


Centrul pentru Dezvoltarea Carierei LINK Group Education Services

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LSA și arii speciale in OSPF

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OSPF – protocol Link-State

- Protoacoalele de rutare se împart în două categorii majore:
 - Interior Gateway Protocols
 - Distance vector
 - RIP, IGRP
 - Link-state
 - **OSPF**, IS-IS
 - Exterior Gateway Protocols
 - BGP
- Protocol Hybrid - EIGRP
- 

Avantajele protocolului OSPF

1. OSPF este un protocol **Open Standard**
2. Convergență **rapidă**
3. Update-urile sunt trimise doar atunci când există evenimente în rețea.
4. Oferă scalabilitate. Sumarizarea rutelor și utilizarea ariilor au ca rezultat ca memoria, CPU și bandwidth sunt folosite judicios
5. Asigură o segmentare logică a rețelilor prin folosirea ariilor.
6. Este un **protocol ierarhic** unde Area 0 este în fruntea ierarhiei. Este **obligatoriu** ca să existe Aria 0 și ea trebuie să fie continuă.
7. Suportă **Variable Length Subnet Mask (VLSM)** ceea ce duce la evitarea risipei adreselor IP în cadrul unei clase de adrese.

Dezavantaje OSPF

1. În procesul de convergență folosește mai multe resurse decât un protocol Distance Vector.
2. Din cauza complexității sale este mai dificil de configurat decât protocoalele Distance Vector care sunt mai puțin evaluate.

Tabele folosite de OSPF

Neighbor table

```
R1#sh ip ospf neighbor
Neighbor ID Pri State Dead Time Address Interface
2.2.2.2 1 FULL/DR 00:00:33 10.0.10.2 GigabitEthernet0/0
```

Topology table (Baza de date)

Ea se formează pe baza informațiilor primite prin LSA-uri

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
Router Link States (Area 0)
Link ID ADV Router Age Seq# Checksum Link count
172.16.10.1 172.16.10.1 694 0x80000003 0x00e7d7 2
2.2.2.2 2.2.2.2 411 0x80000005 0x003efd 2
1.1.1.1 1.1.1.1 14 0x80000007 0x007b24 2

Net Link States (Area 0)
Link ID ADV Router Age Seq# Checksum
10.0.10.2 2.2.2.2 411 0x80000001 0x00cac9
```

Primele două tipuri de LSA

Routing table

```
10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 10.0.10.0/24 is directly connected, GigabitEthernet0/0
L 10.0.10.1/32 is directly connected, GigabitEthernet0/0
172.16.0.0/32 is subnetted, 1 subnets
O 172.16.10.1/32 [110/2] via 10.0.10.2, 00:07:11, GigabitEthernet0/0
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.1.0/24 is directly connected, Loopback0
L 192.168.1.1/32 is directly connected, Loopback0
```

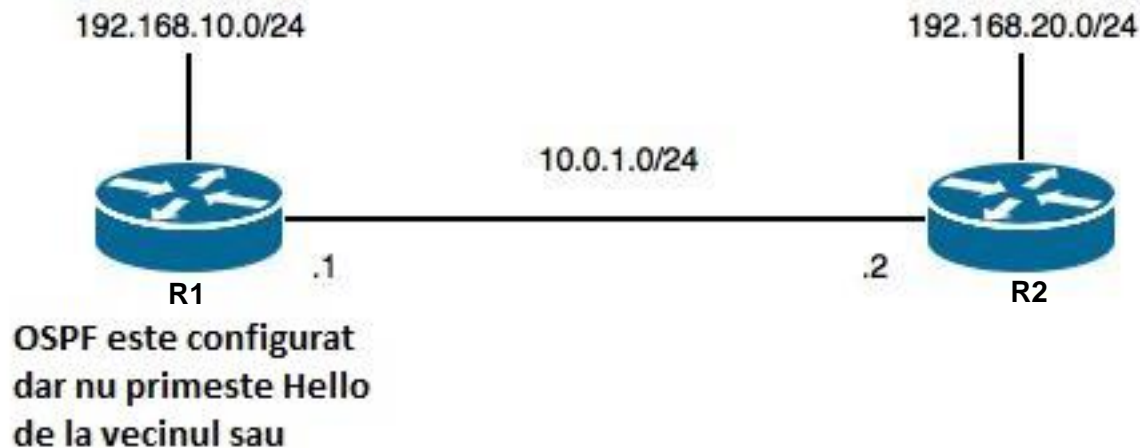
Rută învățată prin OSPF

Sincronizarea bazei de date

Stadii în formarea adiacenței a două routere

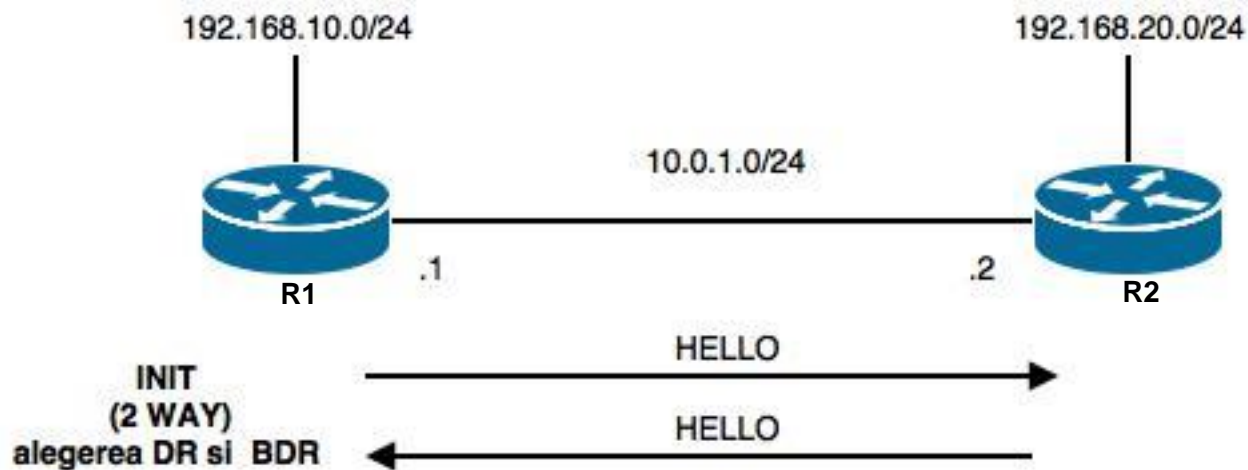
1. DOWN – stadiul în care un router trimite mesaje de Hello dar nu primește aceste mesaje de la vecinul sau.
2. INIT – un router primește un mesaj Hello în care își regăsește adresa IP.
3. 2WAY – routerele primesc mesaje HELLO compatibile și aleg DR, BDR și DROTHER
4. EXSTART – se stabilește relația Master-Slave
5. EXCHANGE – Schimbarea bazei de date între routere
6. LOADING – LSA Request, LSA Update și LSA Acknowledgment.
7. FULL – Se atinge convergența rețelei

Stadiul DOWN



Routerul R1 este configurat cu OSPF, interfața către R2 este up, însă nu primește mesaje de Hello de la R2.

Stadiul INIT/2WAY



```
01:39:57: OSPF: Rcv hello from 192.168.20.1 area 0 from GigabitEthernet0/0 10.0.1.2
```

```
01:39:57: OSPF: 2 Way Communication to 192.168.20.1 on GigabitEthernet0/0, state 2WAY
```

Ambele routere sunt configurate OSPF și trimit mesaje de Hello

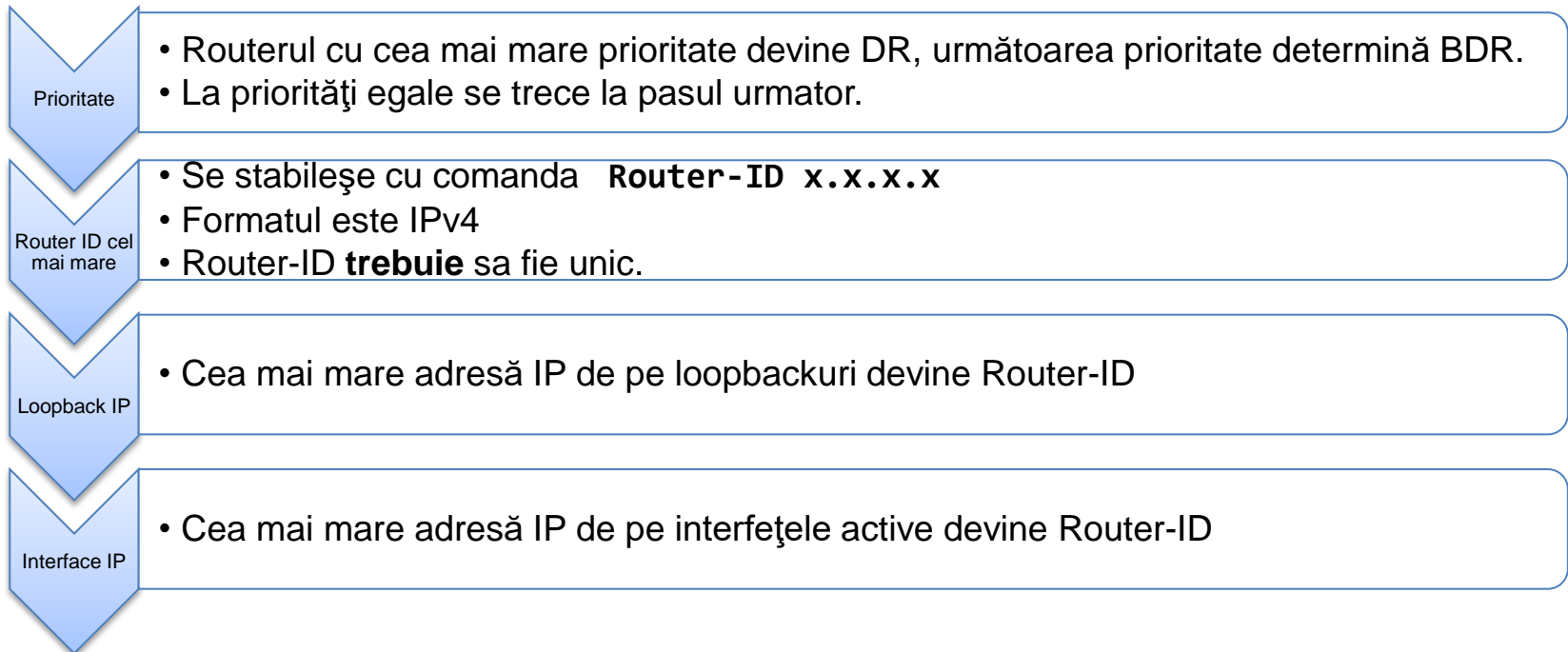
R1 primește mesaj Hello de la R2 ➡ **Init**

R2 primește mesaj de la R1 și își regăsește adresa IP ➡ **2WAY**

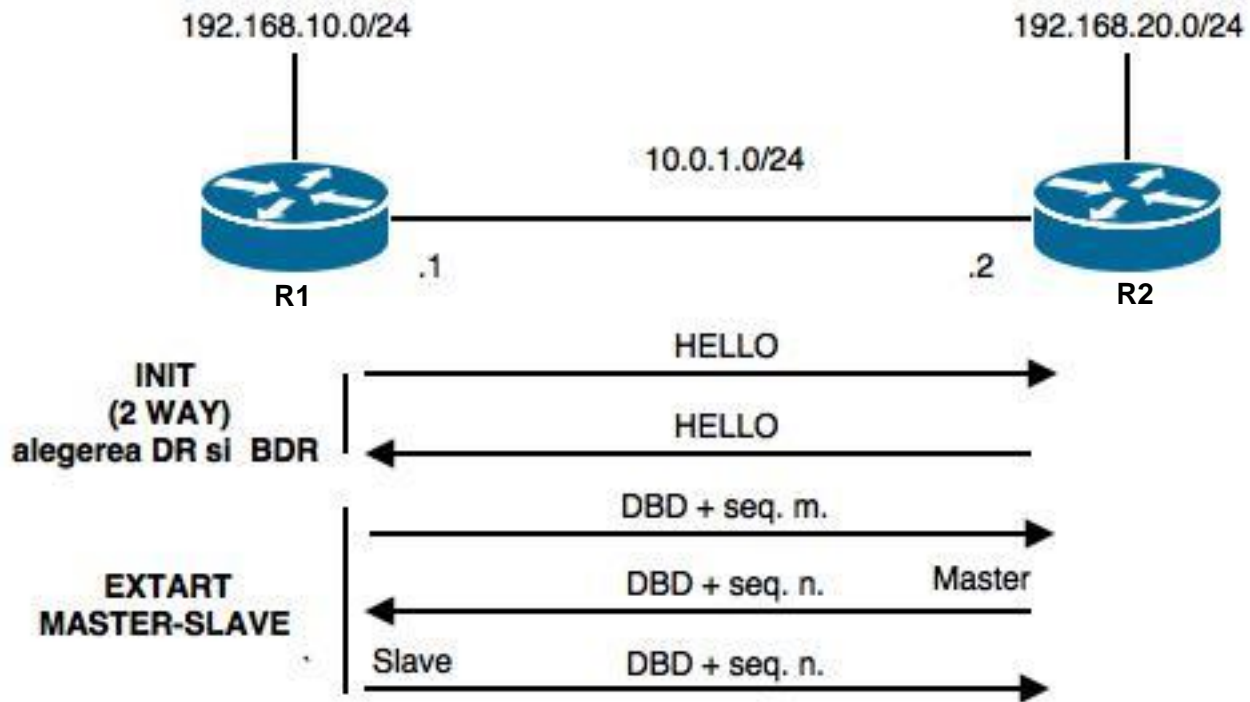
Alegerea DR, BDR si DROTHER

