OSPF multiárea

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Objetivos

- Explicar porqué se utiliza OSPF multiárea.
- Explicar cómo OSPF multiárea utiliza anuncios de estado de enlace para mantener las tablas de enrutamiento.
- Explicar cómo OSPF establece adyacencias con vecinos en una implementación OSPF multiárea.
- Configurar en los sistemas multiárea la ruta de resumen en una red enrutada.
- Verificar las operaciones OSPFv2 multiárea.

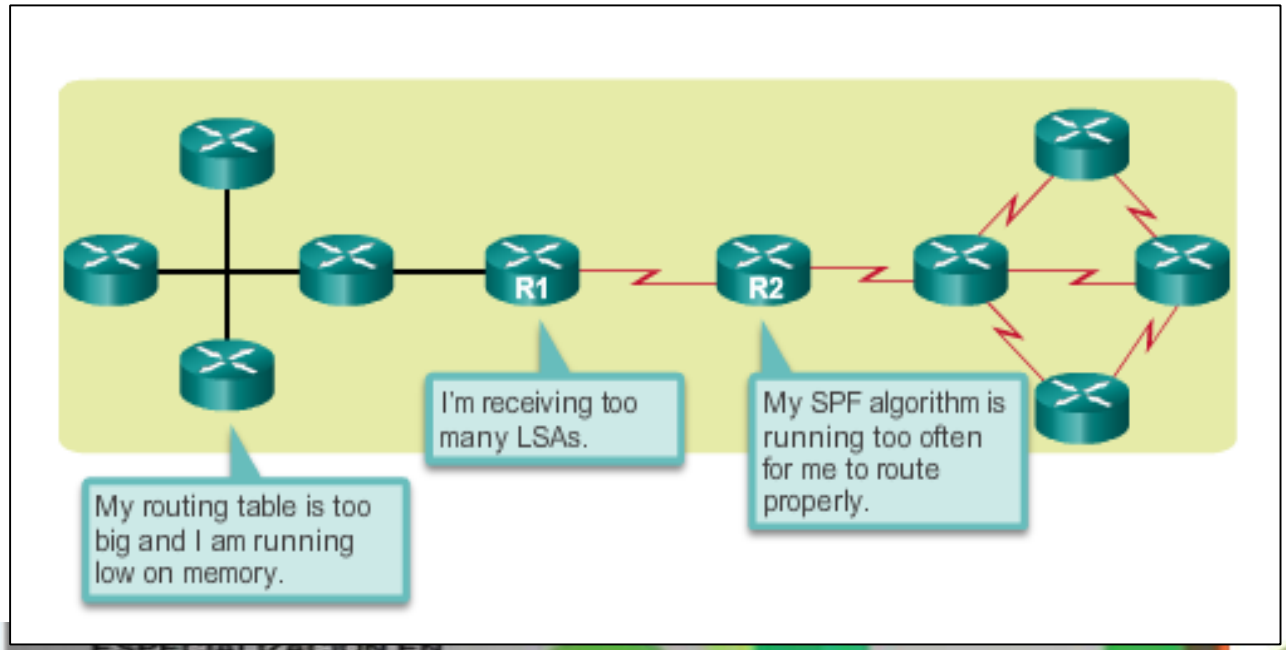
OSPF Single-área

OSPF Single-área es útil en redes pequeñas. Si un área es demasiado grande, los siguientes asuntos deben ser abordados:

Tabla de enrutamiento grande (sin sumarización por defecto)

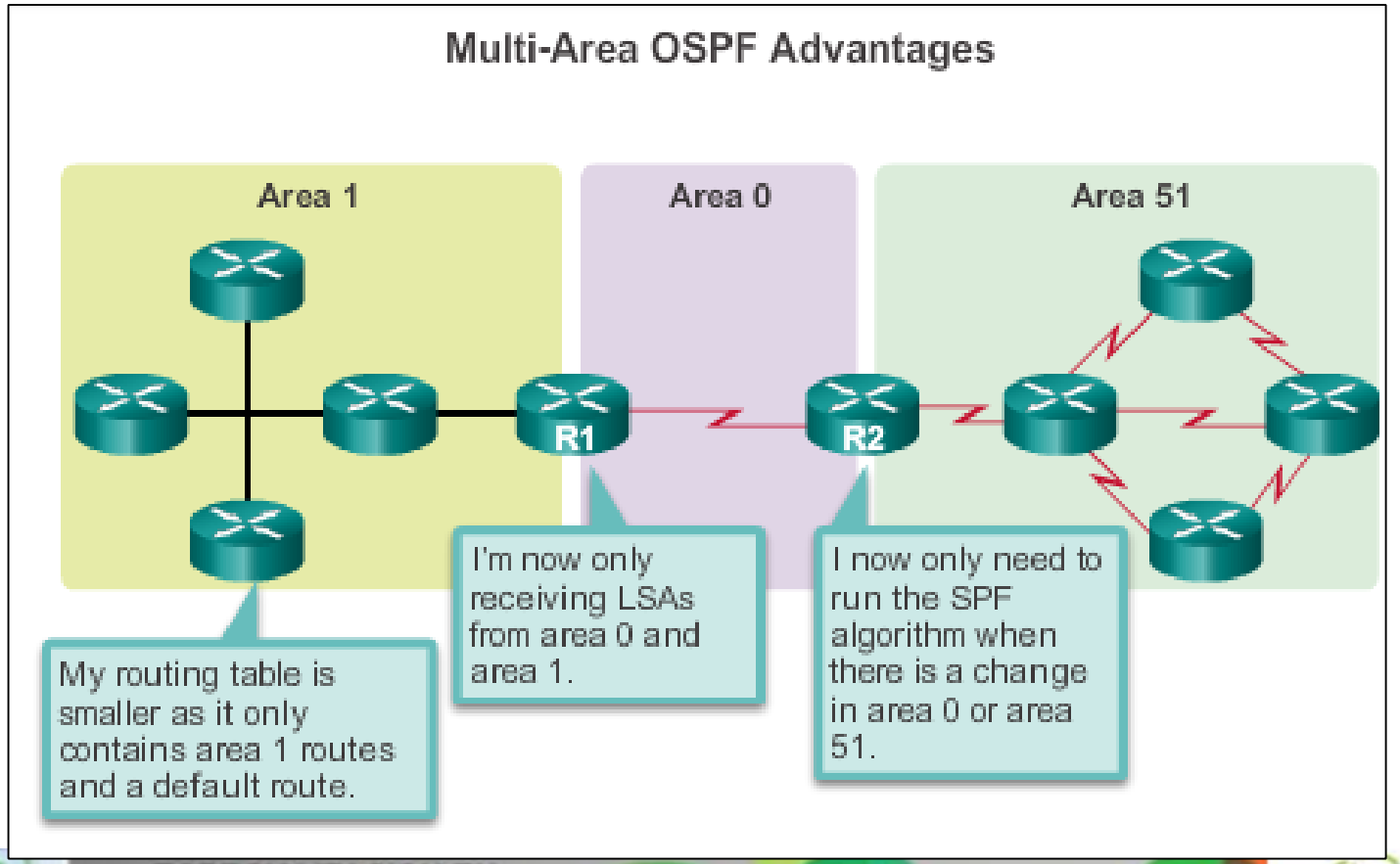
Una gran base de datos de estado de enlace (LSDB)

Los Cálculos del algoritmo SPF Frecuentes



Multiarea OSPF

Requiere de un diseño jerárquico de la red y el área principal se llama el área backbone, o área 0, y todas las otras áreas deben conectarse backbone



OSPF area incremental de dos capas

Multiárea OSPF se implementa en una área jerarquía de dos capas:

Área Backbone (tránsito) : su función es el movimiento rápido y eficiente de los paquetes IP.

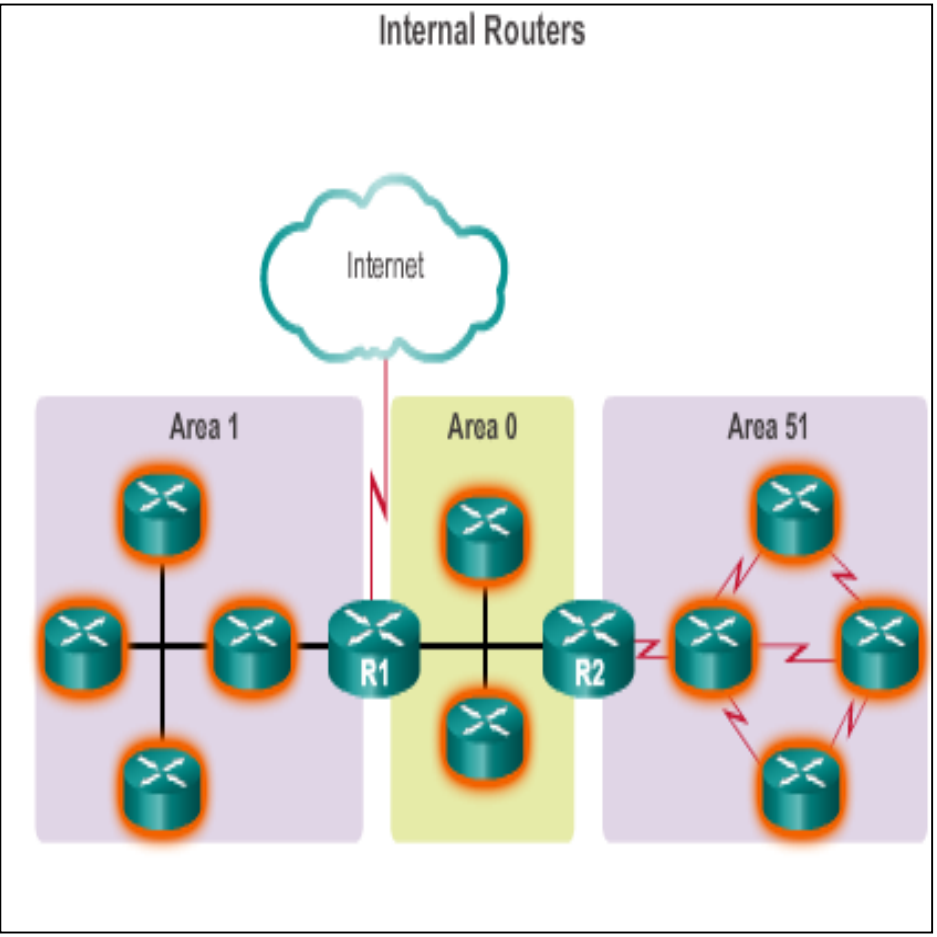
Se Interconecta con otros tipos de área OSPF.

