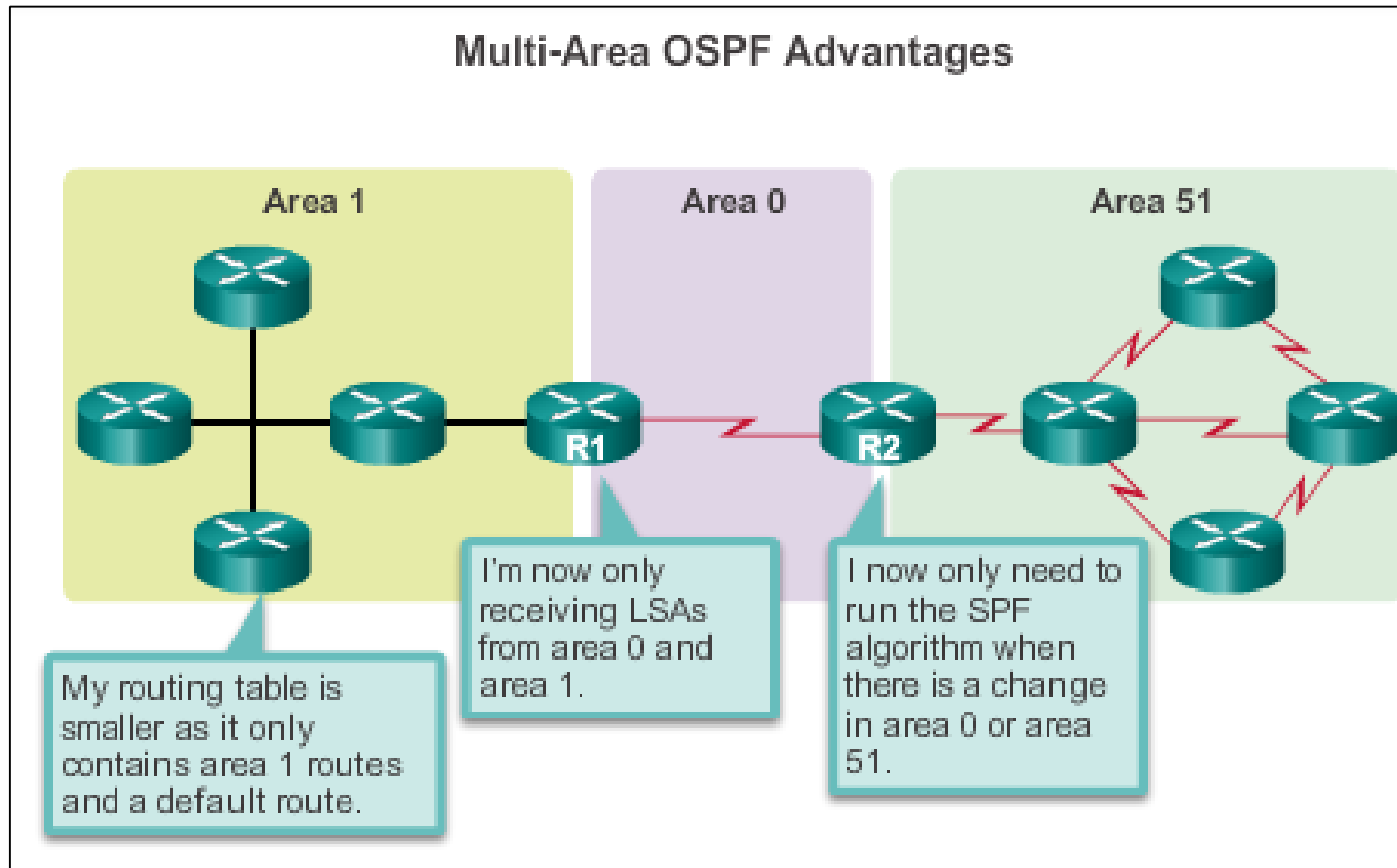




Why Multiarea OSPF?

Multiarea OSPF

Multiarea OSPF requires a hierarchical network design and the main area is called the backbone area, or area 0, and all other areas must connect to the backbone area.





Why Multiarea OSPF?

OSPF Two-Layer Area Hierarchy

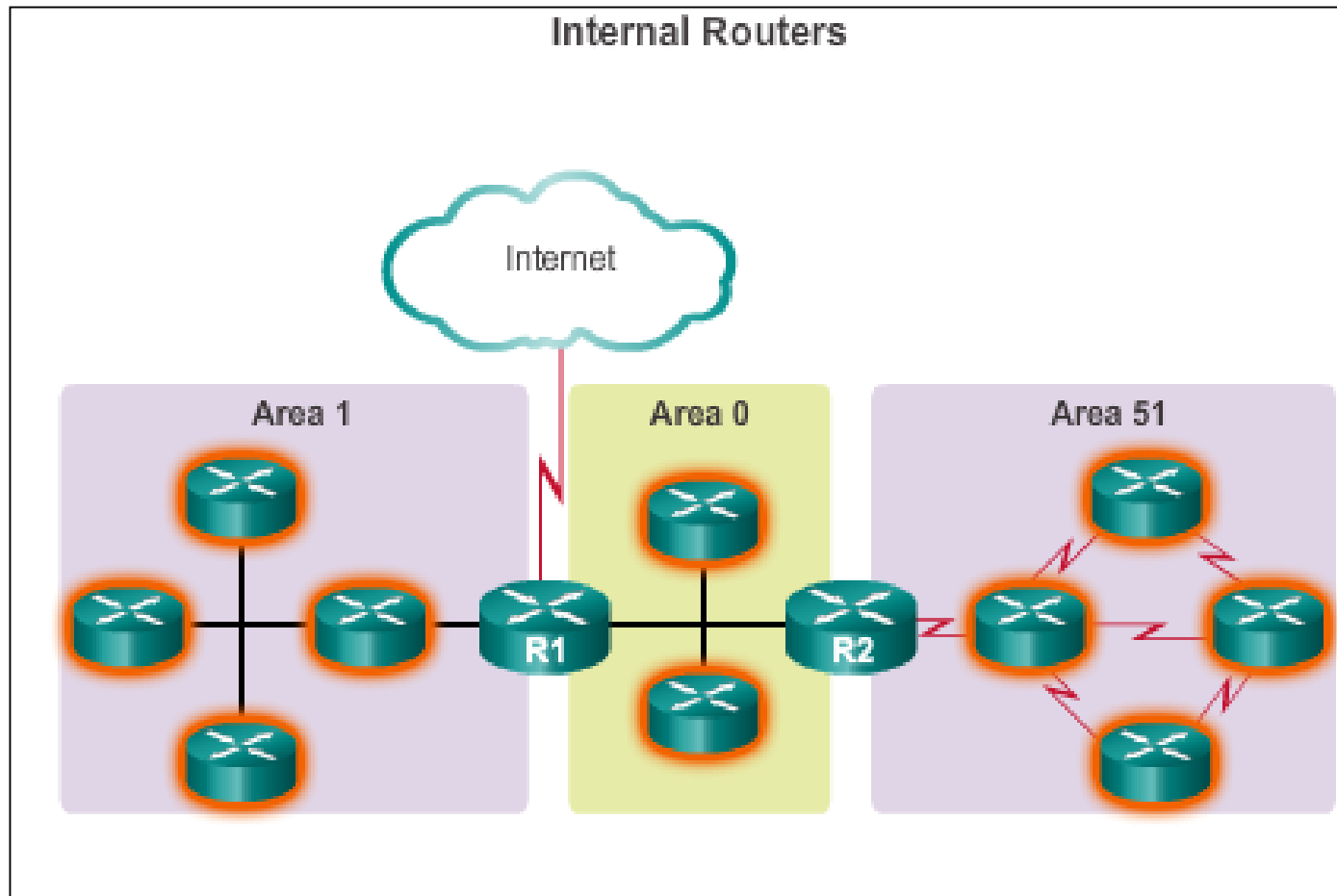
Multiarea OSPF is implemented in a two-layer area hierarchy:

- **Backbone (transit) area**
 - Area whose primary function is the fast and efficient movement of IP packets.
 - Interconnects with other OSPF area types.
 - Called OSPF area 0, to which all other areas directly connect.
- **Regular (nonbackbone) area**
 - Connects users and resources.
 - A regular area does not allow traffic from another area to use its links to reach other areas.



Why Multiarea OSPF?

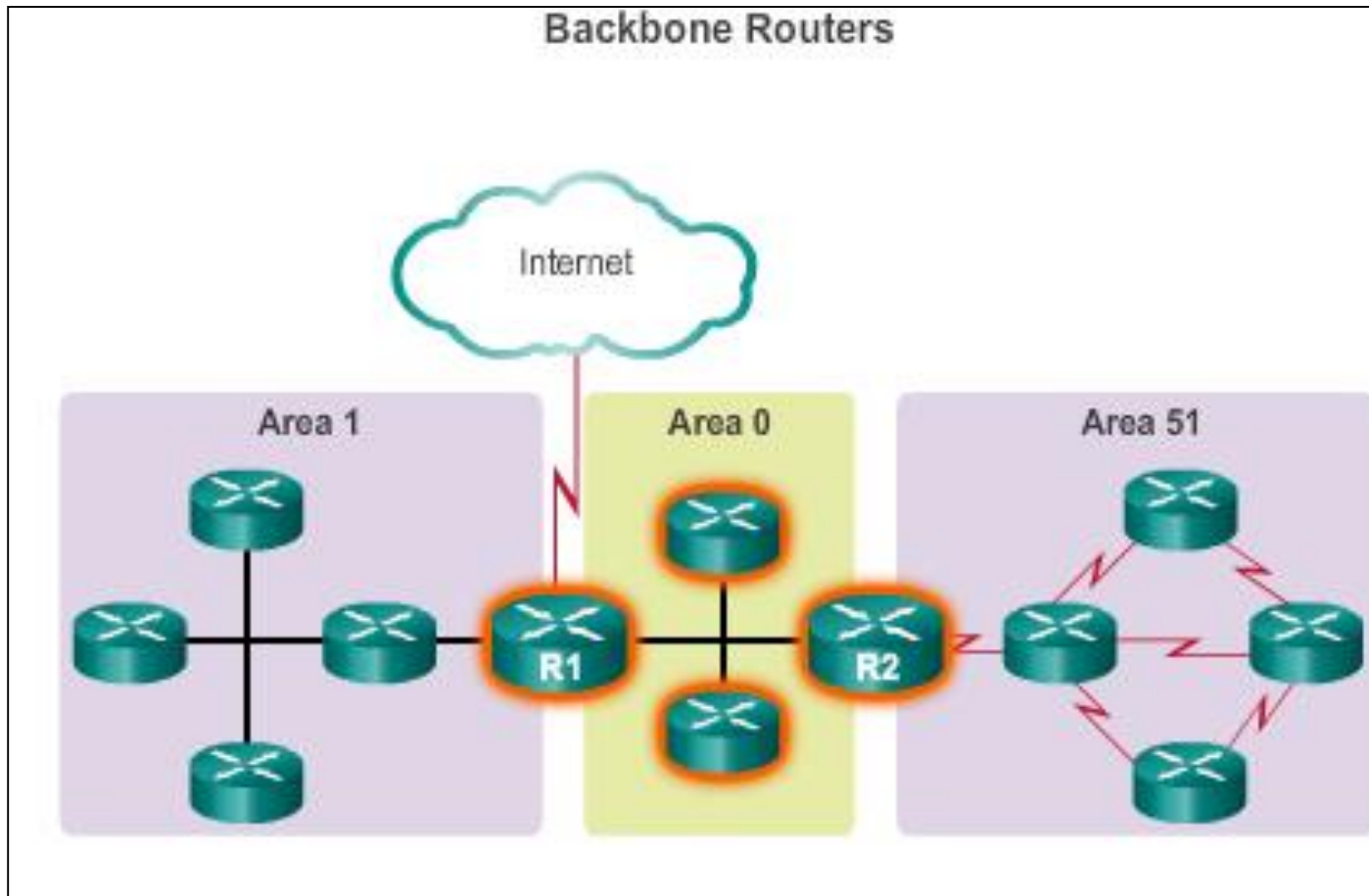
Types of OSPF Routers





Why Multiarea OSPF?