```
01:40:27: OSPF: DR/BDR election on GigabitEthernet0/0
01:40:27: OSPF: Elect BDR 192.168.20.1
01:40:27: OSPF: Elect DR 192.168.10.1
01:40:27: DR: 192.168.20.1 (Id) BDR: 192.168.10.1 (Id)
```

Această alegere se face pe orice link ce nu este point-to-point. Pe linkurile Point-to-point se trece la stadiul în care se stabilește o relație de tip Master-Slave.



Stadiul EXSTART

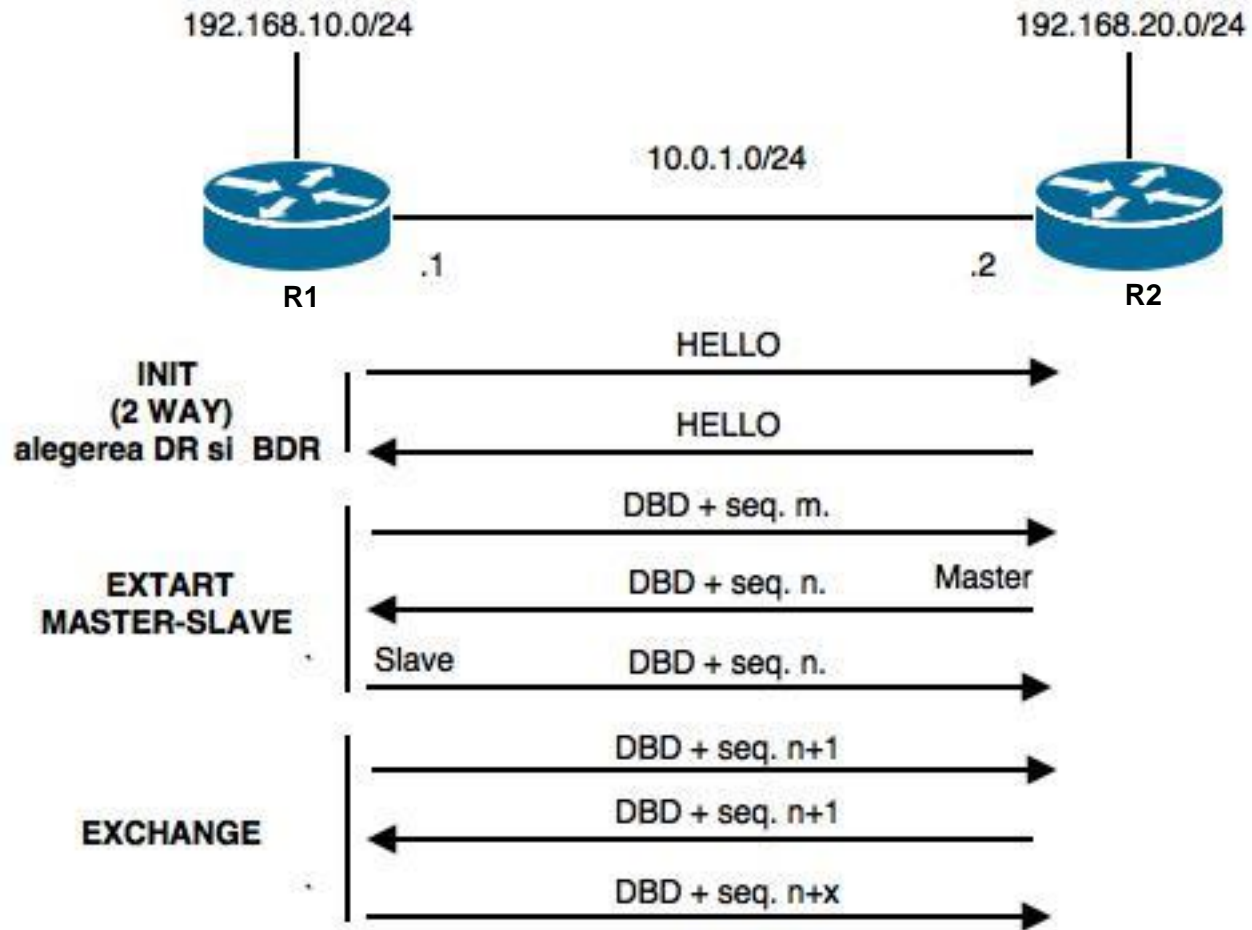


Stadiul EXSTART (cont.)

Dupa ce s-au ales DR și BDR se trece la stadiul 2: **EXTART**. În acest stadiu se stabilește între routere o relație de tip **MASTER – SLAVE**, în care se determină cine comunică primul și cine stabilește numărul secvenței. Acesta este folosit pentru a identifica ordinea mesajelor și a le ignora pe cele mai vechi (ce pot ajunge cu un delay la router).

```
01:40:32: OSPF: Retransmitting DBD to 192.168.20.1 on GigabitEthernet0/0 [1]
01:40:32: OSPF: Send DBD to 192.168.20.1 on GigabitEthernet0/0 seq 0x208a opt 0x00 flag 0x7 len 32
01:40:32: OSPF: Rcv DBD from 192.168.20.1 on GigabitEthernet0/0 seq 0x7548 opt 0x00 flag 0x7 len 32 mtu
1500 state EXSTART
01:40:32: OSPF: NBR Negotiation Done. We are the SLAVE
```

Stadiul EXCHANGE



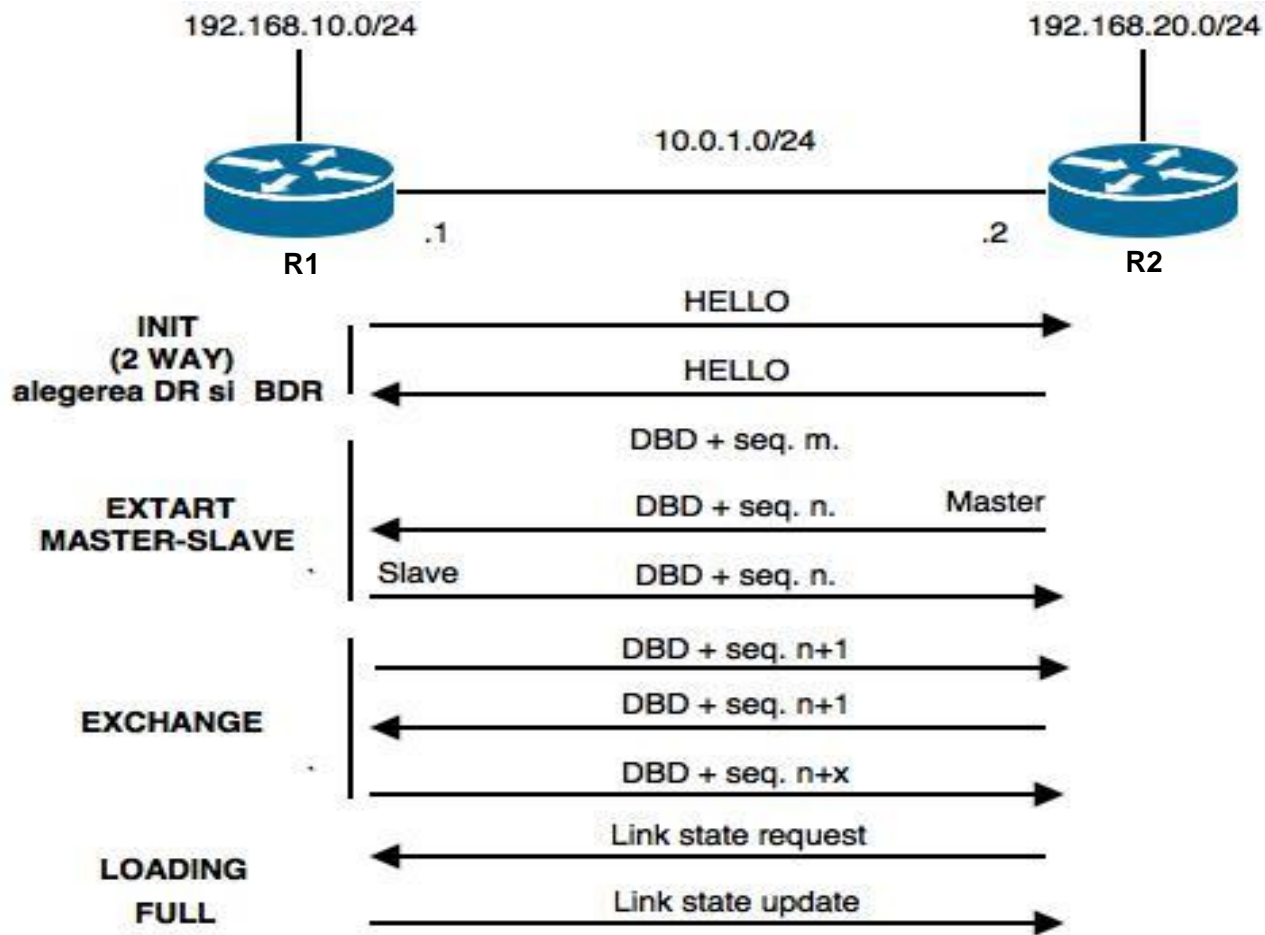
Stadiul EXCHANGE (cont.)

EXCHANGE este stadiul în care se transmite baza de date între routere până la momentul în care **toate** routerelor de pe segment au aceeași baza de date. Știm că în protocoalele Link-state toate routerelor trebuie să cunoască întreaga topologie a rețelei.

În baza de date trimisă se află informații sumare despre rute ca: adresa IP a rețelei anunțate, routerul care a făcut anunțul, când a fost făcut anunțul etc.

```
01:40:32: OSPF: Rcv DBD from 192.168.20.1 on GigabitEthernet0/0 seq 0x754a opt 0x00 flag 0x1 len
32 mtu 1500 state EXCHANGE
01:40:32: OSPF: Send DBD to 192.168.20.1 on GigabitEthernet0/0 seq 0x754a opt 0x00 flag 0x0 len
32
01:40:32: Exchange Done with 192.168.20.1 on GigabitEthernet0/0
01:40:32: OSPF: Database request to 192.168.20.1
```

Stadiile LOADING și FULL



Stadiile **LOADING** și **FULL** (cont.)

În momentul în care un router primește acest sumar el nu deține informații complete în tabela de topologie, trimite un LSR (link state request) pentru a obține mai multe date și primește LSA (link state advertisements) ca răspuns la cererea lui.

La aceste mesaje se trimit și LSAck (link state acknowledgment).

Acest stadiu se numește **LOADING**.