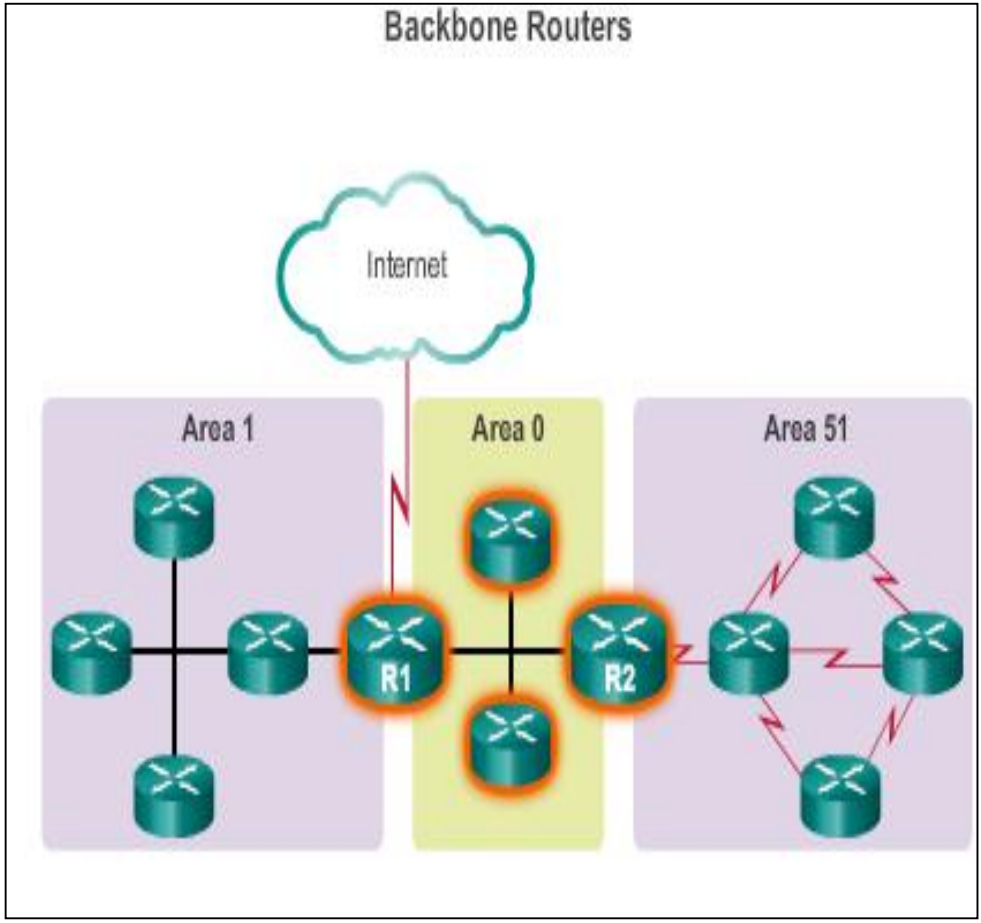
Llamado OSPF área 0, todas las áreas se conectan directamente.

Área Regular (nonbackbone) : Se conecta a usuarios y los recursos.

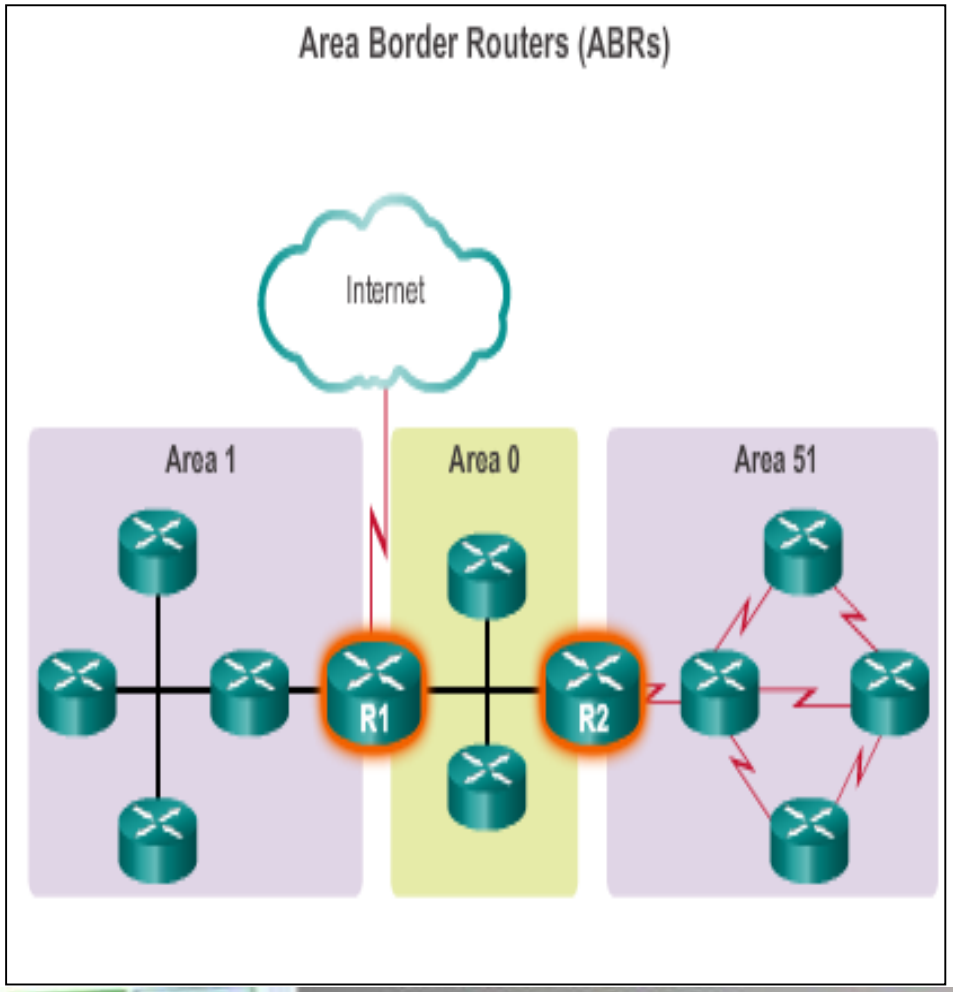
Un área normal no permite el tráfico procedente de otra zona para utilizar sus enlaces para llegar a otras áreas.