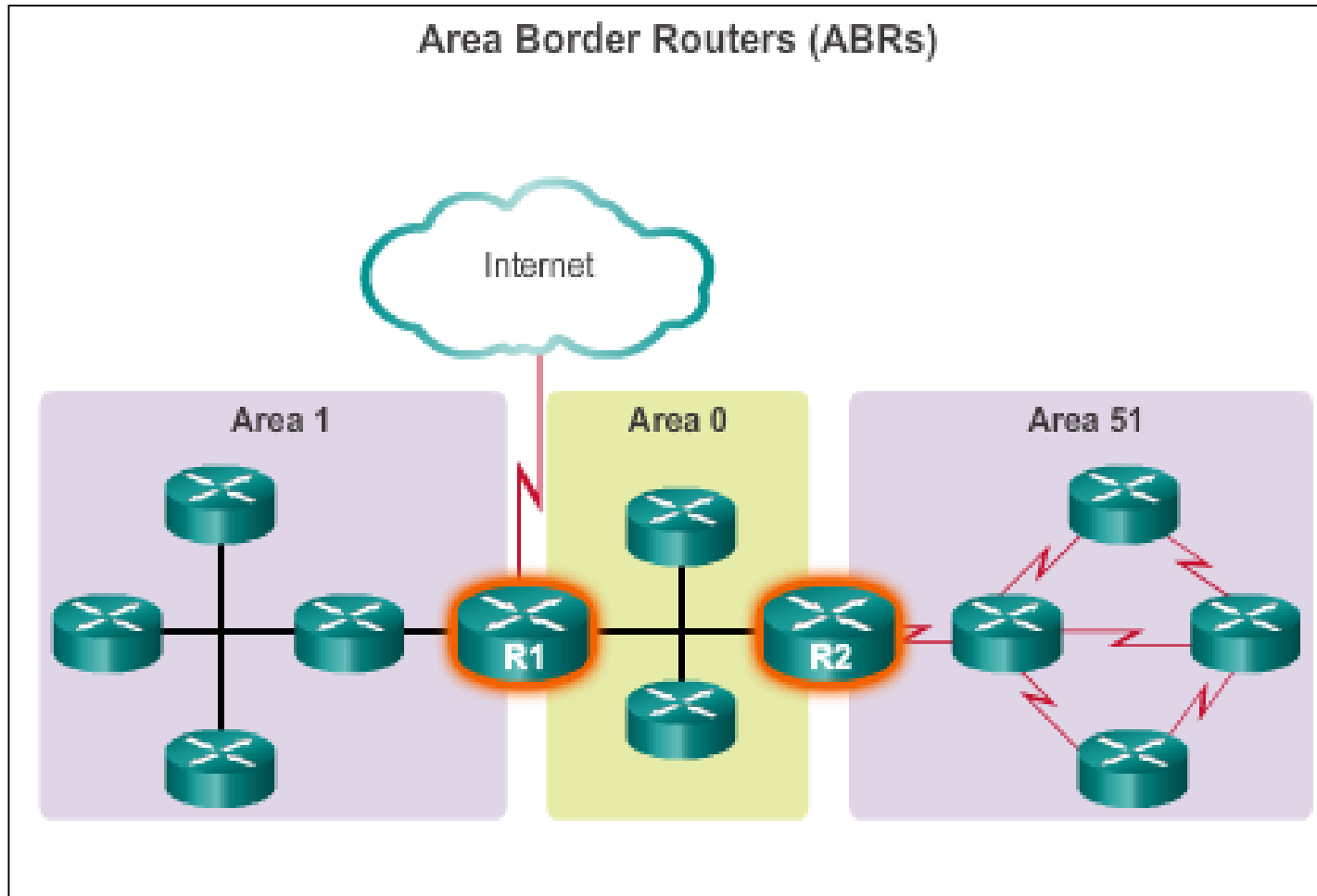
Types of OSPF Routers





Why Multiarea OSPF?

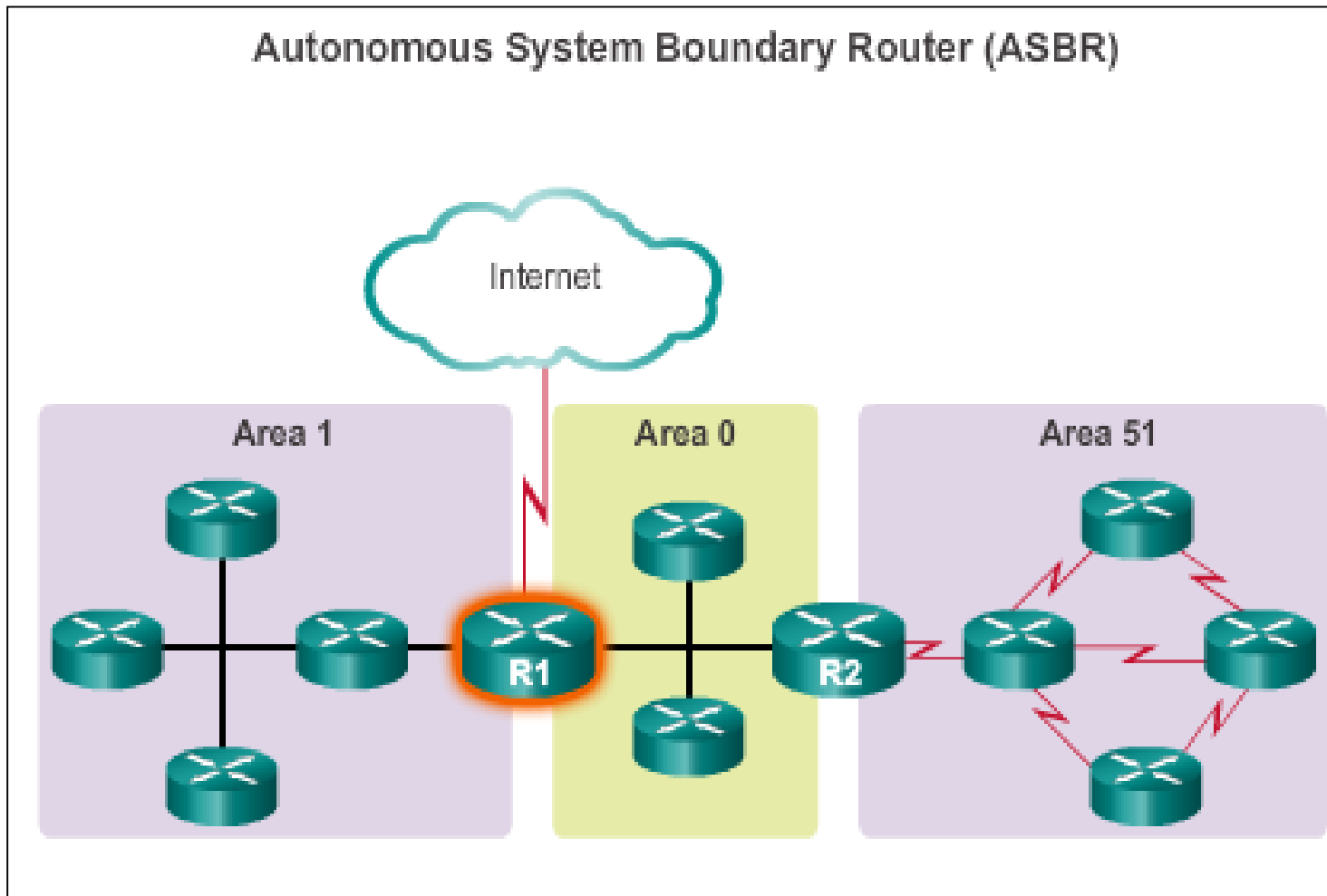
Types of OSPF Routers





Why Multiarea OSPF?

Types of OSPF Routers





Multiarea OSPF LSA Operation

OSPF LSA Types

LSA Type	Description
1	Router LSA
2	Network LSA
3 and 4	Summary LSAs
5	AS External LSA