```
01:40:32: OSPF: sent LS REQ packet to 10.0.1.2, length 12
01:40:27: OSPF: Build router LSA for area 0, router ID 192.168.10.1, seq 0x80000008
```

Când baza de date se completează cu aceleași date pentru fiecare router se consideră că s-a ajuns la convergență iar routerele trec în stadiul de **FULL**.

```
01:40:32: Exchange Done with 192.168.20.1 on GigabitEthernet0/0
01:40:32: OSPF: Database request to 192.168.20.1
01:40:32: OSPF: sent LS REQ packet to 10.0.1.2, length 12
01:40:32: OSPF: Send DBD to 192.168.20.1 on GigabitEthernet0/0 seq 0x754a opt 0x00 flag 0x0 len 32
01:40:32: Synchronized with with 192.168.20.1 on GigabitEthernet0/0, state FULL
```

Situații în care nu se formează vecinătăți

1. Router ID nu este unic.
2. Interfețele de pe segment nu sunt în același subnet.
3. Area ID este diferit.
4. Hello și Dead Timer nu sunt identice pe routerele de pe segment.
5. Parola nu corespunde în autentificare

Output pentru Router-ID identic

```
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#network 10.0.1.0 0.0.0.255 area 0
R1(config-router)#end
```

```
R2(config)#router ospf 1
R2(config-router)#router-id 1.1.1.1
R2(config-router)#network 192.168.1.0 0.0.0.255 area 0
R2(config-router)#network 10.0.1.0 0.0.0.255 area 0
R2(config-router)#end
```

```
00:29:46: OSPF: Rcv DBD from 1.1.1.1 on GigabitEthernet0/0 seq 0x42bb opt 0x00 flag 0x7 len 32 mtu 1500 state INIT
00:29:46: OSPF: Send DBD to 1.1.1.1 on GigabitEthernet0/0 seq 0x3777 opt 0x00 flag 0x7 len 32
00:29:46: OSPF: First DBD and we are not SLAVE
00:29:51: OSPF: Retransmitting DBD to 1.1.1.1 on GigabitEthernet0/0 [1]
00:29:51: OSPF: Send DBD to 1.1.1.1 on GigabitEthernet0/0 seq 0x3777 opt 0x00 flag 0x7 len 32
00:29:51: OSPF: Rcv DBD from 1.1.1.1 on GigabitEthernet0/0 seq 0x42bb opt 0x00 flag 0x7 len 32 mtu 1500 state EXSTART
00:29:51: OSPF: First DBD and we are not SLAVE
00:29:56: OSPF: Rcv hello from 1.1.1.1 area 0 from GigabitEthernet0/0 10.0.1.2
00:29:56: OSPF: End of hello processing
00:29:56: OSPF: Retransmitting DBD to 1.1.1.1 on GigabitEthernet0/0 [2]
00:29:56: OSPF: Send DBD to 1.1.1.1 on GigabitEthernet0/0 seq 0x3777 opt 0x00 flag 0x7 len 32
00:29:56: OSPF: Rcv DBD from 1.1.1.1 on GigabitEthernet0/0 seq 0x42bb opt 0x00 flag 0x7 len 32 mtu 1500 state EXSTART
00:29:56: OSPF: First DBD and we are not SLAVE
00:30:01: OSPF: Retransmitting DBD to 1.1.1.1 on GigabitEthernet0/0 [3]
00:30:01: OSPF: Send DBD to 1.1.1.1 on GigabitEthernet0/0 seq 0x3777 opt 0x00 flag 0x7 len 32
00:30:01: OSPF: Rcv DBD from 1.1.1.1 on GigabitEthernet0/0 seq 0x42bb opt 0x00 flag 0x7 len 32 mtu 1500 state EXSTART
00:30:01: OSPF: First DBD and we are not SLAVE
00:30:06: OSPF: Rcv hello from 1.1.1.1 area 0 from GigabitEthernet0/0 10.0.1.2
00:30:06: OSPF: End of hello processing
00:30:06: OSPF: Retransmitting DBD to 1.1.1.1 on GigabitEthernet0/0 [4]
00:30:06: OSPF: Send DBD to 1.1.1.1 on GigabitEthernet0/0 seq 0x3777 opt 0x00 flag 0x7 len 32
00:30:06: OSPF: Rcv DBD from 1.1.1.1 on GigabitEthernet0/0 seq 0x42bb opt 0x00 flag 0x7 len 32 mtu 1500 state EXSTART
```

Output pentru Area mismatch

```
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1
R1(config-router)#network 192.168.10.0 0.0.0.255 area 0
R1(config-router)#network 10.0.1.0 0.0.0.255 area 0
R1(config-router)#end
```

```
R2(config)#router ospf 1
R2(config-router)#router-id 2.2.2.2
R2(config-router)#network 192.168.20.0 0.0.0.255 area 0
R2(config-router)#network 10.0.1.0 0.0.0.255 area 1
R2(config-router)#end
```

```
02:31:13: %OSPF-4-ERRRCV: Received invalid packet: mismatch area ID, from backbone area must be virtual-link but not found
from 10.0.1.2, GigabitEthernet0/0
```

Timers mismatch

- R1#
- 01:34:26: OSPF: Rcv hello from 2.2.2.2 area 0 from GigabitEthernet0/0 10.0.1.2
- 01:34:26: **OSPF: Mismatched hello parameters from 10.0.1.2**
- 01:34:26: OSPF: Dead R 40 C 40 **Hello R 20 C 10** Mask R 255.255.255.0 C 255.255.255.0

- R1#
- 01:34:36: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Dead timer expired
- 01:34:36: OSPF: Neighbor change Event on interface GigabitEthernet0/0
- 01:34:36: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
- 01:34:36: OSPF: Build router LSA for area 0, router ID 1.1.1.1, seq 0x80000005
- 01:34:36: OSPF: DR/BDR election on GigabitEthernet0/0
- 01:34:36: OSPF: Elect BDR 1.1.1.1
- 01:34:36: OSPF: Elect DR 1.1.1.1
- 01:34:36: DR: 1.1.1.1 (Id) BDR: 1.1.1.1 (Id)
- 01:34:36: OSPF: Build router LSA for area 0, router ID 1.1.1.1, seq 0x80000006
- 01:34:36: OSPF: **No full nbrs to build Net Lsa for interface GigabitEthernet0/0**

Comenzi SHOW – utile în troubleshooting

Show ip interface brief	Arata IP-ul si statusul interfetelor. Daca sunt up-up este bine
Show ip route	Arata tabela de rutare
Show ip ospf interfaces	Arata statusul interfetelor OSPF enabled
Show ip protocols	Arata Router-ID, networkurile rutate, gateway si distanta administrativa
Show ip ospf neighbors	Arata vecinii, statusul lor, adresa IP
Show ip ospf border-routers	Arata ce routere sunt ABR si/sau ASBR
Show ip ospf database [router network summary asbr-summary external]	Afiseaza baza de date [și date detaliate pentru fiecare tip de LSA]

Tabela de rutare – OSPF single area

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

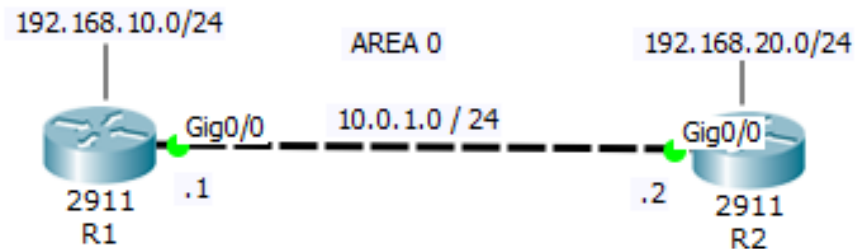
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, 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

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

C 10.0.1.0/24 is directly connected, GigabitEthernet0/0

L 10.0.1.1/32 is directly connected, GigabitEthernet0/0

192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.10.0/24 is directly connected, Loopback0

L 192.168.10.1/32 is directly connected, Loopback0

192.168.20.0/32 is subnetted, 1 subnets

O 192.168.20.1/32 [110/2] via 10.0.1.2, 00:00:08, GigabitEthernet0/0

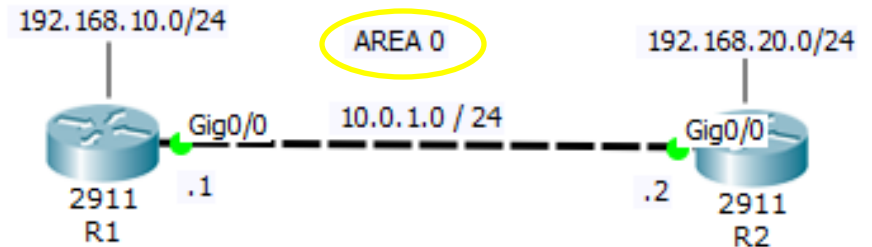
Ruta invatata prin OSPF



Baza de date

```
R1#show ip ospf database
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```



LSA tip 1

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	1150	0x80000011	0x005e40	2
2.2.2.2	2.2.2.2	1151	0x8000001c	0x001f60	2

LSA tip 2

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
10.0.1.2	2.2.2.2	1151	0x80000007	0x008aa1

LSA Type-1

```
R1#sh ip ospf database router
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Router Link States (Area 0)
```

```
LS age: 477  
Options: (No TOS-capability, DC)  
LS Type: Router Links  
Link State ID: 1.1.1.1  
Advertising Router: 1.1.1.1  
LS Seq Number: 80000008  
Checksum: 0x1c8b  
Length: 48  
Number of Links: 2
```

```
Link connected to: a Stub Network  
(Link ID) Network/subnet number: 192.168.10.1  
(Link Data) Network Mask: 255.255.255.255  
Number of TOS metrics: 0  
TOS 0 Metrics: 1
```

```
Link connected to: a Transit Network  
(Link ID) Designated Router address: 10.0.1.2  
(Link Data) Router Interface address: 10.0.1.1  
Number of TOS metrics: 0  
TOS 0 Metrics: 1
```

```
LS age: 477  
Options: (No TOS-capability, DC)  
LS Type: Router Links  
Link State ID: 2.2.2.2  
Advertising Router: 2.2.2.2  
LS Seq Number: 80000004  
Checksum: 0x4bdb  
Length: 36  
Area Border Router  
Number of Links: 1
```

```
Link connected to: a Transit Network  
(Link ID) Designated Router address: 10.0.1.2  
(Link Data) Router Interface address: 10.0.1.2  
Number of TOS metrics: 0  
TOS 0 Metrics: 1
```

LSA Type-2

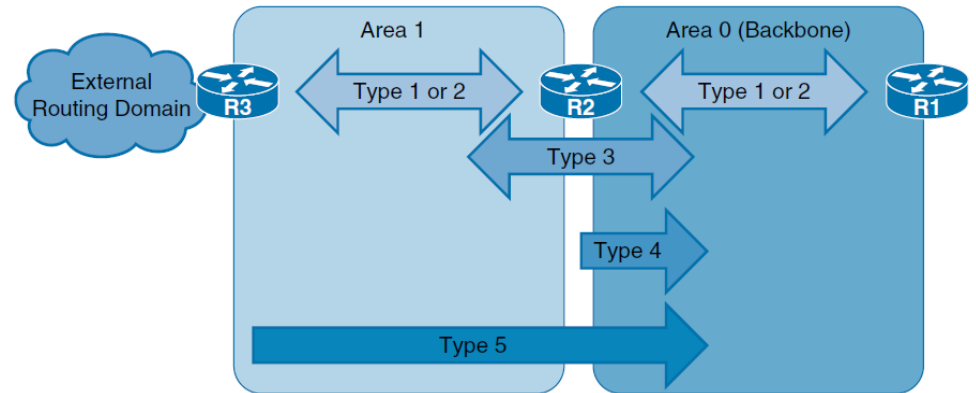
```
R1#sh ip ospf database network
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Net Link States (Area 0)
```