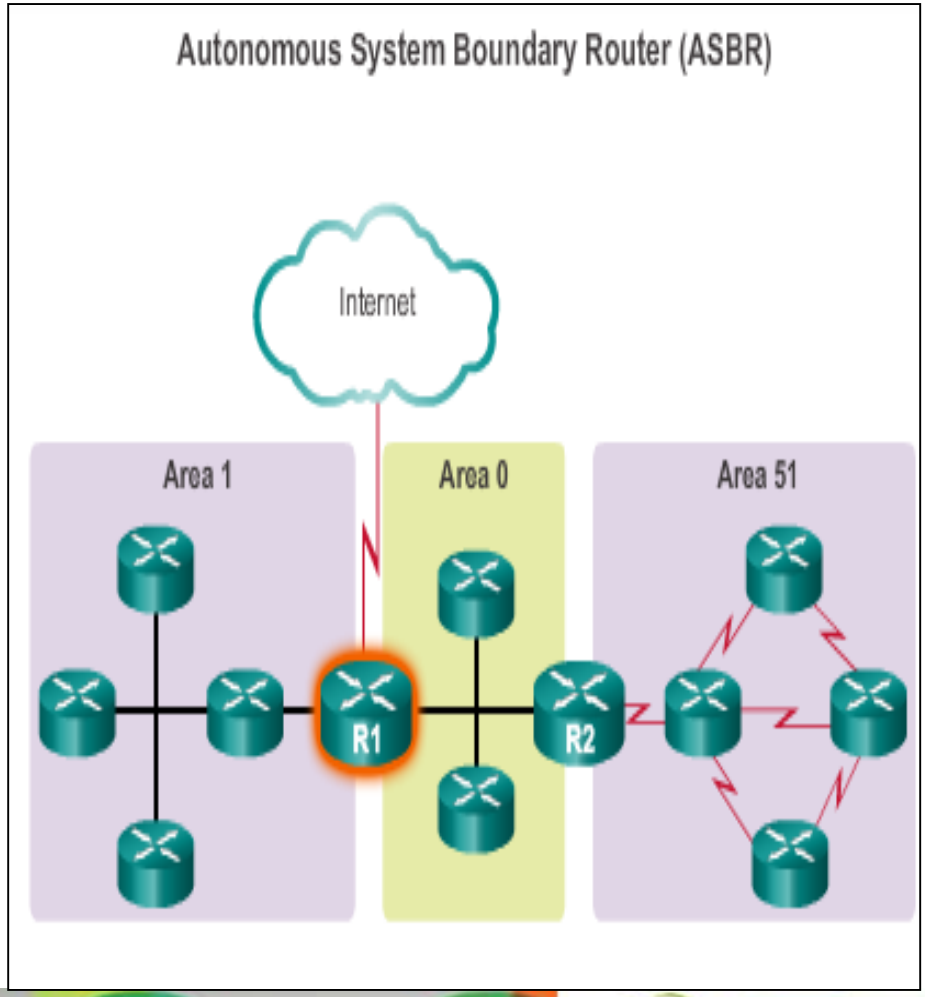
Tipos de routers OSPF





Tipos de routers OSPF



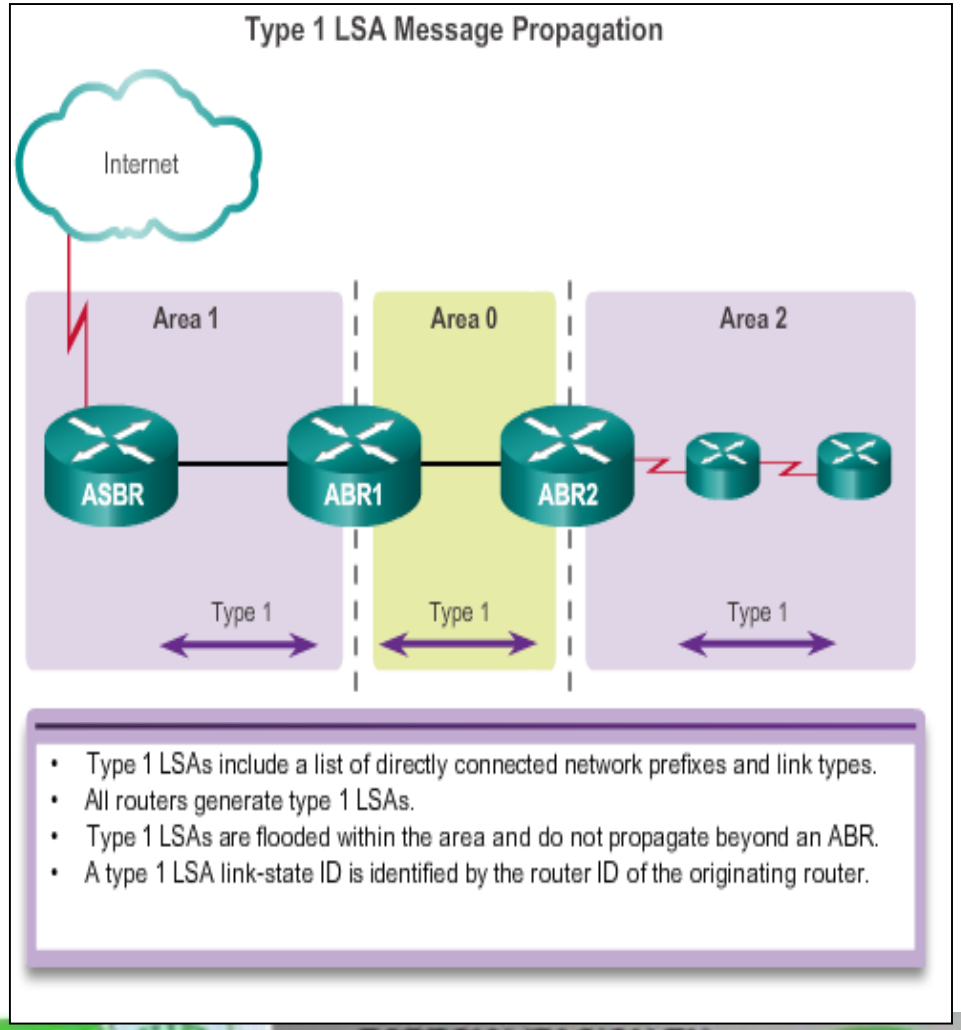


Tipos LSA OSPF

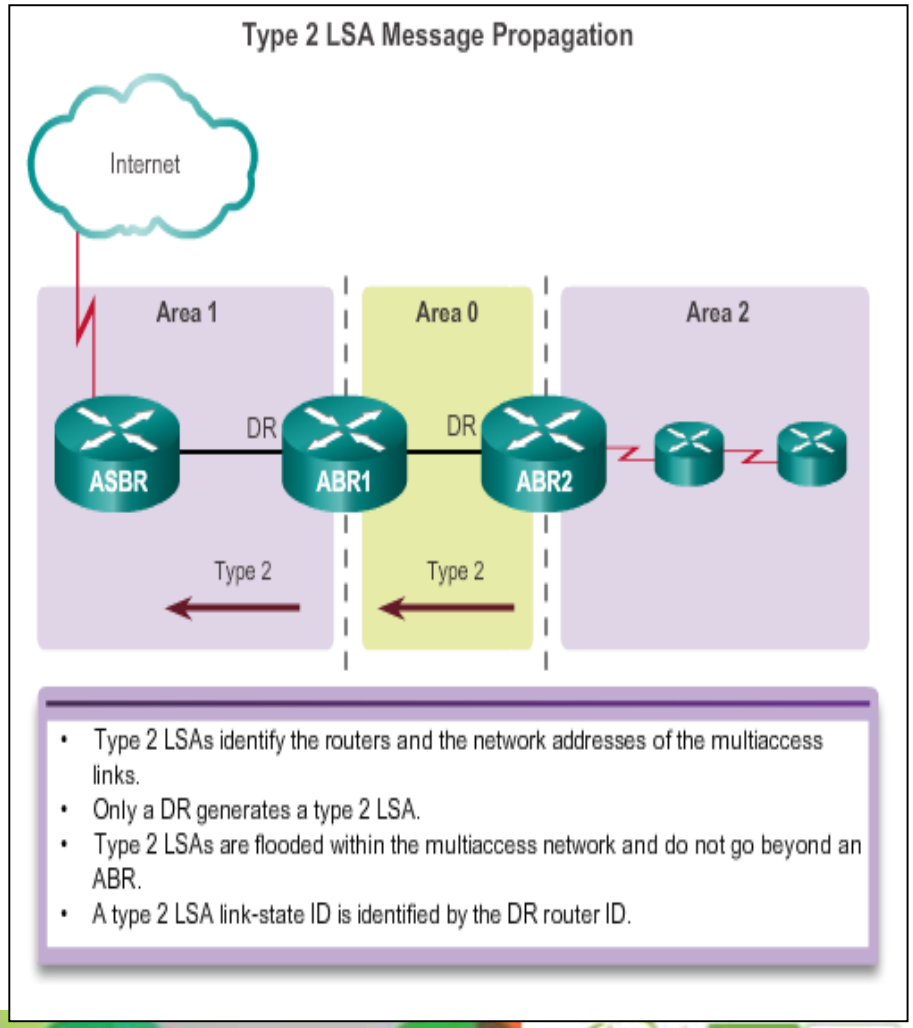
LSA Type	Description
1	Router LSA
2	Network LSA
3 and 4	Summary LSAs
5	AS External LSA
6	Multicast OSPF LSA
7	Defined for NSSAs
8	External Attributes LSA for Border Gateway Protocol (BGP)
9, 10, or 11	Opaque LSAs

Los más comunes y cubierto en este curso 1-5

OSPF LSA Tipo 1 y 2

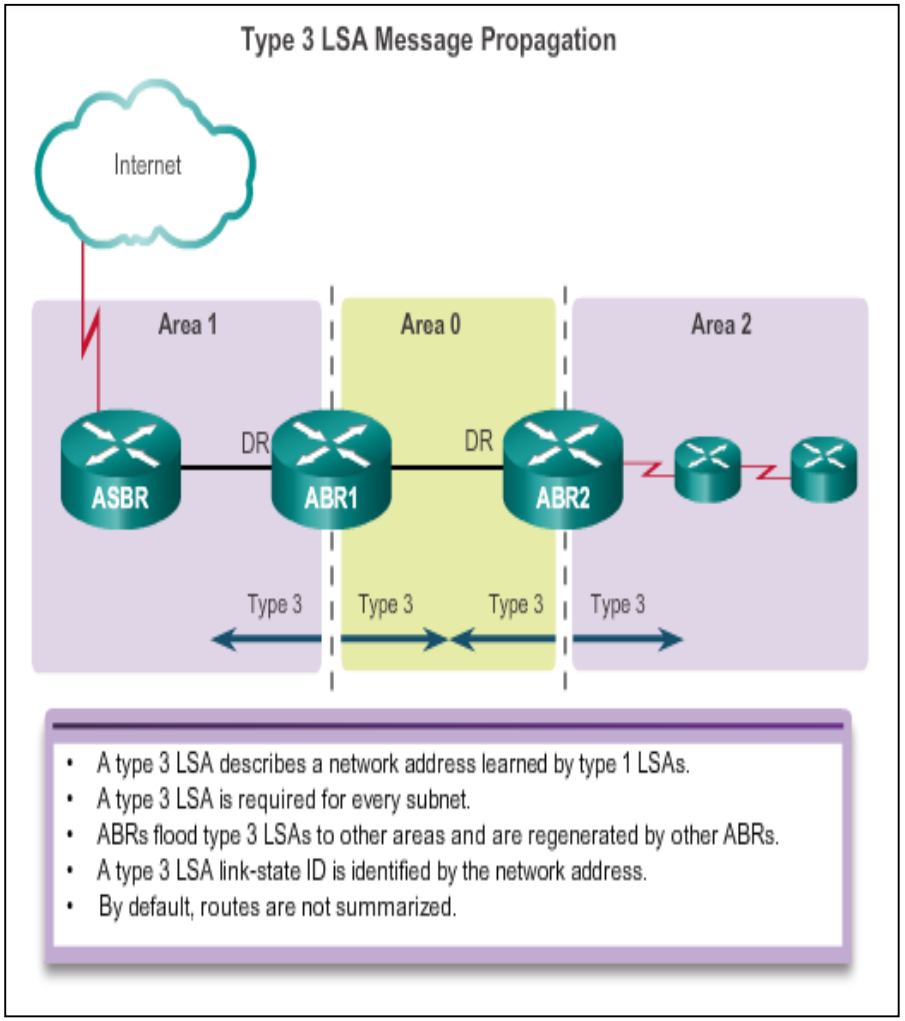


- Type 1 LSAs include a list of directly connected network prefixes and link types.
- All routers generate type 1 LSAs.
- Type 1 LSAs are flooded within the area and do not propagate beyond an ABR.
- A type 1 LSA link-state ID is identified by the router ID of the originating router.