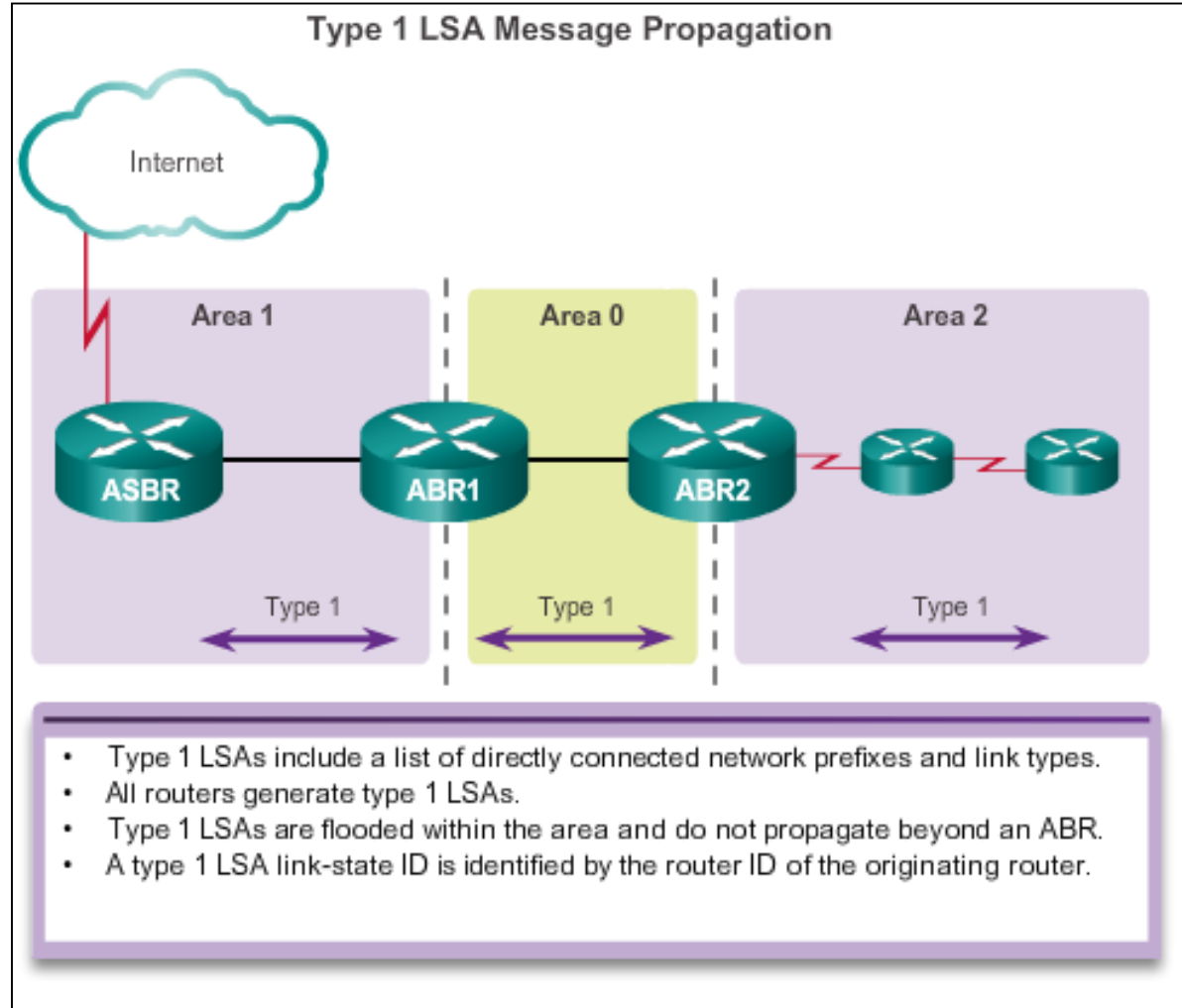


Multiarea OSPF LSA Operation

OSPF LSA Type 1

Reititinilmoitus

- Vastuussa jokainen reititin
- OSPF-tunnus, Router-ID, suoraankytketyt verkot, linkkien tilat ja kustannukset
- Alueen sisäinen

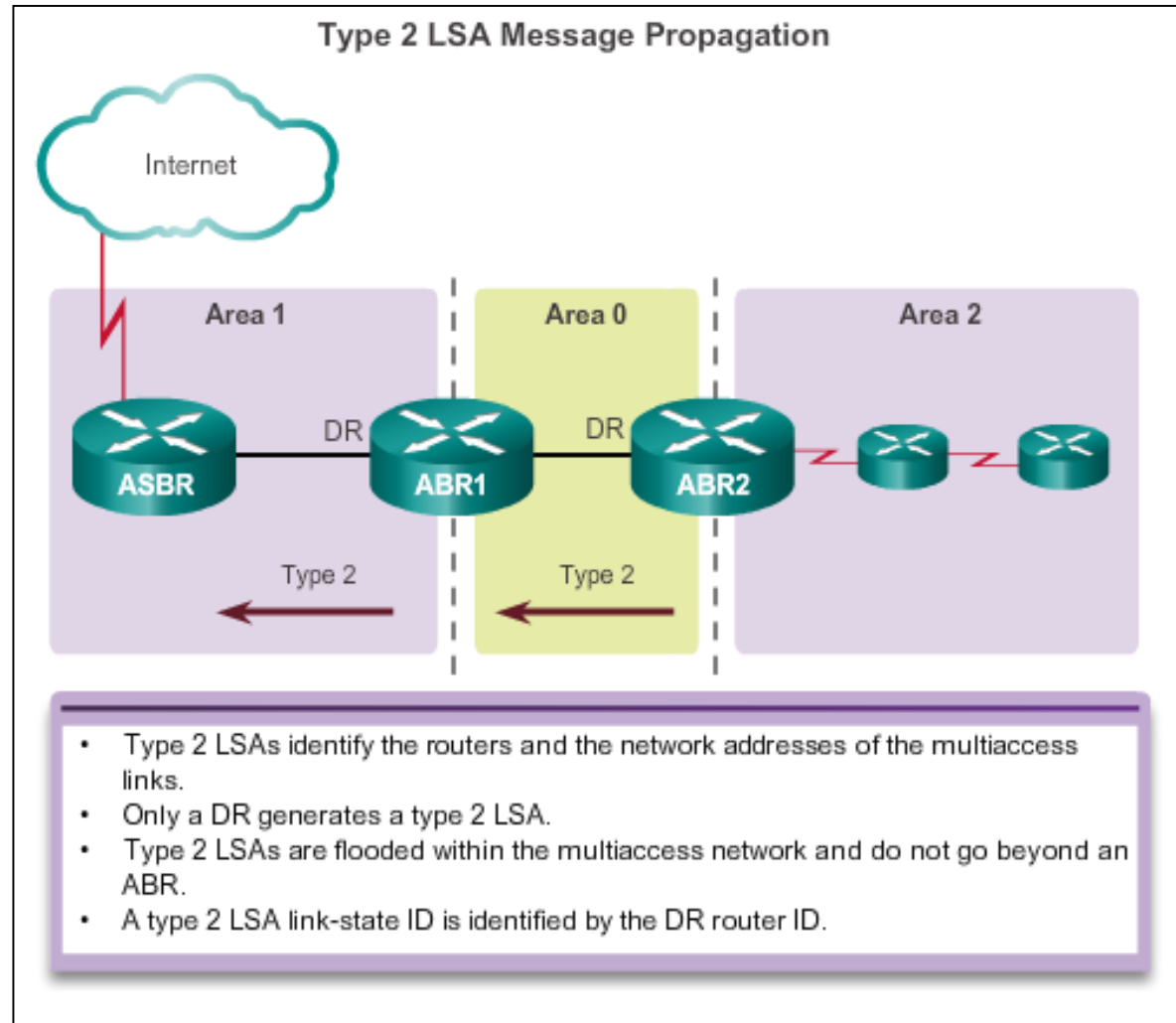


Multiarea OSPF LSA Operation

OSPF LSA Type 2

Verkkoilmoitus

- Vastuussa MA/NBMA verkosta vastaava pääreititin (DR)
- OSPF-tunnus, Router-ID, suoraankytketyt verkot, linkkien tilat ja kustannukset
- Alueen sisäinen