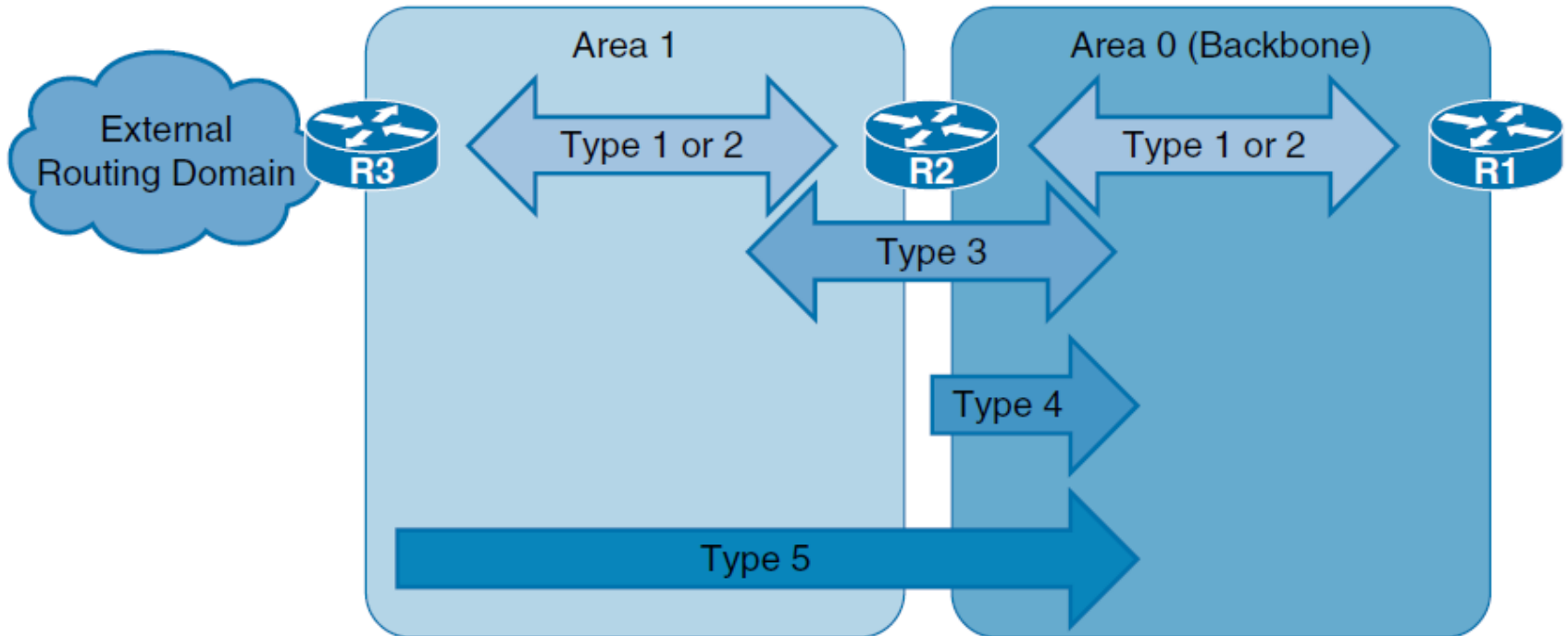
```
Routing Bit Set on this LSA  
LS age: 1628  
Options: (No TOS-capability, DC)  
LS Type: Network Links  
Link State ID: 10.0.1.2 (address of Designated Router)  
Advertising Router: 2.2.2.2  
LS Seq Number: 80000002  
Checksum: 0x4a0d  
Length: 32  
Network Mask: /24  
Attached Router: 1.1.1.1  
Attached Router: 2.2.2.2
```

Tipurile de LSA



Tip LSA	Denumirea LSA	Descriere	Tip	Cine originează LSA
1	Router LSA	Routerul include în LSA informații despre starea linkurilor, Router-ID, cost etc.	Intra-area	Fiecare router
2	Network LSA	Descrie toate rutele atașate pe un segment	Intra-area	DR
3				
4				
5				
7				

Tipuri de LSA

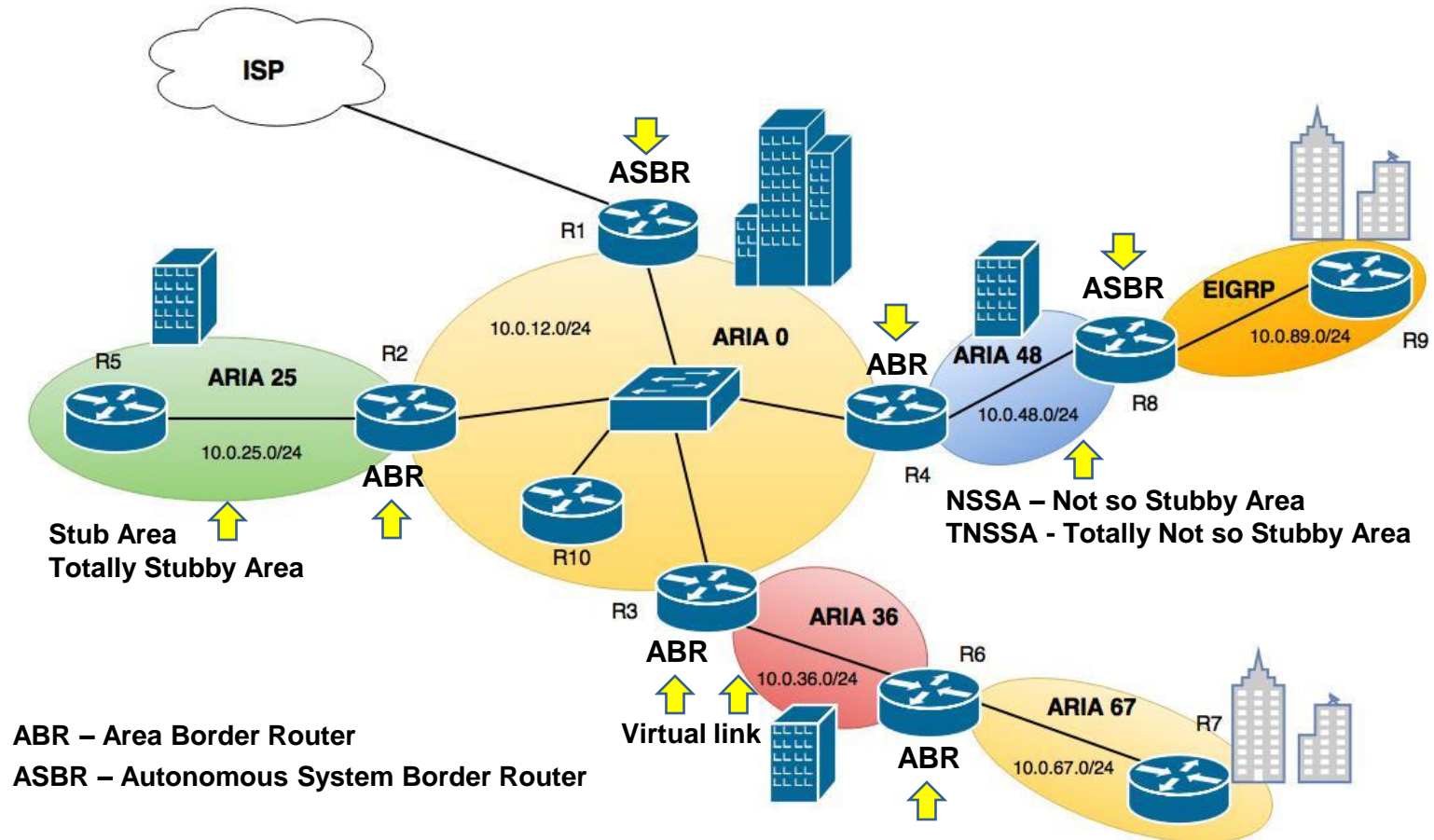


Sursa: Cisco

Importanța implementării unei topologii multiarea

- Ierarhizare logică a rețelei.
- Limitarea utilizării excesive a lățimii de bandă în procesul de sincronizare a bazei de date
- Micșorarea mărimii tabelelor de rutare, ceea ce duce la o utilizare redusă a CPU.
- Sumarizarea și filtrarea rutelor nu se poate face decât între arii, deoarece OSPF cere ca toate routerele să aibă aceeași bază de date.

Topologie OSPF multiarea și arii speciale

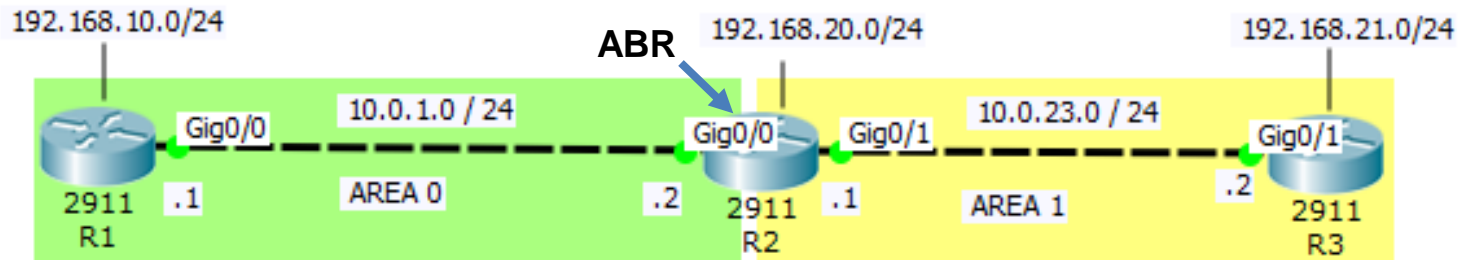


! Un router poate fi in acelasi timp si ABR si ASBR

Tipuri de routere

- **ABR** –routere care au cel puțin două interfețe conectate în arii diferite.
- **ASBR** –routere ce conectează cel puțin două sisteme autonome
- **Intra-area router** – router ce are toate interfețele conectate într-o singură arie.
- **Backbone router** – router are cel puțin o interfață în aria 0.

Tabela de rutare – OSPF multiarea



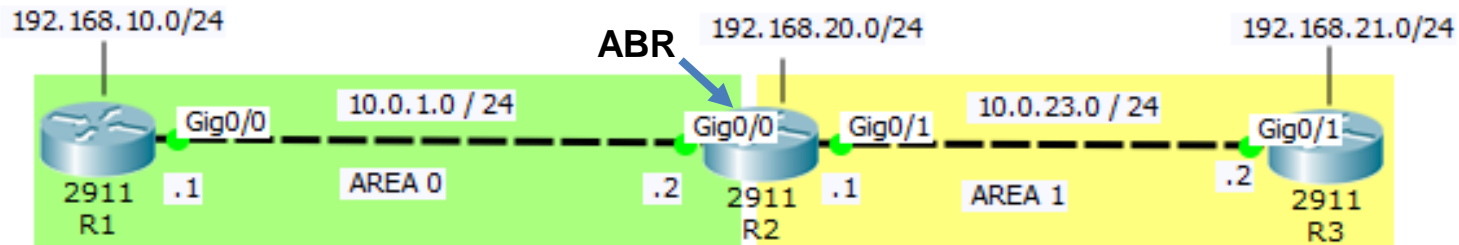
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
 i - IS-IS, L1 - IS-IS level-1, L2 - 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

```

10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C    10.0.1.0/24 is directly connected, GigabitEthernet0/0
L    10.0.1.1/32 is directly connected, GigabitEthernet0/0
O IA 10.0.23.0/24 [110/2] via 10.0.1.2, 00:26:55, GigabitEthernet0/0
192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.10.0/24 is directly connected, Loopback0
L    192.168.10.1/32 is directly connected, Loopback0
192.168.20.0/32 is subnetted, 1 subnets
O IA 192.168.20.1/32 [110/2] via 10.0.1.2, 00:26:55, GigabitEthernet0/0
192.168.21.0/32 is subnetted, 1 subnets
O IA 192.168.21.1/32 [110/3] via 10.0.1.2, 00:26:45, GigabitEthernet0/0
  