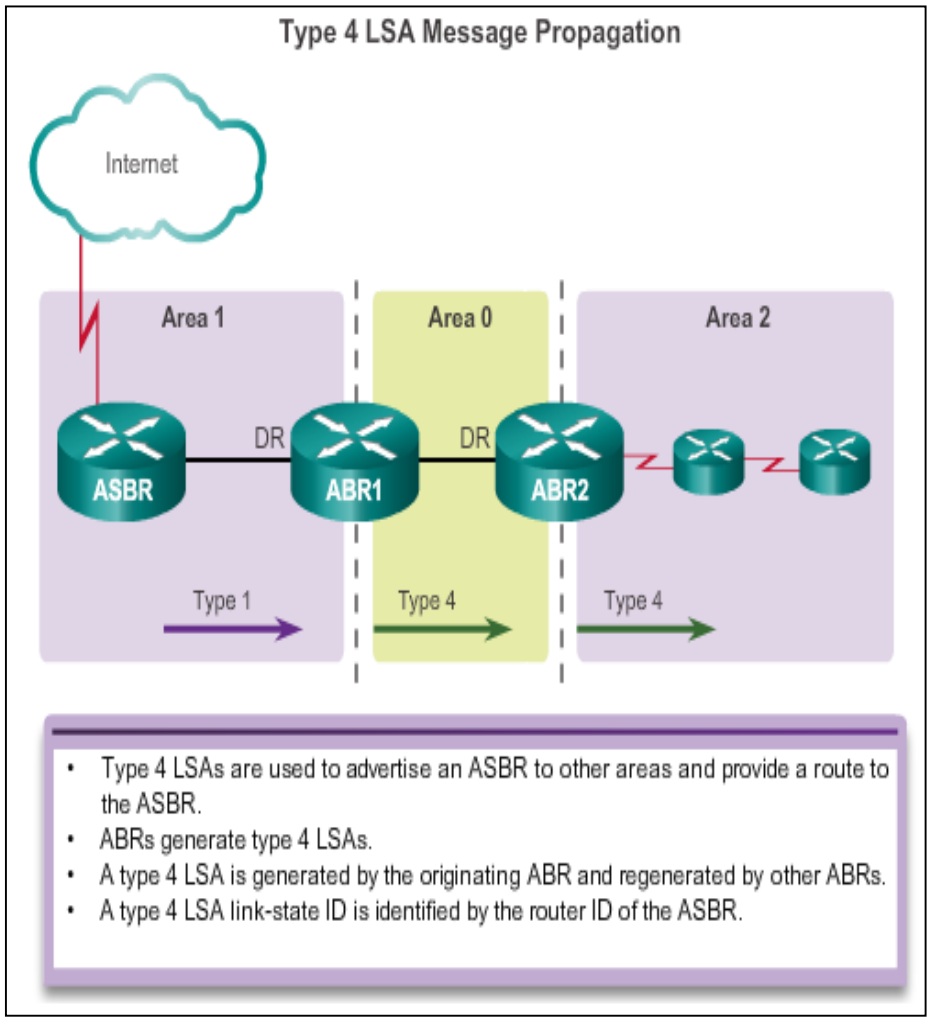


- Type 2 LSAs identify the routers and the network addresses of the multiaccess links.
- Only a DR generates a type 2 LSA.
- Type 2 LSAs are flooded within the multiaccess network and do not go beyond an ABR.
- A type 2 LSA link-state ID is identified by the DR router ID.

OSPF LSA Tipo 3 y 4

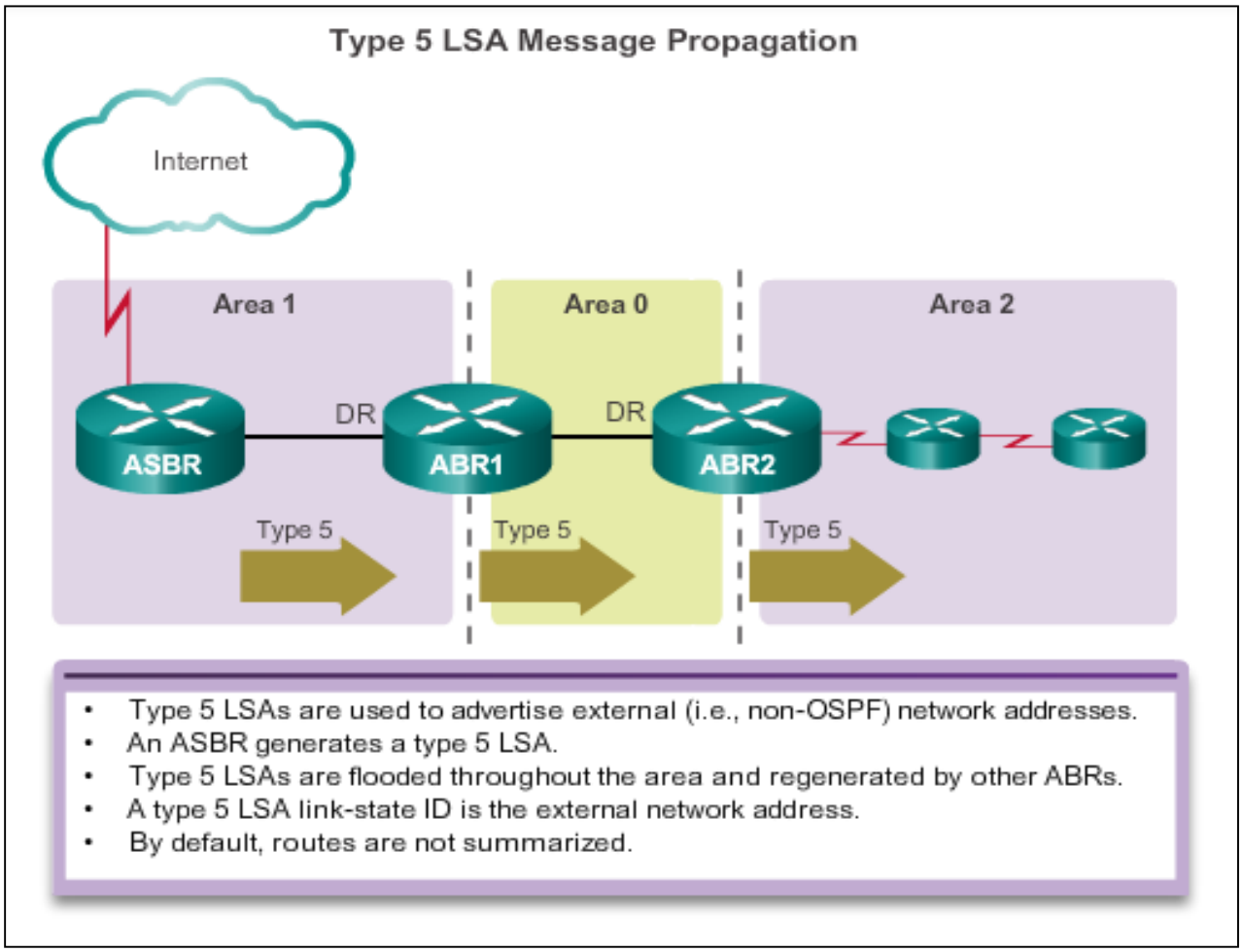


- A type 3 LSA describes a network address learned by type 1 LSAs.
- A type 3 LSA is required for every subnet.
- ABRs flood type 3 LSAs to other areas and are regenerated by other ABRs.
- A type 3 LSA link-state ID is identified by the network address.
- By default, routes are not summarized.



- Type 4 LSAs are used to advertise an ASBR to other areas and provide a route to the ASBR.
- ABRs generate type 4 LSAs.
- A type 4 LSA is generated by the originating ABR and regenerated by other ABRs.
- A type 4 LSA link-state ID is identified by the router ID of the ASBR.

OSPF LSA Tipo 5



Entradas de la tabla Enrutamiento OSPF

- **O** Router (tipo 1) y de red (tipo 2) los LSAs describen detalles dentro de un área (ruta dentro de zona (intraarea)).