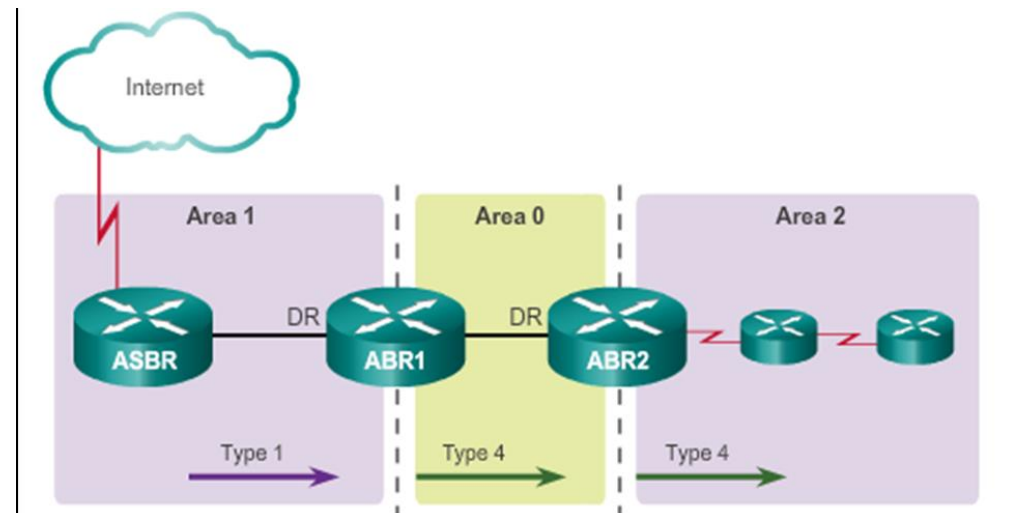
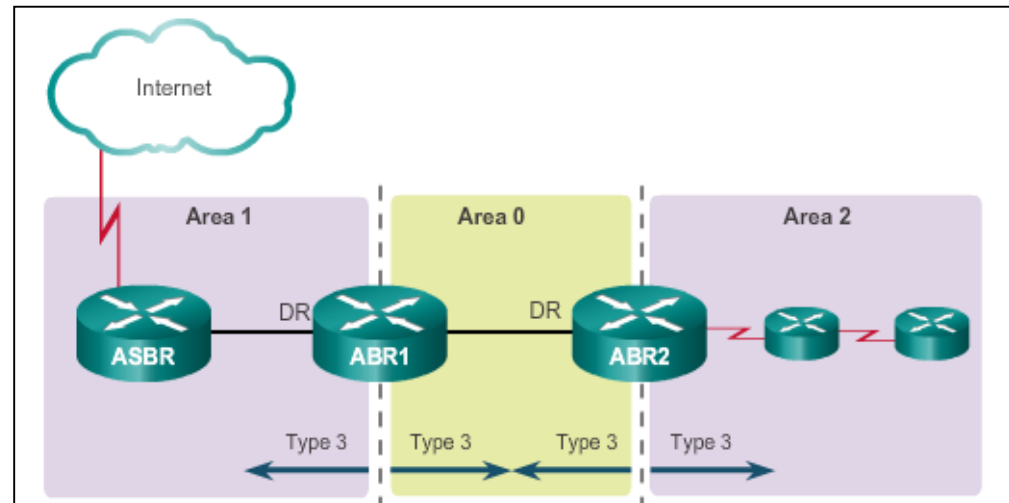


Multiarea OSPF LSA Operation

OSPF LSA Type 3 & 4

Yhteenvetoilmoitus

- Vastuussa aluerajareititin
- Reitittimen OSPF-tunnus
- Mainos reiteistä aluerajareitittimen takana oleviin verkkoihin
- Mainos reiteistä AS-rajareitittimeen ja AS-rajareitittimen tunnus



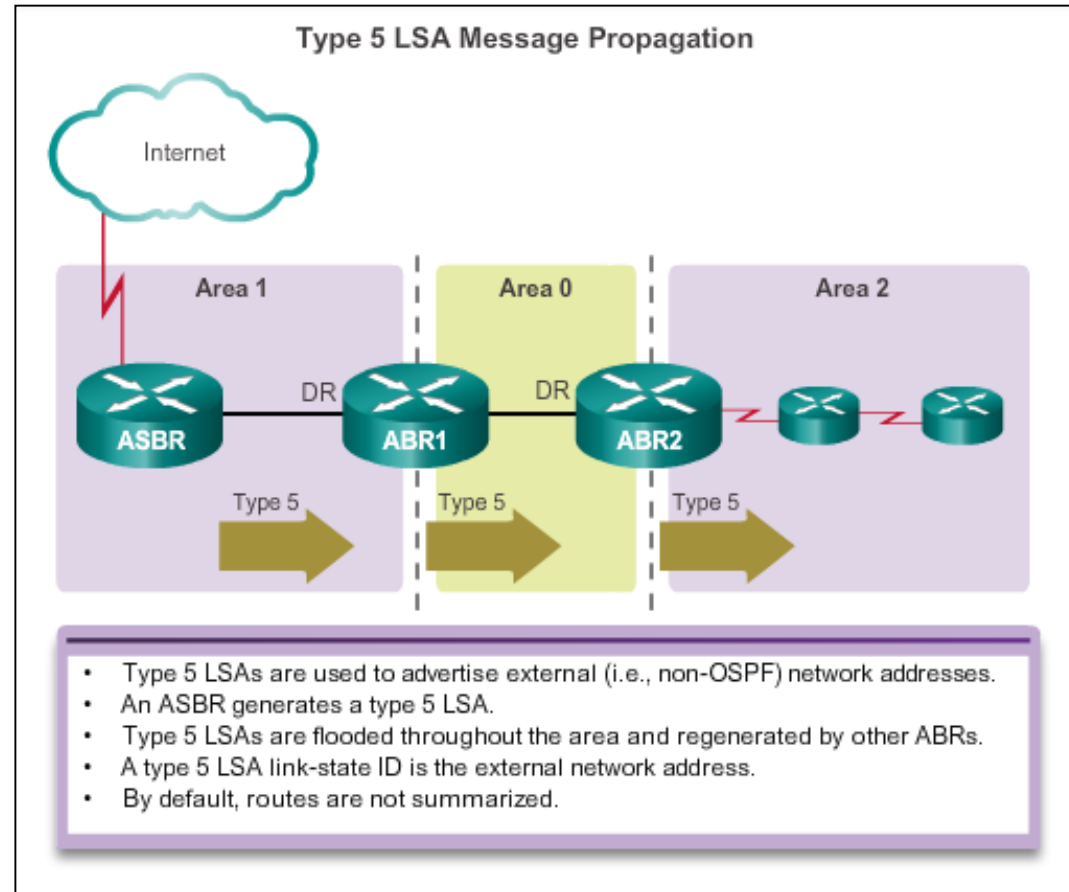


Multiarea OSPF LSA Operation

OSPF LSA Type 5

Ulkoisten reittien ilmoitus

- Vastuussa AS-rajareititin
- AS-rajareitittimen tunnus
- Ulkoisen verkon IP-osoite ja maski
- Mahdollinen varareitti ulkoiseen verkkoon
- Kustannus vakiona tai huomioiden sisäiset kustannukset