```

Baza de date OSPF multiarea



```
R1#show ip ospf database
      OSPF Router with ID (1.1.1.1) (Process ID 1)
```

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	1071	0x80000007	0x001e8a	2
2.2.2.2	2.2.2.2	1071	0x80000007	0x0045de	1

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
10.0.1.2	2.2.2.2	1071	0x80000005	0x00d64e

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.20.1	2.2.2.2	1066	0x8000000d	0x00a625
10.0.23.0	2.2.2.2	1066	0x8000000e	0x00bc6b
192.168.21.1	2.2.2.2	1062	0x8000000f	0x00a126

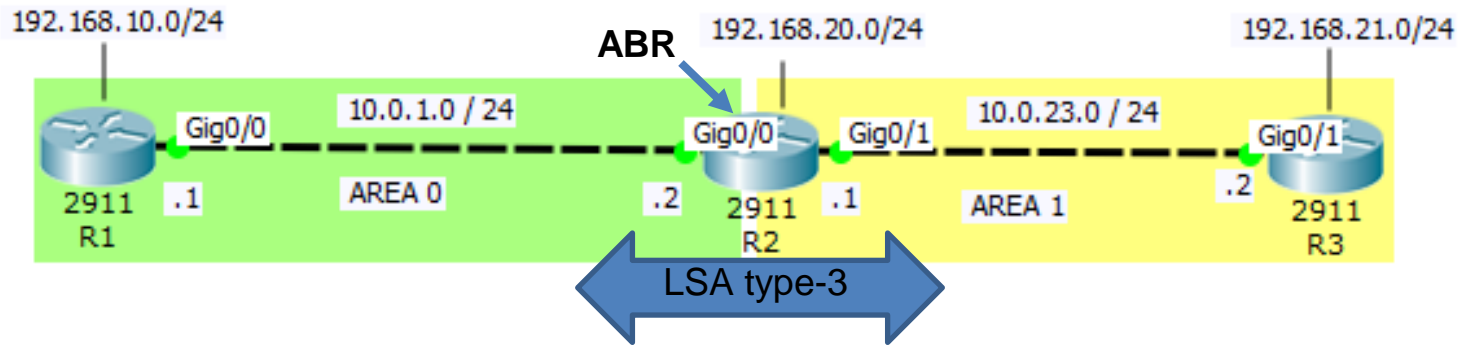
← LSA tip 3

```
R1#show ip ospf border-routers
      OSPF Process 1 internal Routing Table
```

Codes: i - Intra-area route, I - Inter-area route

```
i 2.2.2.2 [1] via 10.0.1.2, GigabitEthernet0/0, ABR, Area 0, SPF 1
```

LSA type-3 Summary LSA



Routerul R2 devine ABR și începe să trimită inter-area LSA de tip 3. Acestea se numesc **Summary LSA**

ABR descrie și sumarizeaza rutele învățate într-o arie și le retransmite în celelalte arii.

LSA Type - 3

```
R1#sh ip ospf database summary
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Summary Net Link States (Area 0)
```

```
LS age: 1033
```

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

```
LS Type: Summary Links(Network)
```

```
Link State ID: 192.168.20.1 (summary Network Number)
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000003
```

```
Checksum: 0xba1b
```

```
Length: 28
```

```
Network Mask: /32
```

```
TOS: 0 Metric: 1
```

```
LS age: 1033
```

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

```
LS Type: Summary Links(Network)
```

```
Link State ID: 10.0.23.0 (summary Network Number)
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000004
```

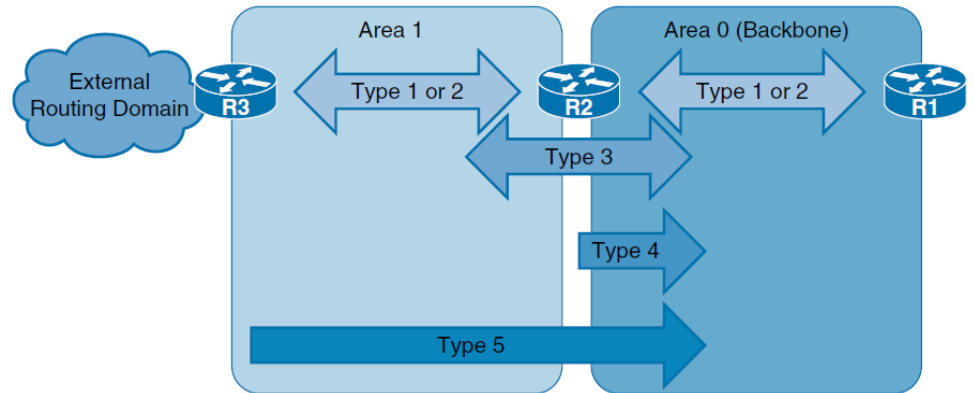
```
Checksum: 0xd061
```

```
Length: 28
```

```
Network Mask: /24
```

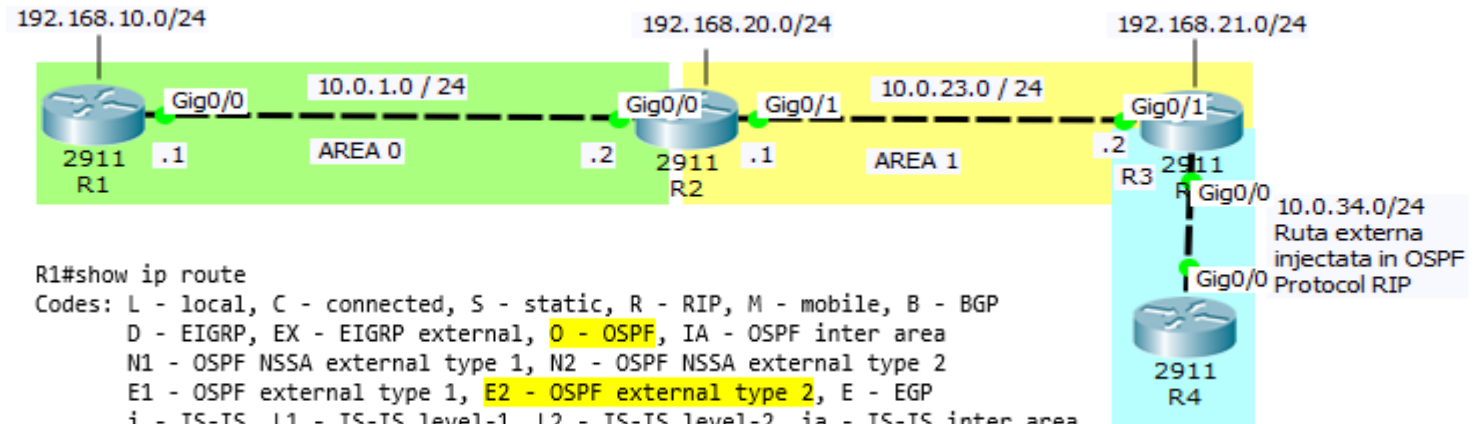
```
TOS: 0 Metric: 1
```


Tipurile de LSA



Tip LSA	Denumirea LSA	Descriere	Tip	Cine originează LSA
1	Router LSA	Routerul include în LSA informații despre starea linkurilor, Router-ID, cost etc.	Intra-area	Fiecare router
2	Network LSA	Describe toate rutele atașate pe un segment	Intra-area	DR
3	Summary LSA	Describe și sumarizează rutele învățate într-o arie și le retransmite în celelalte arii	Inter-area	ABR
4				
5				
7				

Tabela de rutare – rute externe



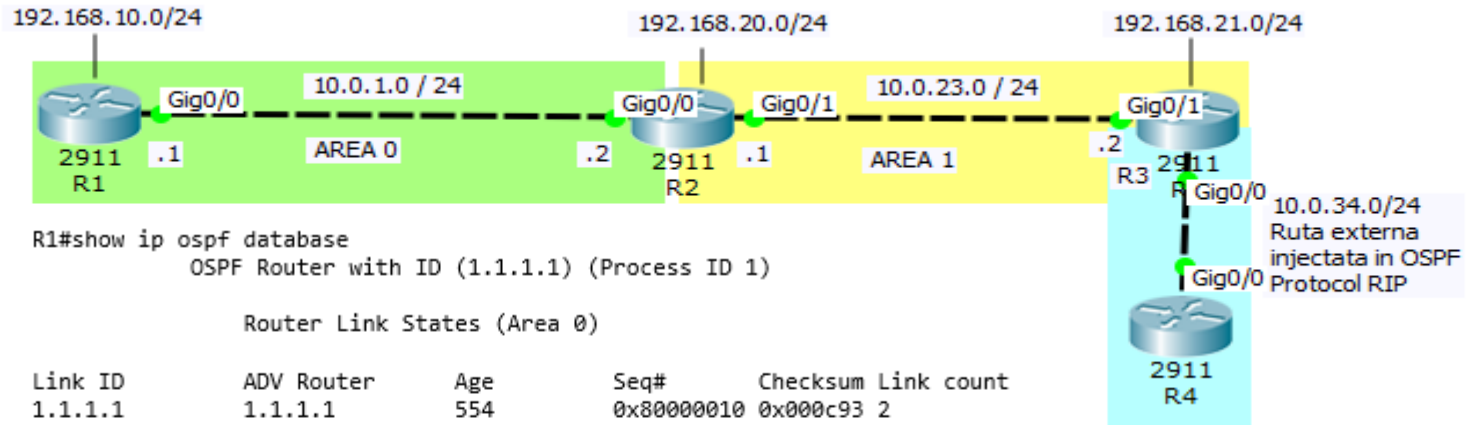
```
R1#show ip route
```

```
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

```
10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks|
C    10.0.1.0/24 is directly connected, GigabitEthernet0/0
L    10.0.1.1/32 is directly connected, GigabitEthernet0/0
O IA  10.0.23.0/24 [110/2] via 10.0.1.2, 00:08:52, GigabitEthernet0/0
O E2  10.0.34.0/24 [110/5] via 10.0.1.2, 00:00:42, GigabitEthernet0/0
192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.10.0/24 is directly connected, Loopback0
L    192.168.10.1/32 is directly connected, Loopback0
192.168.20.0/32 is subnetted, 1 subnets
O IA  192.168.20.1/32 [110/2] via 10.0.1.2, 00:08:52, GigabitEthernet0/0
192.168.21.0/32 is subnetted, 1 subnets
O IA  192.168.21.1/32 [110/3] via 10.0.1.2, 00:06:37, GigabitEthernet0/0
```

Baza de date OSPF – rute externe