- **O IA** - Resumen de LSA aparecen en la tabla como IA (rutas entre areas)

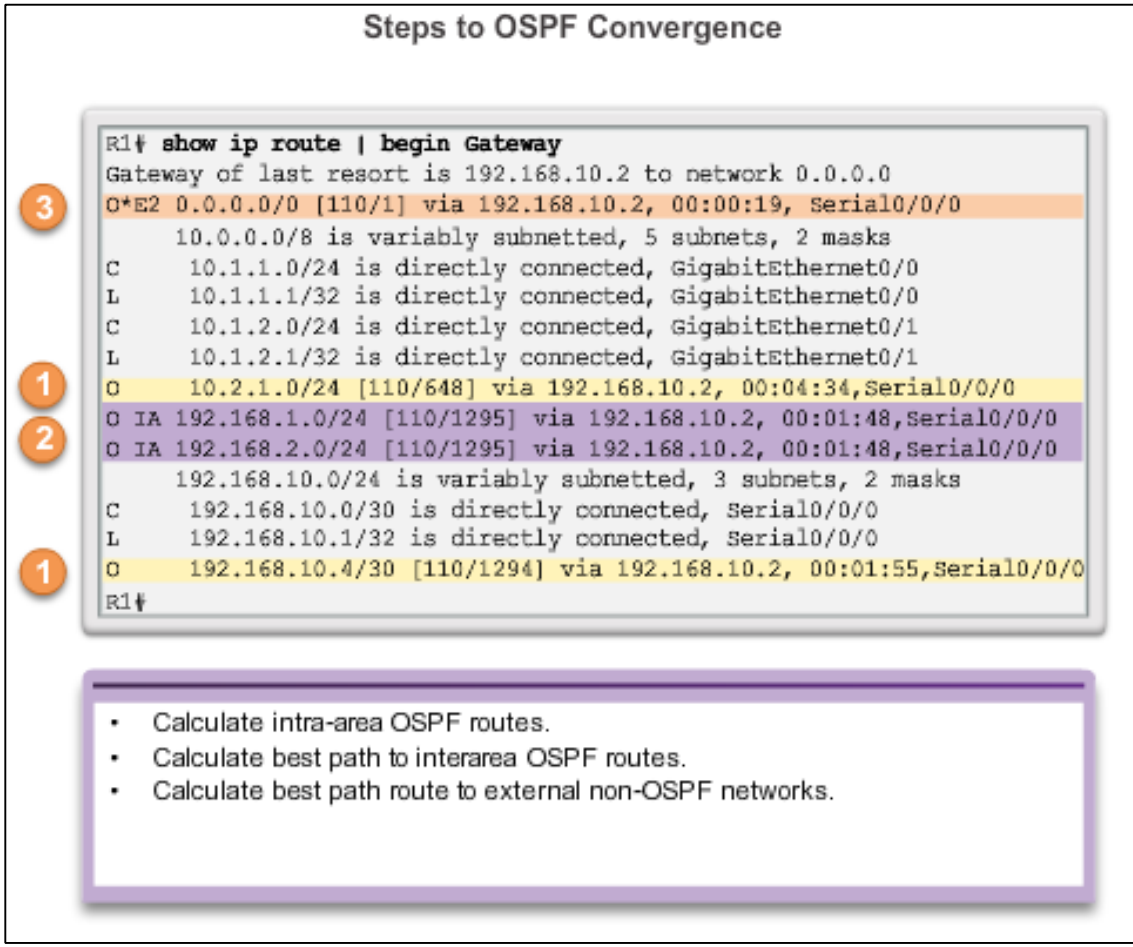
- **O E1** o **OE 2** LSA Externas tipo 1 (E1) o rutas externas tipo 2 (E2)

```
Gateway of last resort is 192.168.10.2 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 192.168.10.2, 00:00:19, Serial0/0/0
     10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C       10.1.1.0/24 is directly connected, GigabitEthernet0/0
L       10.1.1.1/32 is directly connected, GigabitEthernet0/0
C       10.1.2.0/24 is directly connected, GigabitEthernet0/1
L       10.1.2.1/32 is directly connected, GigabitEthernet0/1
O       10.2.1.0/24 [110/648] via 192.168.10.2, 00:04:34, Serial0/0/0
O IA 192.168.1.0/24 [110/1295] via 192.168.10.2, 00:01:48,Serial0/0/0
O IA 192.168.2.0/24 [110/1295] via 192.168.10.2, 00:01:48,Serial0/0/0
     192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0
L       192.168.10.1/32 is directly connected, Serial0/0/0
O       192.168.10.4/30 [110/1294] via 192.168.10.2, 00:01:55,Serial0/0/0
```

```
OE2 ::/0 [110/1], tag 10
      via FE80::2, Serial0/0/0
C     2001:DB8:CAFE:1::/64 [0/0]
      via GigabitEthernet0/0, directly connected
L     2001:DB8:CAFE:1::1/128 [0/0]
      via GigabitEthernet0/0, receive
O     2001:DB8:CAFE:2::/64 [110/648]
      via FE80::2, Serial0/0/0
OI    2001:DB8:CAFE:3::/64 [110/1295]
      via FE80::2, Serial0/0/0
C     2001:DB8:CAFE:A001::/64 [0/0]
      via Serial0/0/0, directly connected
L     2001:DB8:CAFE:A001::1/128 [0/0]
      via Serial0/0/0, receive
O     2001:DB8:CAFE:A002::/64 [110/1294]
      via FE80::2, Serial0/0/0
L     FF00::/8 [0/0]
      via Null0, receive
```

OSPF Cálculo de Ruta

1. Todos los routers calculan las mejores rutas a destinos en su área (intra-area) y añade estas entradas a la tabla.
2. Calculan las mejores rutas de acceso a otras áreas dentro de la red interna (Inter área) o LSA tipo 3 y tipo 4.
3. Calculan las mejores rutas al destino del sistema autónomo externo (tipo 5). Estos se indican, ya sea con un O E1 o un O E2 de ruta