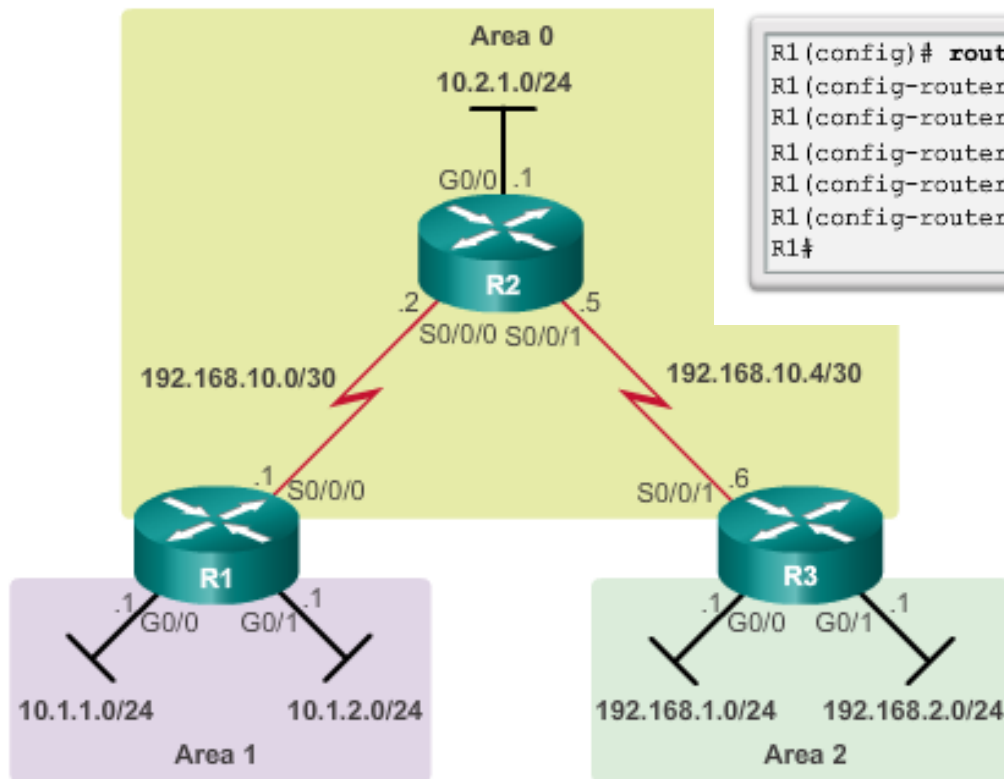
6.2 Configuring Multiarea OSPF



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Configuring Multiarea OSPF

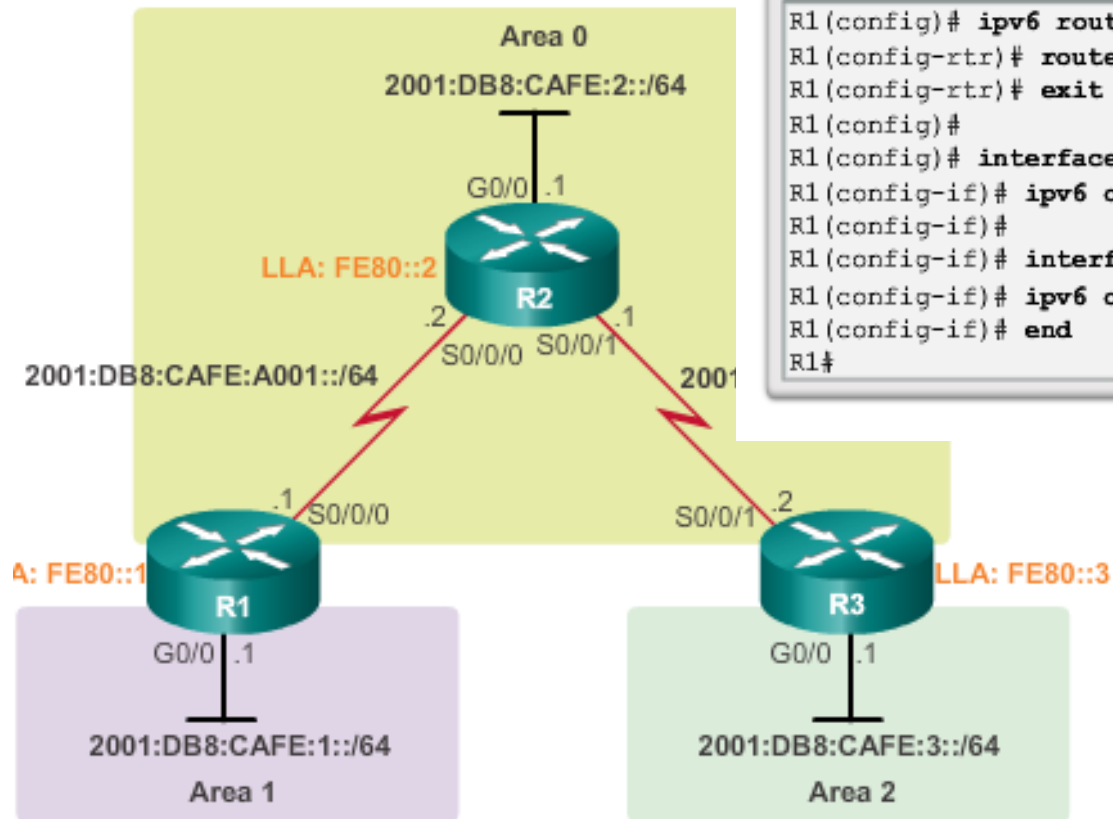


```
R1(config)# router ospf 10
R1(config-router)# router-id 1.1.1.1
R1(config-router)# network 10.1.1.1 0.0.0.0 area 1
R1(config-router)# network 10.1.2.1 0.0.0.0 area 1
R1(config-router)# network 192.168.10.1 0.0.0.0 area 0
R1(config-router)# end
R1#
```