```
R1#show ip ospf database
      OSPF Router with ID (1.1.1.1) (Process ID 1)
```

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	554	0x80000010	0x000c93	2
2.2.2.2	2.2.2.2	554	0x8000000f	0x0035e6	1

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
10.0.1.2	2.2.2.2	554	0x8000000a	0x003a15

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.20.1	2.2.2.2	1079	0x8000001a	0x008c32
10.0.23.0	2.2.2.2	1079	0x8000001b	0x00a278
192.168.21.1	2.2.2.2	409	0x80000020	0x007f37

Summary ASB Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
3.3.3.3	2.2.2.2	409	0x8000001f	0x0082a8

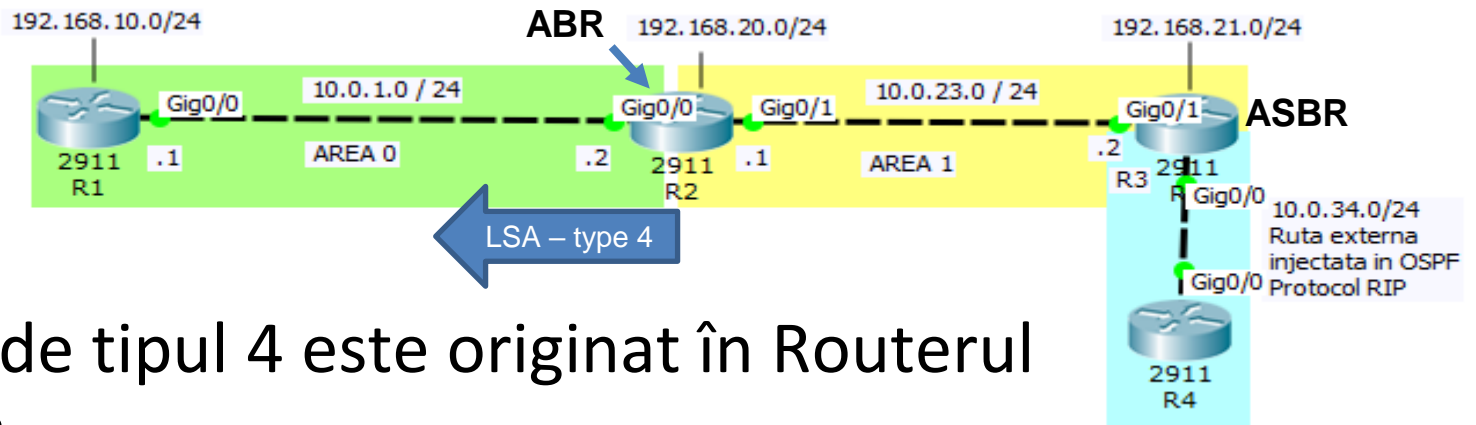
← LSA tip 4

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
10.0.34.0	3.3.3.3	56	0x80000001	0x00deb8	0

← LSA tip 5

LSA type-4 ASBR Summary LSA



1. LSA de tipul 4 este originat în Routerul ABR.
2. Scopul emiterii acestui mesaj este de a indica celorlalte routere din domeniul OSPF cum să ajungă la ASBR.
3. LSA de tipul 4 include router-id-ul ASBR

LSA type-4

```
R2#sh ip ospf database asbr-summary
```

```
OSPF Router with ID (2.2.2.2) (Process ID 1)
```

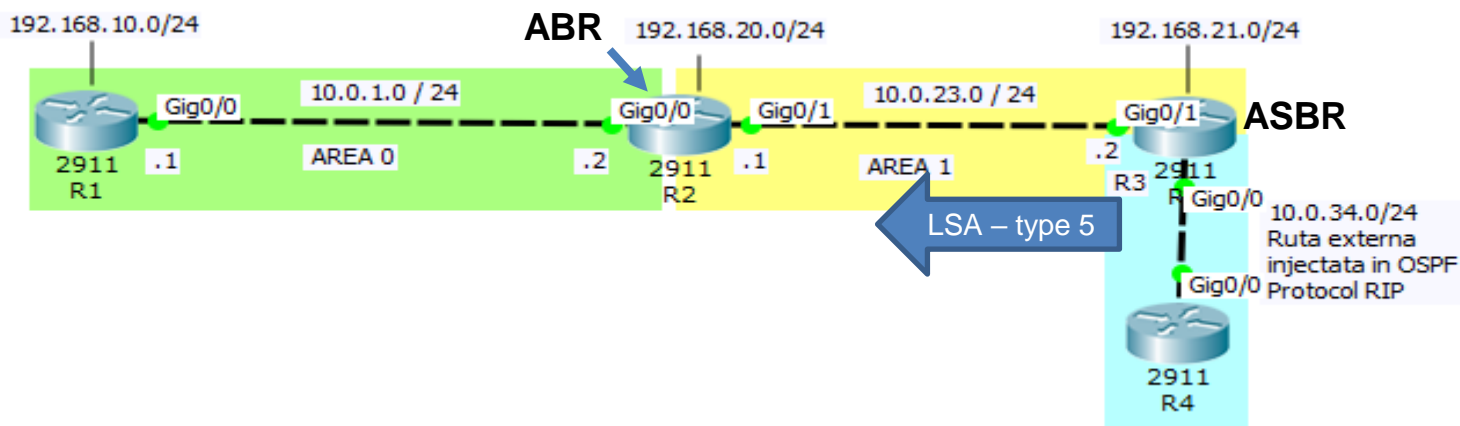
```
Summary ASB Link States (Area 0)
```

```
LS age: 216  
Options: (No TOS-capability, DC, Upward)  
LS Type: Summary Links(AS Boundary Router)  
Link State ID: 3.3.3.3 (AS Boundary Router address)  
Advertising Router: 2.2.2.2  
LS Seq Number: 8000000f  
Checksum: 0xa298  
Length: 28  
Network Mask: /0  
TOS: 0 Metric: 1
```

```
Summary ASB Link States (Area 1)
```

```
LS age: 231  
Options: (No TOS-capability, DC, Upward)  
LS Type: Summary Links(AS Boundary Router)  
Link State ID: 3.3.3.3 (AS Boundary Router address)  
Advertising Router: 2.2.2.2  
LS Seq Number: 8000000e  
Checksum: 0x9aa2  
Length: 28  
Network Mask: /0  
TOS: 0 Metric: 0
```

LSA type-5 Autonomous System LSA



1. LSA de tipul 5 este originat în Routerul ASBR.
2. Face publice rutele externe injectate în domeniul OSPF de alte protocoale.
3. LSA de tipul 5 include router-id-ul ASBR și rutele externe

LSA type-5

```
R1#sh ip ospf database external
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

Type-5 AS External Link States

```
Routing Bit Set on this LSA
```

```
LS age: 822
```

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

```
LS Type: AS External Link
```

```
Link State ID: 10.0.34.0 (External Network Number )
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000006
```

```
Checksum: 0xf2a3
```

```
Length: 36
```

```
Network Mask: /24
```

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

```
TOS: 0
```

```
Metric: 5
```

```
Forward Address: 0.0.0.0
```

```
External Route Tag: 0
```

```
Routing Bit Set on this LSA
```

```
LS age: 812
```

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

```
LS Type: AS External Link
```

```
Link State ID: 10.0.34.0 (External Network Number )
```

```
Advertising Router: 3.3.3.3
```

```
LS Seq Number: 80000003
```

```
Checksum: 0xdaba
```

```
Length: 36
```

```
Network Mask: /24
```

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

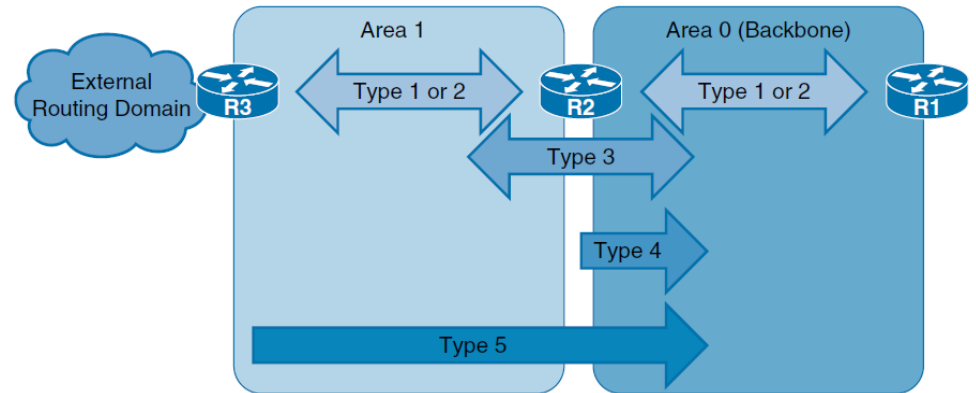
```
TOS: 0
```

```
Metric: 5
```

```
Forward Address: 0.0.0.0
```

```
External Route Tag: 0
```

Tipurile de LSA



Tip LSA	Denumirea LSA	Descriere	Tip	Cine originează LSA
1	Router LSA	Routerul include în LSA informații despre starea linkurilor, Router-ID, cost etc.	Intra-area	Fiecare router
2	Network LSA	Descrie toate rutele atașate pe un segment	Intra-area	DR
3	Summary LSA	Descrie și sumarizează rutele învățate într-o arie și le retransmite în celelalte arii	Inter-area	ABR
4	ASBR Summary LSA	Indică celorlalte routere din domeniul OSPF cum să ajungă la ASBR.	Inter-area	ABR
5	Autonomous System LSA	Publică rutele externe injectate în domeniul OSPF de alte protocoale	Inter-area	ASBR
7				

Aree speciali in OSPF

- Stub areas
- Totally stubby areas
- Not-so-stubby areas (NSSA)
- Totally not-so-stubby areas (Totally NSSA)
- Virtual link

Configurare Arii Stub

- Configurare stub

```
R5(config)#router ospf 1  
R5(config-router)#area 51 stub  
R5(config-router)#exit
```

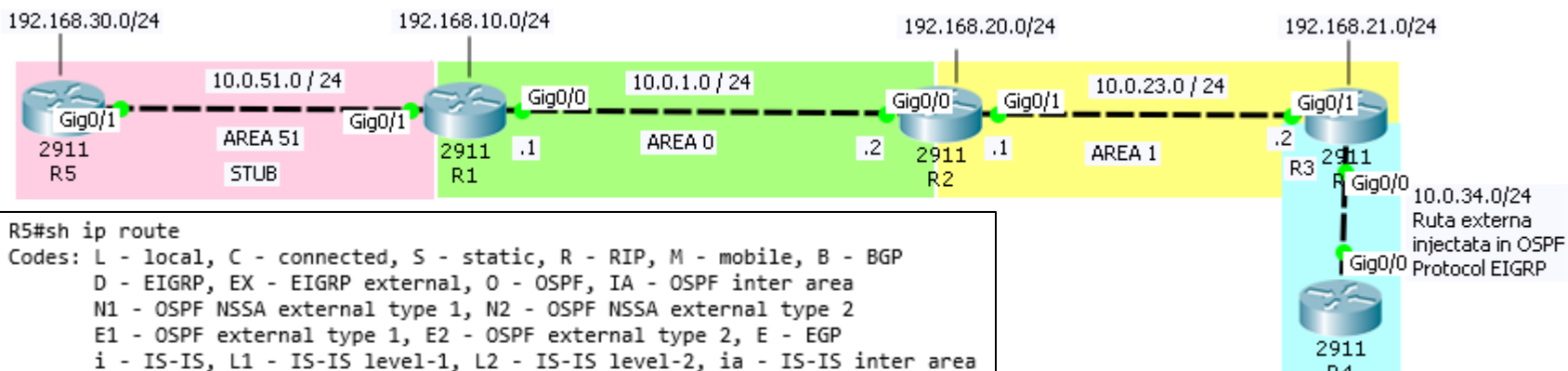
```
R1(config)#router ospf 1  
R1(config-router)#area 51 stub  
R1(config-router)#exit
```

- Configurare Totally stub

```
R5(config)#router ospf 1  
R5(config-router)#area 51 stub  
R5(config-router)#exit
```

```
R1(config)#router ospf 1  
R1(config-router)#area 51 stub no-summary  
R1(config-router)#exit
```

Tabela de rutare - Arii Stub



```
R5#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
P - periodic downloaded static route
```

```
Gateway of last resort is not set
  10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O IA  10.0.1.0/24 [110/2] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
O IA  10.0.23.0/24 [110/3] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
O E2  10.0.34.0/24 [110/20] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
C     10.0.51.0/24 is directly connected, GigabitEthernet0/1
L     10.0.51.1/32 is directly connected, GigabitEthernet0/1
  192.168.10.0/32 is subnetted, 1 subnets
O IA  192.168.10.1/32 [110/2] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
  192.168.20.0/32 is subnetted, 1 subnets
O IA  192.168.20.1/32 [110/3] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
  192.168.21.0/32 is subnetted, 1 subnets
O IA  192.168.21.1/32 [110/4] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
  192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.30.0/24 is directly connected, Loopback0
L     192.168.30.1/32 is directly connected, Loopback0
O E2  192.168.40.0/24 [110/20] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
```