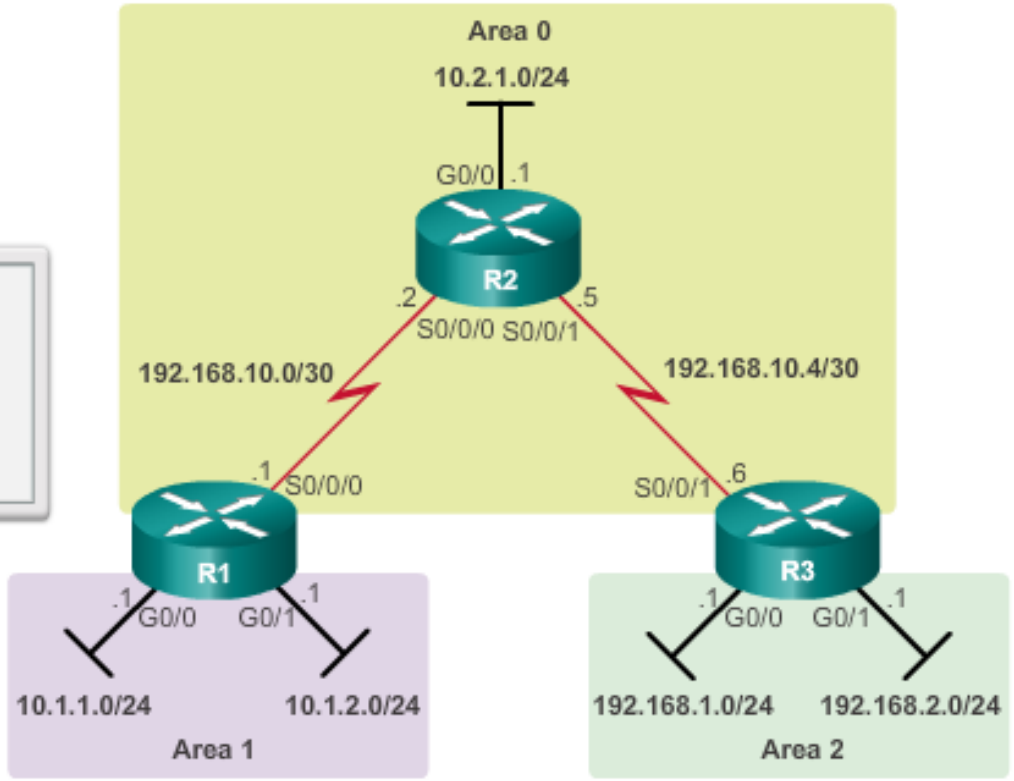


Implementando OSPF multiárea

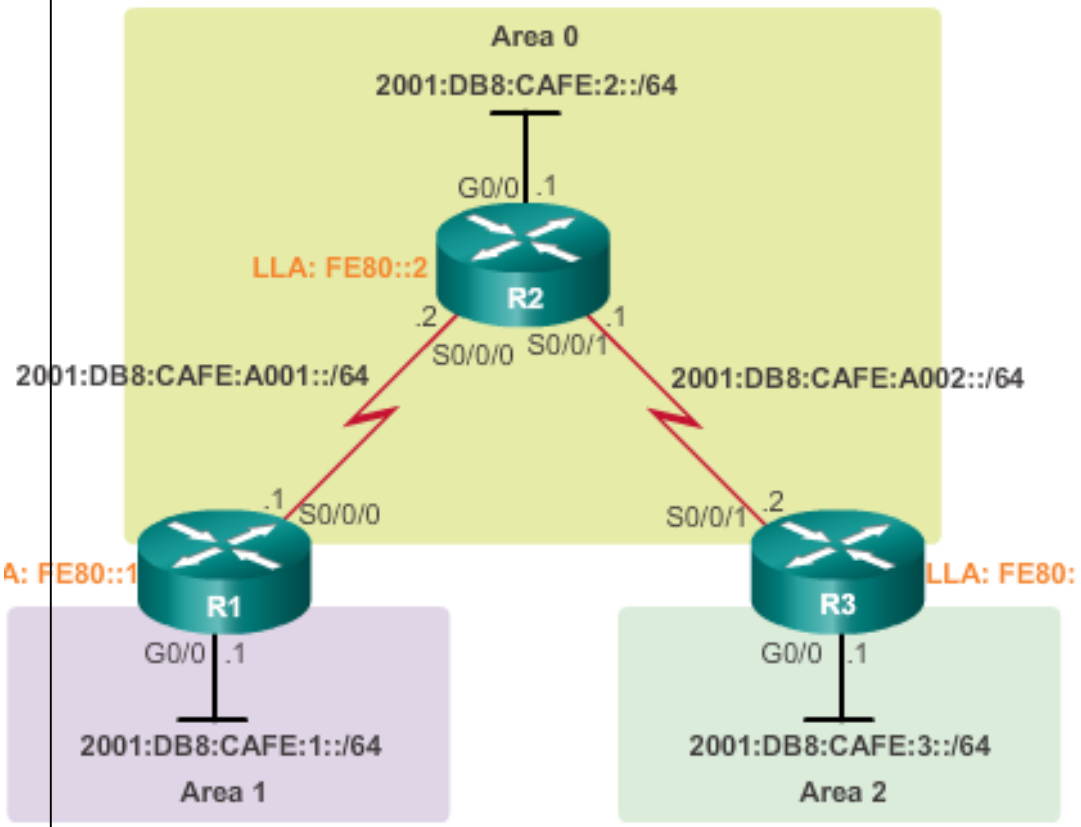
Pasos de Implementación

1. Gather the network requirements and parameters.
2. Define the OSPF parameters.
3. Configure OSPF.
4. Verify 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#
```



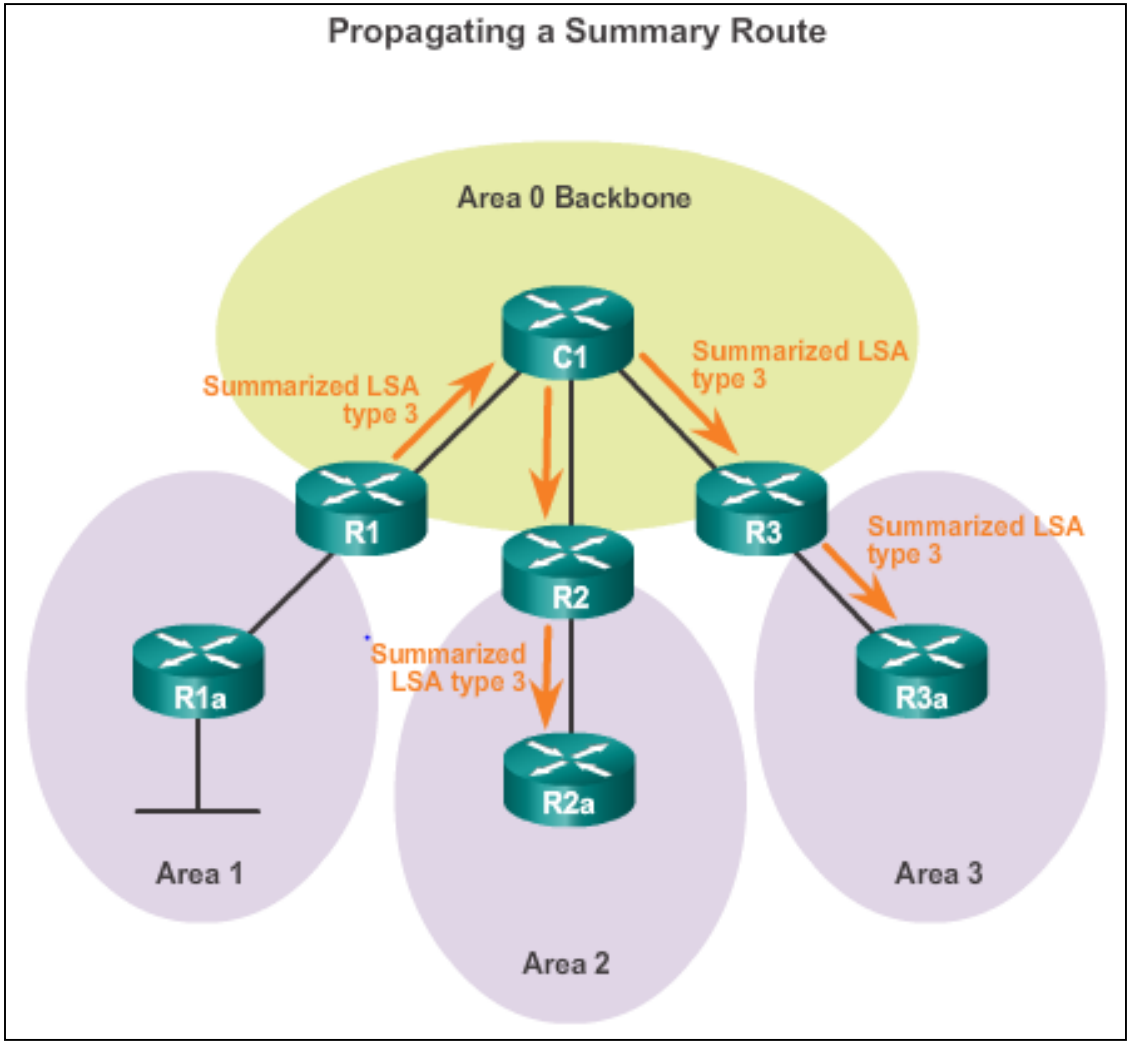
Implementando OSPFv3 multiárea




```
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 resumen de ruta

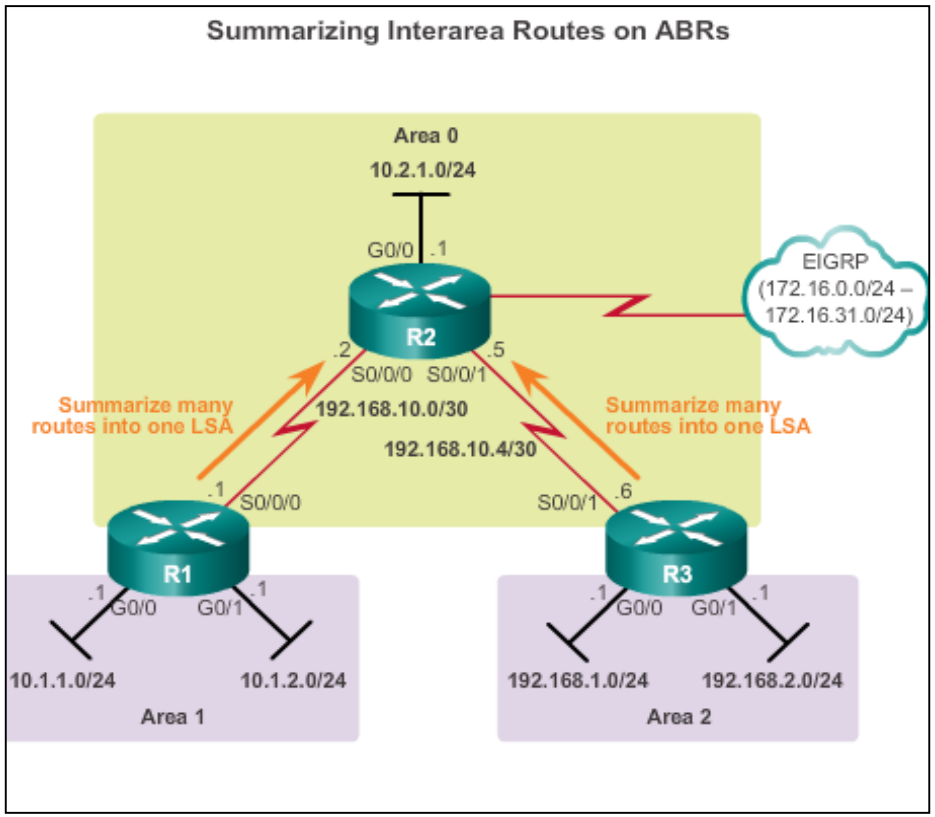
- R1 reenvía un LSA de resumen al router del core C1.
- C1, a su vez, envía la LSA de resumen para R2 y R3.
- R2 y R3 lo reenvían a sus respectivos routers internos.