Configuring Multiarea OSPF

Configuring Multiarea OSPFv3



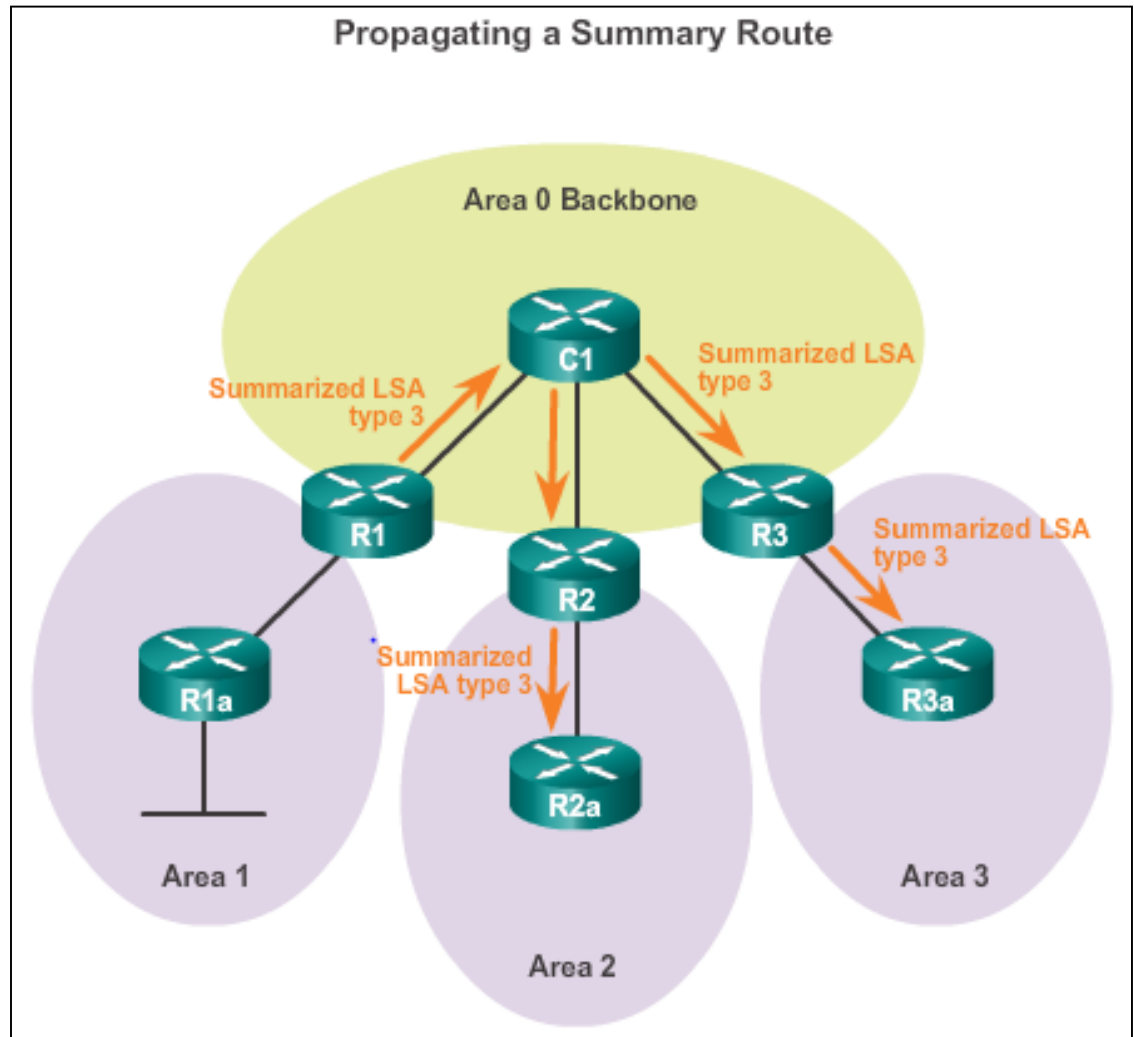
```
R1(config)# ipv6 router ospf 10
R1(config-rtr)# router-id 1.1.1.1
R1(config-rtr)# exit
R1(config)#
R1(config)# interface GigabitEthernet 0/0
R1(config-if)# ipv6 ospf 10 area 1
R1(config-if)#
R1(config-if)# interface Serial0/0/0
R1(config-if)# ipv6 ospf 10 area 0
R1(config-if)# end
R1#
```




OSPF Route Summarization

OSPF Route Summarization

- Summarization helps keep routing tables small
- Summarization also helps increase the network's stability, because it reduces unnecessary LSA flooding
- R1 forwards a summary LSA to the core router C1.
- C1, in turn, forwards the summary LSA to R2 and R3.
- R2 and R3 then forward it to their respective internal routers.