Rutele externe marcate O E2 au disparut

```
R5#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 10.0.51.2 to network 0.0.0.0
  10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA  10.0.1.0/24 [110/2] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
O IA  10.0.23.0/24 [110/3] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
C     10.0.51.0/24 is directly connected, GigabitEthernet0/1
L     10.0.51.1/32 is directly connected, GigabitEthernet0/1
  192.168.10.0/32 is subnetted, 1 subnets
O IA  192.168.10.1/32 [110/2] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
  192.168.20.0/32 is subnetted, 1 subnets
O IA  192.168.20.1/32 [110/3] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
  192.168.21.0/32 is subnetted, 1 subnets
O IA  192.168.21.1/32 [110/4] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
  192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.30.0/24 is directly connected, Loopback0
L     192.168.30.1/32 is directly connected, Loopback0
O*IA 0.0.0.0/0 [110/2] via 10.0.51.2, 00:00:34, GigabitEthernet0/1
```

Dupa Stub

LSDB Stub Area

```
R5#sh ip ospf database
      OSPF Router with ID (5.5.5.5) (Process ID 1)

Inainte de Stub
Router Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum Link count
1.1.1.1      1.1.1.1     22         0x80000008  0x00d5f1  1
5.5.5.5      5.5.5.5     22         0x80000005  0x00947e  2

Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
10.0.51.1    5.5.5.5     22         0x80000002  0x0038d5

Summary Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
10.0.1.0     1.1.1.1     56         0x80000001  0x00e767
192.168.10.1 1.1.1.1     56         0x80000002  0x00499b
10.0.23.0    1.1.1.1     56         0x80000003  0x00
192.168.20.1 1.1.1.1     56         0x80000004  0x00
192.168.21.1 1.1.1.1     56         0x80000005  0x00

Summary ASB Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Chec
3.3.3.3      1.1.1.1     41         0x80000006  0x00

Type-5 AS External Link States
Link ID      ADV Router   Age         Seq#         Chec
10.0.34.0    3.3.3.3     200        0x80000001  0x00
192.168.40.0 3.3.3.3     199        0x80000001  0x00
```

Singura referinta in LSDB este catre routerul 1.1.1.1



```
R5#sh ip ospf database
      OSPF Router with ID (5.5.5.5) (Process ID 1)

Dupa Stub
Router Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum Link count
5.5.5.5      5.5.5.5     51         0x8000000f  0x008088  2
1.1.1.1      1.1.1.1     51         0x80000012  0x00c1fb  1

Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
10.0.51.1    5.5.5.5     310        0x80000004  0x006912

Summary Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
10.0.1.0     1.1.1.1     823        0x80000001  0x00e767
192.168.10.1 1.1.1.1     823        0x80000002  0x00499b
10.0.23.0    1.1.1.1     823        0x80000003  0x00fa3b
192.168.20.1 1.1.1.1     823        0x80000004  0x00e0f6
192.168.21.1 1.1.1.1     823        0x80000005  0x00ddf6
0.0.0.0      1.1.1.1     345        0x80000007  0x0069ea
```

Tabela de rutare Totally Stub

```
R5#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

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O IA 10.0.1.0/24 [110/2] via 10.0.51.2, 00:00:30, GigabitEthernet0/1
O IA 10.0.23.0/24 [110/3] via 10.0.51.2, 00:00:30, GigabitEthernet0/1
```

Inainte de
Totally
Stub

```
O E2 10.0.34.0/24 [110/20] via 10.0.51.2, 00:00:20, GigabitEthernet0/1
C 10.0.51.0/24 is directly connected, GigabitEthernet0/1
L 10.0.51.1/32 is directly connected, GigabitEthernet0/1
192.168.10.0/32 is subnetted, 1 subnets
O IA 192.168.10.1/32 [110/2] via 10.0.51.2, 00:00:30, GigabitEthernet0/1
192.168.20.0/32 is subnetted, 1 subnets
O IA 192.168.20.1/32 [110/3] via 10.0.51.2, 00:00:30, GigabitEthernet0/1
192.168.21.0/32 is subnetted, 1 subnets
O IA 192.168.21.1/32 [110/4] via 10.0.51.2, 00:00:30, GigabitEthernet0/1
192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.30.0/24 is directly connected, Loopback0
L 192.168.30.1/32 is directly connected, Loopback0
O E2 192.168.40.0/24 [110/20] via 10.0.51.2, 00:00:20, GigabitEthernet0/1
```

```
R5#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 10.0.51.2 to network 0.0.0.0

```
10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 10.0.51.0/24 is directly connected, GigabitEthernet0/1
L 10.0.51.1/32 is directly connected, GigabitEthernet0/1
192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.30.0/24 is directly connected, Loopback0
L 192.168.30.1/32 is directly connected, Loopback0
O*IA 0.0.0.0/0 [110/2] via 10.0.51.2, 03:38:58, GigabitEthernet0/1
```

Dupa
Totally
Stub

Au disparut atat Rutele externe
marcate O E2 cat si cele inter-area
O IA

Arii Totally Stub

```
R5#sh ip ospf database
      OSPF Router with ID (5.5.5.5) (Process ID 1)

      Router Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum Link count
1.1.1.1      1.1.1.1      22         0x80000008  0x00d5f1 1
5.5.5.5      5.5.5.5      22         0x80000005  0x00947e 2

      Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
10.0.51.1   5.5.5.5      22         0x80000002  0x0038d5

      Summary Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
10.0.1.0     1.1.1.1      56         0x80000001  0x00e767
192.168.10.1 1.1.1.1      56         0x80000002  0x00499b
10.0.23.0    1.1.1.1      56         0x80000003  0x00fa3b
192.168.20.1 1.1.1.1      56         0x80000004  0x00e0f6
192.168.21.1 1.1.1.1      56         0x80000005  0x00
```

Inainte de
Totally
Stub

```
      Summary ASB Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Chec
3.3.3.3      1.1.1.1      41         0x80000006  0x00

      Type-5 AS External Link States

Link ID      ADV Router   Age         Seq#         Chec
10.0.34.0    3.3.3.3      200        0x80000001  0x00
192.168.40.0 3.3.3.3      199        0x80000001  0x00
```

```
R5#sh ip ospf database
      OSPF Router with ID (5.5.5.5) (Process ID 1)

      Router Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum Link count
5.5.5.5      5.5.5.5      508        0x80000016  0x00728f 2
1.1.1.1      1.1.1.1      51         0x8000001e  0x00a908 1

      Net Link States (Area 51)

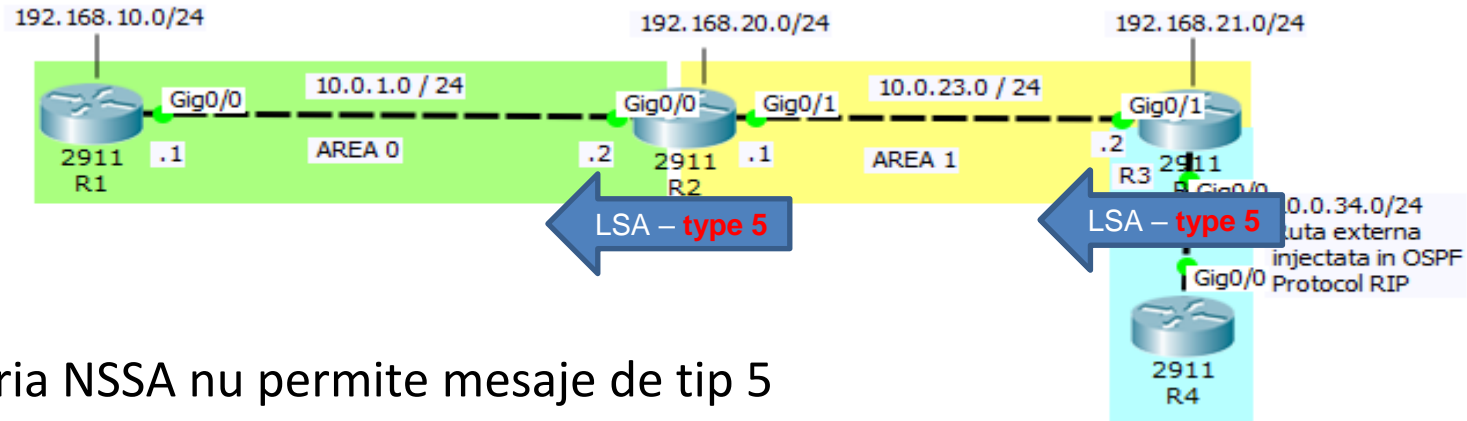
Link ID      ADV Router   Age         Seq#         Checksum
10.0.51.1   5.5.5.5      767        0x8000000b  0x007e5f

      Summary Net Link States (Area 51)

Link ID      ADV Router   Age         Seq#         Checksum
0.0.0.0     1.1.1.1      804        0x80000031  0x001515
```

Dupa
Totally
Stub

NSSA area si Totally NSSA area



- Aria NSSA nu permite mesaje de tip 5
- Routerul ASBR generează mesaje de tip 7 care sunt transportate peste aria NSSA până în ABR.
- Routerul ABR transformă mesajele de tip 7 în mesaje de tip 5 și le distribuie în domeniul OSPF.
- Aria totally NSSA nu permite nici trecerea mesajelor de tipul 3 și 4.
- Spre deosebire de ariile Stub și Totally Stub când o arie este declarată NSSA sau T-NSSA nu se introduce o ruta default din oficiu.

Configurare NSSA și Totally NSSA area

- Configurarea NSSA se face atât pe routerul ABR cât și pe routerul ASBR
- Aria NSSA nu permite traficul LSA de tip 5 însă permite restul traficului.
- Aria Totally NSSA blochează atât mesajele LSA de tip 5 cât și pe cele de tip 3 și 4.
- Prin configurarea NSSA și Totally NSSA, ruta default nu se introduce automat în Tabela de rutare, ca în cazul Stub și Totally Stub Area.
- Comanda *area X default-information originate* introdusă pe ABR va avea ca efect și apariția rutei default în tabela de rutare.

Configurare NSSA și Totally NSSA area

- Comenzi pentru NSSA

```
R2(config)#router ospf 1  
R2(config-router)#area 1 nssa  
R2(config-router)#exit
```

```
R3(config)#router ospf 1  
R3(config-router)#area 1 nssa  
R3(config-router)#exit
```

- Comenzi pentru Totally NSSA

```
R2(config)#router ospf 1  
R2(config-router)#area 1 nssa no-summary  
R2(config-router)#exit
```

```
R3(config)#router ospf 1  
R3(config-router)#area 1 nssa no-summary  
R3(config-router)#exit
```

- Comanda pentru default-route (doar de pe ABR)

```
R2(config)#router ospf 1  
R2(config-router)#network 5.0.0.0 0.255.255.255 area 1  
R2(config-router)#network 6.0.0.0 0.255.255.255 area 0  
R2(config-router)#area 1 nssa default-information originate  
R2(config-router)#exit
```

Modificările in DB introduse de NSSA

Inainte de NSSA

```
R2#sh ip ospf data
OSPF Router with ID (3.3.3.3) (Process ID 1)

  Router Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum Link count
2.2.2.2        2.2.2.2       134        0x80000005   0x004fd4 1
1.1.1.1        1.1.1.1       79         0x80000008   0x001c8b 2

  Net Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.1.2       2.2.2.2       134        0x80000002   0x004a0d

  Summary Net Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.23.0     2.2.2.2       703       0x80000001   0x00d65e
192.168.20.1  2.2.2.2       703       0x80000003   0x00ba1b
192.168.21.1  2.2.2.2       134       0x8000000a   0x00ab21

  Summary ASB Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
2.2.2.2        2.2.2.2       139       0x80000008   0x00d472
2.2.2.2        1.1.1.1       386       0x80000001   0x000151
3.3.3.3        2.2.2.2       134       0x80000009   0x00ae92

  Router Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum Link count
3.3.3.3        3.3.3.3       368       0x80000007   0x00015d 2
2.2.2.2        2.2.2.2       139       0x8000000a   0x00273d 2

  Net Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.23.2     3.3.3.3       709       0x80000001   0x006fc6

  Summary Net Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.1.0       2.2.2.2       704       0x80000001   0x00c981
192.168.10.1  2.2.2.2       699       0x80000002   0x0035aa

  Summary ASB Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
2.2.2.2        3.3.3.3       139       0x80000001   0x00c485

  Type-5 AS External Link States

Link ID        ADV Router    Age         Seq#          Checksum Tag
10.0.34.0     3.3.3.3       415       0x80000002   0x00dc09 0
10.0.34.0     2.2.2.2       139       0x80000002   0x004bcf 0
```

Dupa NSSA