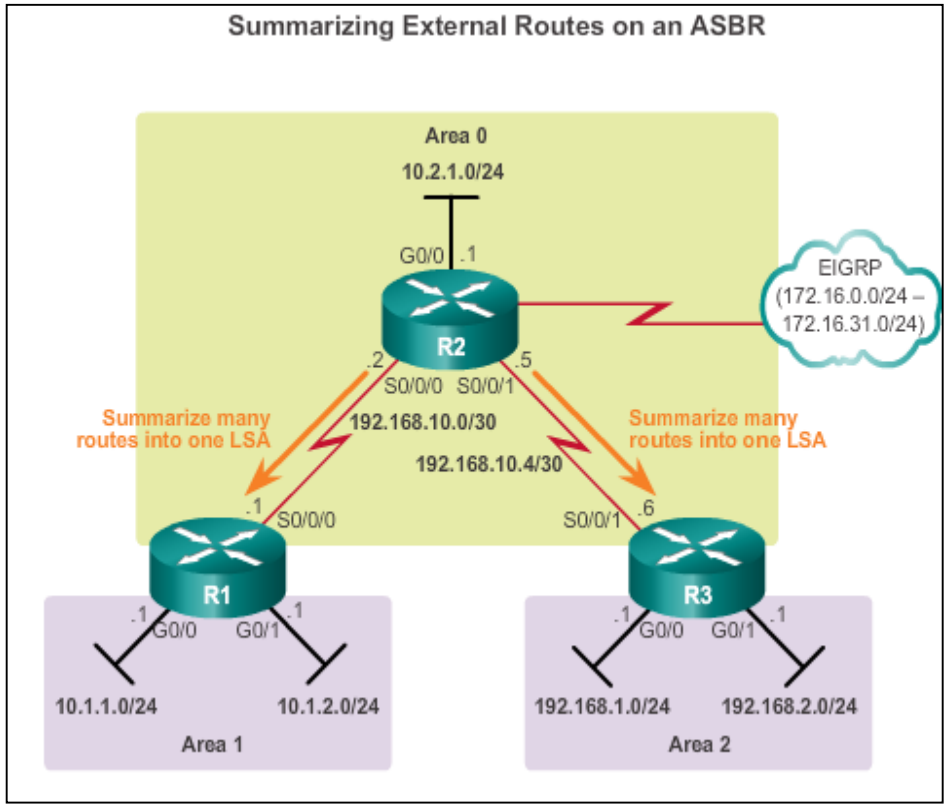


Interárea y resumen de ruta Externa

Ocurre en los ABR y se aplica a las rutas dentro de cada área

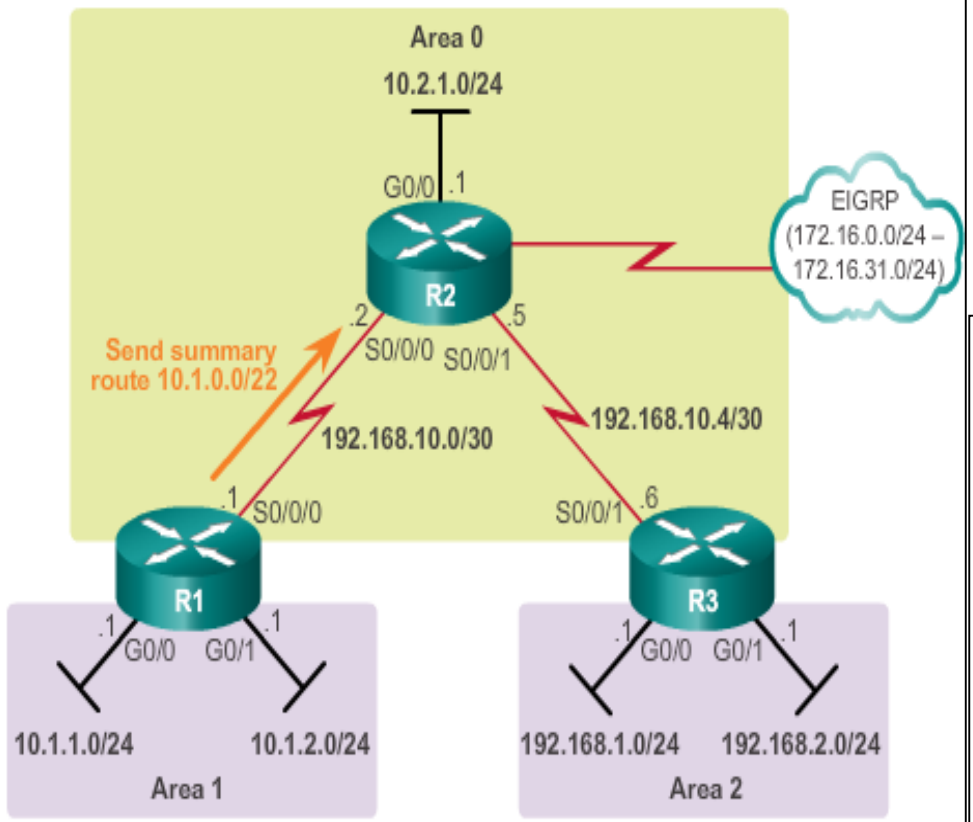
Específico para rutas externas que se inyectan en OSPF a través de la redistribución de rutas; los ASBRs resumen rutas externas





Resumen de ruta Interárea

Summarizing Interarea Routes on ABRs



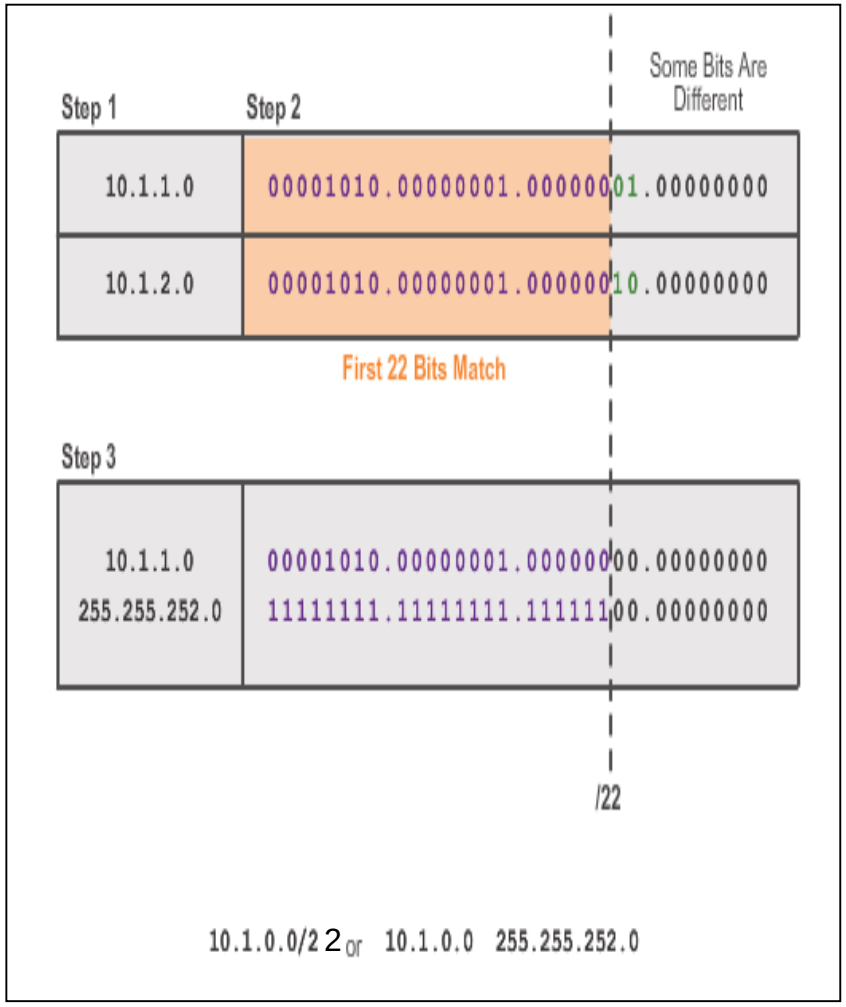
Verify the R1 Routing Table Before Summarization

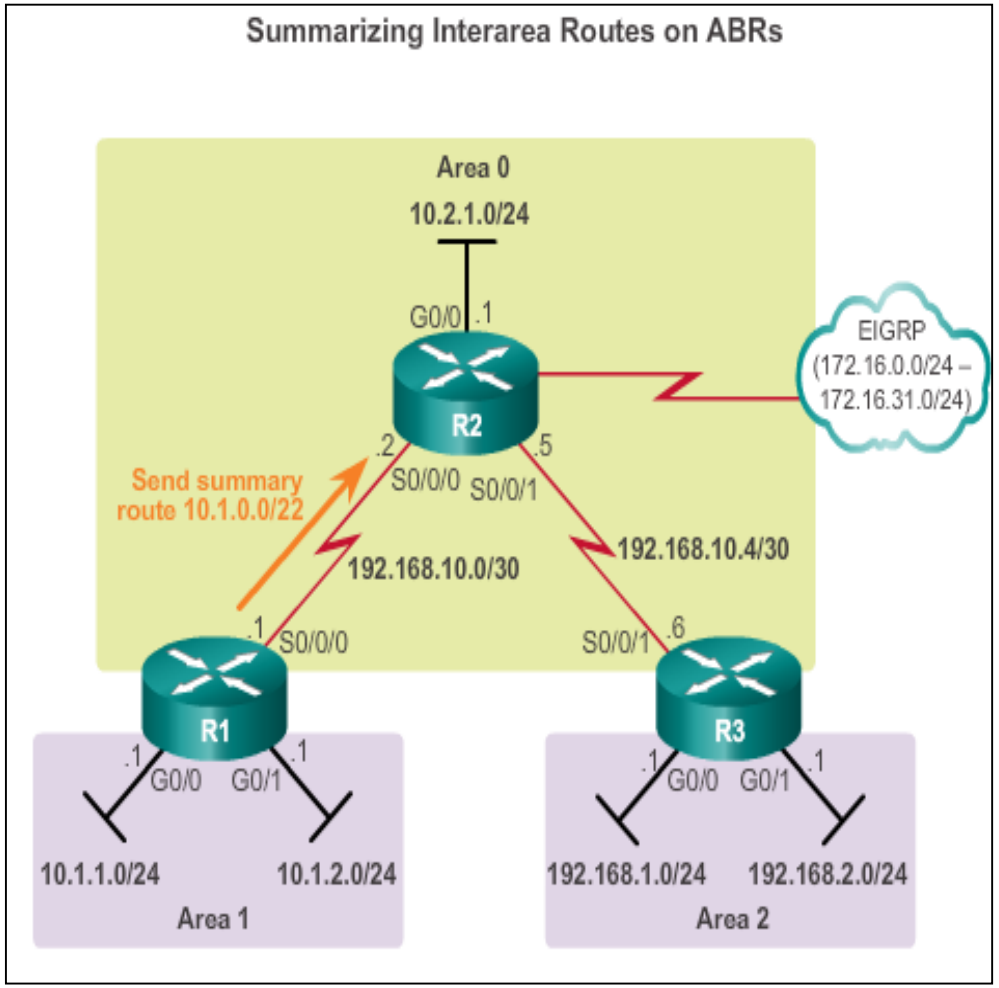
```
R1# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O        10.2.1.0/24 [110/648] via 192.168.10.2, 00:00:49,
         Serial0/0/0
O IA  192.168.1.0/24 [110/1295] via 192.168.10.2, 00:00:49,
      Serial0/0/0
O IA  192.168.2.0/24 [110/1295] via 192.168.10.2, 00:00:49,
      Serial0/0/0
      192.168.10.0/24 is variably subnetted, 3 subnets, 2
      masks
O        192.168.10.4/30 [110/1294] via 192.168.10.2,
         00:00:49, Serial0/0/0
```