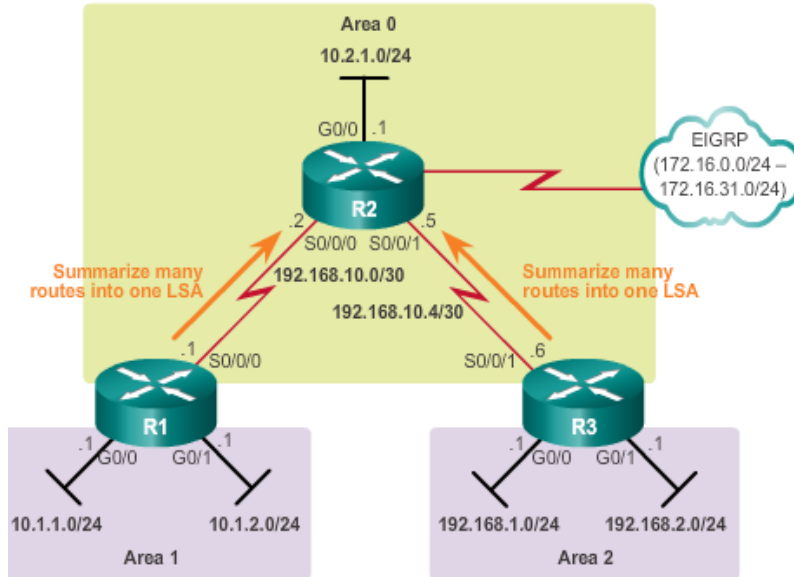




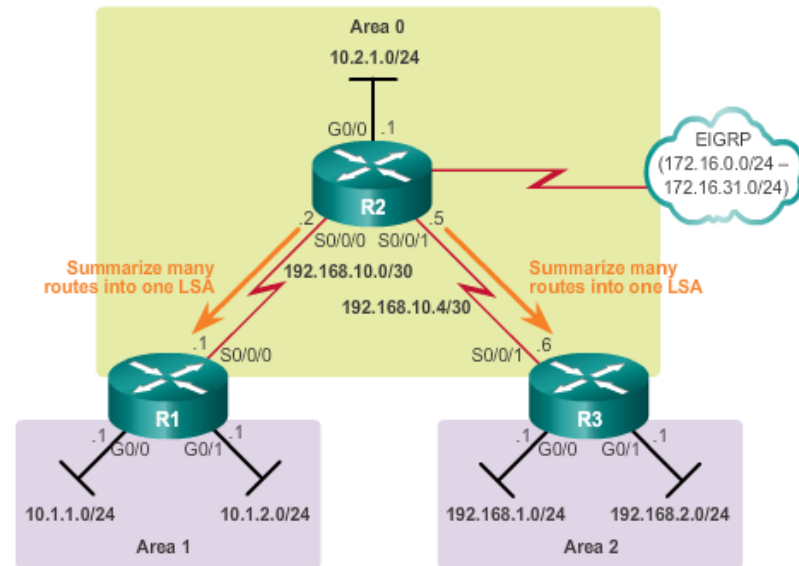
OSPF Route Summarization

Interarea and External Route Summarization

Summarizing Interarea Routes on ABRs



Summarizing External Routes on an ASBR

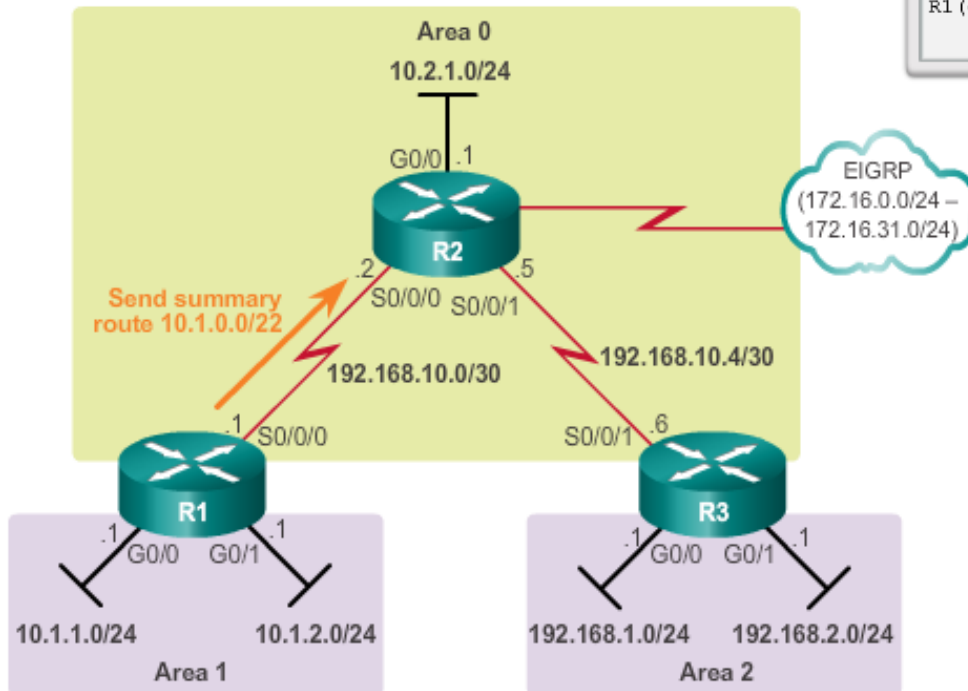




OSPF Route Summarization

Interarea Route Summarization

Summarizing Interarea Routes on ABRs

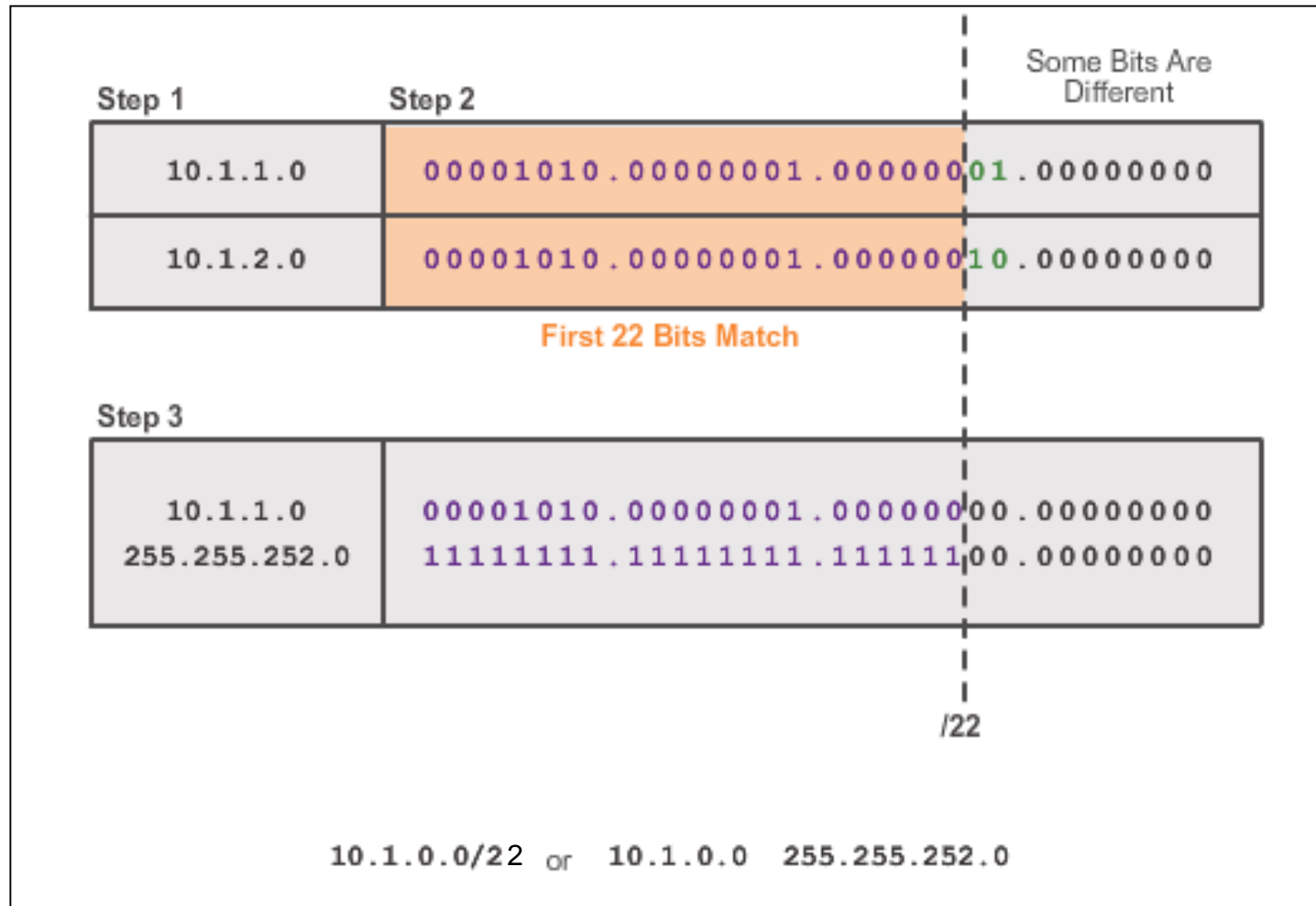


```
R1(config)# router ospf 10
R1(config-router)# area 1 range 10.1.0.0 255.255.252.0
R1(config-router)#
```



OSPF Route Summarization

Calculating the Summary Route





Verifying Multiarea OSPF

Verifying Multiarea OSPF

The same verification commands are used to verify single-area OSPF and can be used to verify multiarea OSPF:

- `show ip ospf neighbor`
- `show ip ospf`
- `show ip ospf interface`

Commands specific to multiarea information include:

- `show ip protocols`
- `show ip ospf interface brief`
- `show ip route ospf`
- `show ip ospf database`

Note: For OSPFv3, substitute `ip` with `ipv6`.