Verify the R3 Routing Table Before Summarization

```
R3# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 3 subnets
O IA     10.1.1.0 [110/1295] via 192.168.10.5, 00:27:14, Serial0/0/1
O IA     10.1.2.0 [110/1295] via 192.168.10.5, 00:27:14, Serial0/0/1
O        10.2.1.0 [110/648] via 192.168.10.5, 00:27:57,  Serial0/0/1
      192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks
O        192.168.10.0/30 [110/1294] via 192.168.10.5, 00:27:57,
         Serial0/0/1
R3#
```

Cálculo de la ruta de resumen





Configuración del resumen de ruta Interárea

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

R1

```
R1# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 6 subnets, 3 masks
O        10.1.0.0/22 is a summary, 00:00:09, Null0
O        10.2.1.0/24 [110/648] via 192.168.10.2, 00:00:09,
Serial0/0/0
O IA  192.168.1.0/24 [110/1295] via 192.168.10.2, 00:00:09,
Serial0/0/0
O IA  192.168.2.0/24 [110/1295] via 192.168.10.2, 00:0
Serial0/0/0
      192.168.10.0/24 is variably subnetted, 3 subnets
masks
O        192.168.10.4/30 [110/1294] via 192.168.10.2,
00:00:09, Serial0/0/0
R1#
```

R3

```
R3# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
O IA     10.1.0.0/22 [110/1295] via 192.168.10.5, 00:00:06,
Serial0/0/1
O        10.2.1.0/24 [110/648] via 192.168.10.5, 00:29:23,
Serial0/0/1
      192.168.10.0/24 is variably subnetted, 3 subnets, 2
masks
O        192.168.10.0/30 [110/1294] via 192.168.10.5,
00:29:23, Serial0/0/1
R3#
```

Verificación multiárea de OSPF

Los mismos comandos para verificar OSPF de una sola área se utilizan para verificar multiárea OSPF:

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

Comandos específicos para información multiárea incluyen :

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

Nota: Para OSPFv3, sustituya IP por IPv6

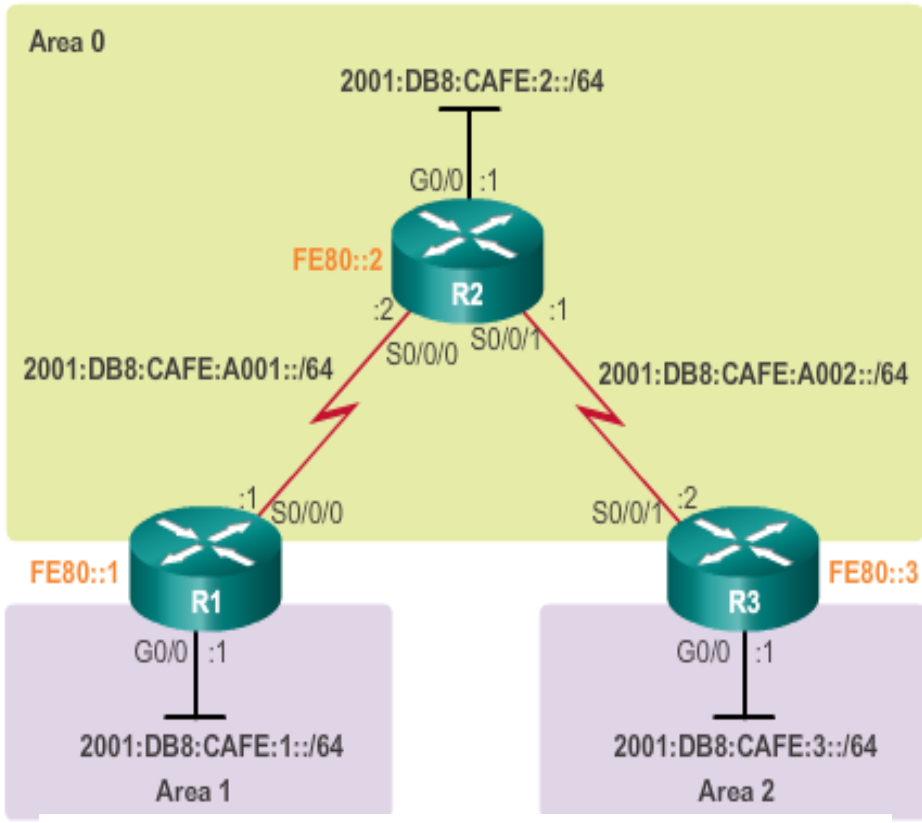
Verificación general de caracteristicas de multiárea OSPF

```
R1# show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospf 10"
  Outgoing update filter list for all interfaces is not
  Incoming update filter list for all interfaces is not
  Router ID 1.1.1.1
  It is an area border router
  Number of areas in this router is 2. 2 normal 0 stub 0
  Maximum path: 4
  Routing for Networks:
    10.1.1.1 0.0.0.0 area 1
    10.1.2.1 0.0.0.0 area 1
    192.168.10.1 0.0.0.0 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    3.3.3.3              110      02:20:36
    2.2.2.2              110      02:20:39
  Distance: (default is 110)

R1#
```

```
R1# show ip route ospf | begin Gateway
Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O       10.2.1.0/24 [110/648] via 192.168.10.2, 00:26:03,
                                                Serial0/0/0
O IA 192.168.1.0/24 [110/1295] via 192.168.10.2, 00:26:03,
                                                Serial0/0/0
O IA 192.168.2.0/24 [110/1295] via 192.168.10.2, 00:26:03,
                                                Serial0/0/0
     192.168.10.0/24 is variably subnetted,3 subnets,2 masks
O       192.168.10.4/30 [110/1294] via 192.168.10.2, 00:26:03,
                                                Serial0/0/0

R1#
```

```
R1# show ip ospf interface brief
Interface  PID   Area  IP Address/Mask   Cost  State Nbrs
Se0/0/0    10    0     192.168.10.1/30   64    P2P   1/1
Gi0/1      10    1     10.1.2.1/24       1     DR    0/0
Gi0/0      10    1     10.1.1.1/24       1     DR    0/0
R1#
```

Verificación multiárea OSPFv3




```
R1# show ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "ND"
IPv6 Routing Protocol is "ospf 10"
  Router ID 1.1.1.1
  Area border router
  Number of areas: 2 normal, 0 stub, 0 nssa
  Interfaces (Area 0):
    Serial0/0/0
  Interfaces (Area 1):
    GigabitEthernet0/0
  Redistribution:
    None
R1#
```

```
R1# show ipv6 route ospf
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static
route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D -
       EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE -
Destination
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF
       ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
O    2001:DB8:CAFE:2::/64 [110/648]
     via FE80::2, Serial0/0/0
OI   2001:DB8:CAFE:3::/64 [110/1295]
     via FE80::2, Serial0/0/0
O    2001:DB8:CAFE:A002::/64 [110/1294]
     via FE80::2, Serial0/0/0
R1#
```

```
R1# show ipv6 ospf interface brief
Interface    PID   Area            Intf ID    Cost  State Nbrs F/C
Se0/0/0      10    0               6          647   P2P   1/1
Gi0/0        10    1               3          1     DR    0/0
R1#
```

Resumen de Multiárea OSPF

- Es la mejor opción para redes más grandes que de una sola área.
- Resuelve problemas de la tablas grandes y de LSDB, y los cálculos frecuentes del algoritmo SPF.
- El área principal área backbone, o área 0.
- Los recálculos de la base de datos se mantienen dentro de un área.
- Cuatro diferentes tipos de routers OSPF:
- Router interno, Backbone, ABR, ASBR
- Un router se convierte en un ABR cuando tiene dos de sus redes en diferentes áreas

Resumen de Multiárea OSPF

- Los Anuncios de estado de enlace (LSA) son básicos de OSPF.
- LSA Tipo 1 las entradas de los enlaces del router.
- LSA Tipo 2 las entradas de los enlaces de red y se inundan por un DR.
- LSA Tipo 3 las entradas de los enlace de resumen que se crean y se propagan por el ABR.
- LSA resumen tipo 4 generados por un ABR sólo cuando existe un ASBR dentro de un área.
- LSA Tipo 5 externos rutas a redes fuera del SA OSPF, originados por el ASBR y se inundan a todo el sistema autónomo.
- Las Rutas OSPF en una tabla IPv4: O, O IA, O E1 o O E2.

Resumen de Multiárea 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**

- No realiza la autosummarization, pero se puede configurar de forma manual utilizando el comando **summary-address** *address mask*

Resumen de Multiárea OSPF

- **show ip ospf neighbor**
  - **show ip ospf**
  - **show ip ospf interface**
  - **show ip protocols**
  - **show ip ospf interface brief**
  - **show ip route ospf**
  - **show ip ospf database**

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