```
R2#sh ip ospf data
OSPF Router with ID (3.3.3.3) (Process ID 1)

  Router Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum Link count
2.2.2.2        2.2.2.2       585       0x80000005   0x004fd4 1
1.1.1.1        1.1.1.1       530       0x80000008   0x001c8b 2

  Net Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.1.2       2.2.2.2       585       0x80000002   0x004a0d

  Summary Net Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.23.0     2.2.2.2       1154      0x80000001   0x00d65e
192.168.20.1  2.2.2.2       1154      0x80000003   0x00ba1b
192.168.21.1  2.2.2.2       4         0x8000000c   0x00a723

  Summary ASB Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
2.2.2.2        1.1.1.1       7         0x80000002   0x00fe52
2.2.2.2        2.2.2.2       4         0x8000000b   0x00d86a

  Router Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum Link count
2.2.2.2        2.2.2.2       12        0x8000000c   0x00233f 2
3.3.3.3        3.3.3.3       12        0x80000009   0x00fc5f 2

  Net Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.23.2     3.3.3.3       1161      0x80000001   0x006fc6

  Summary Net Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
10.0.1.0       2.2.2.2       1156      0x80000001   0x00c981
192.168.10.1  2.2.2.2       1151      0x80000002   0x0035aa

  Summary ASB Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
2.2.2.2        3.3.3.3       591       0x80000001   0x00c485]

  Type-7 AS External Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum Tag
10.0.34.0     2.2.2.2       44        0x80000001   0x00ac62 1
10.0.34.0     3.3.3.3       15        0x80000004   0x007692 0

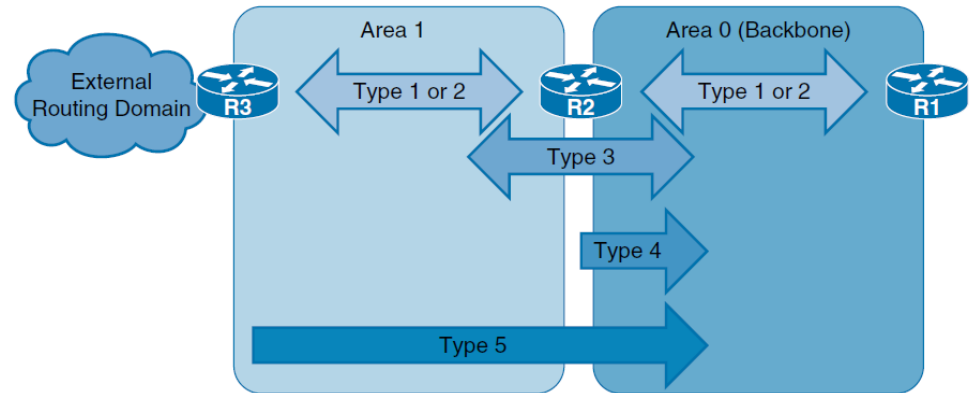
  Type-5 AS External Link States

Link ID        ADV Router    Age         Seq#          Checksum Tag
10.0.34.0     2.2.2.2       4         0x80000002   0x005dbc 1
```

LSA tip 7

Type-7 AS External Link States (Area 1)

Tipurile de LSA



Tip LSA	Denumirea LSA	Descriere	Tip	Cine originează LSA
1	Router LSA	Routerul include în LSA informații despre starea linkurilor, Router-ID, cost etc.	Intra-area	Fiecare router
2	Network LSA	Descrie toate rutele atașate pe un segment	Intra-area	DR
3	Summary LSA	Descrie și sumarizează rutele învățate într-o arie și le retransmite în celelalte arii	Inter-area	ABR
4	ASBR Summary LSA	Indică celorlalte routere din domeniul OSPF cum să ajungă la ASBR.	Inter-area	ABR
5	Autonomous System LSA	Publică rutele externe injectate în domeniul OSPF de alte protocoale	Inter-area	ASBR
7	External Link States	Publică rute externe ce sunt transportate peste o arie NSSA sau T-NSSA	Inter-area	ASBR

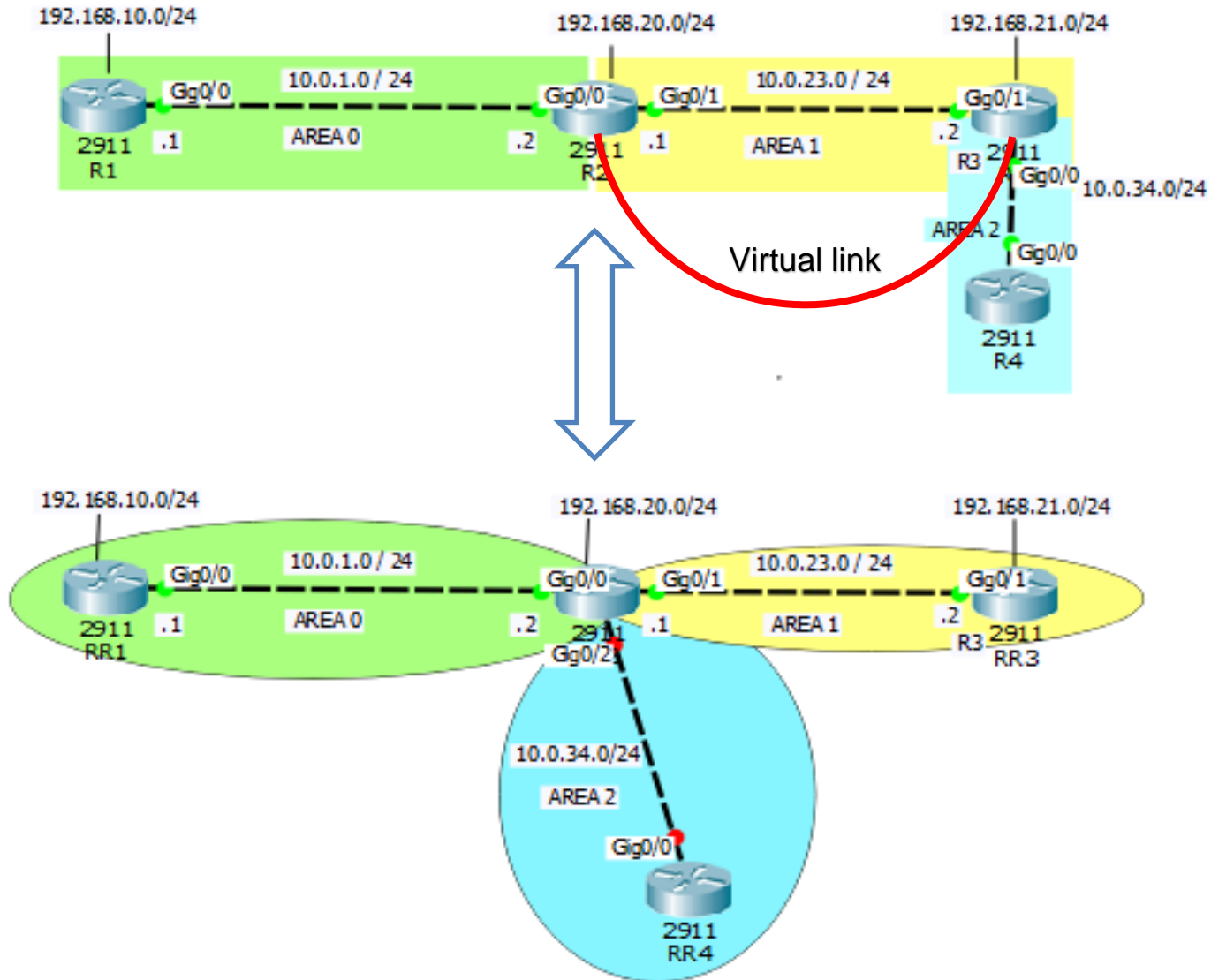
Specificitatea ariilor în OSPF

- Este obligatoriu ca aria 0 să existe într-o topologie OSPF.
- Aria 0 trebuie să fie continuă.
- Orice altă arie **trebuie** să se conecteze la aria 0.

Se ridică două întrebări:

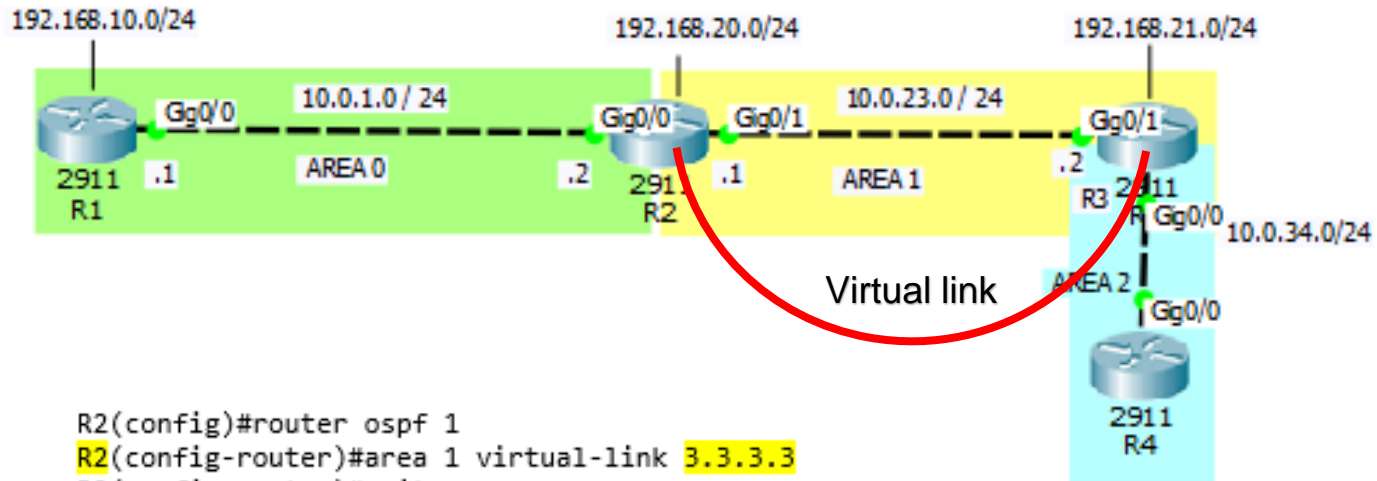
1. Ce facem dacă aria 0 este discontinuă, de exemplu în cazul preluării unei companii care are implementat protocolul OSPF și are, normal, aria 0?
2. Dar dacă o arie, care nu este aria 0, este conectată direct la o altă arie, care la rândul ei, este diferită de aria 0?

Virtual link



- Aria 0 va vedea aria conectată prin virtual link ca fiind conectată direct.
- LSA-urile vor fi marcate DNA (Do not age) iar în LSDB vor apărea marcate în acest mod. Astfel vom ști că adresele IP marcate astfel sunt accesibile prin virtual link.

Configurarea unui Virtual Link



```
R2(config)#router ospf 1
R2(config-router)#area 1 virtual-link 3.3.3.3
R2(config-router)#exit
```

```
R3(config)#router ospf 1
R3(config-router)#area 1 virtual-link 2.2.2.2
R3(config-router)#exit
```

LSA Virtual Link

```
R2#sh ip ospf virtual-links
Virtual Link OSPF_VL0 to router 3.3.3.3 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 1, via interface Ethernet0/1
Topology-MTID      Cost      Disabled      Shutdown      Topology Name
   0              10         no            no            Base
Transmit Delay is 1 sec, State POINT_TO_POINT,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  Hello due in 00:00:04
  Adjacency State FULL (Hello suppressed)
  Index 2/3, 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
```


LSDB Virtual link

```
R1#sh ip ospf database
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Router Link States (Area 0)
```

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	824	0x80000003	0x001B51	2
2.2.2.2	2.2.2.2	31	0x80000003	0x00BDE0	2
3.3.3.3	3.3.3.3	2 (DNA)	0x80000002	0x00C31F	1

```
Net Link States (Area 0)
```

Link ID	ADV Router	Age	Seq#	Checksum
10.0.12.1	1.1.1.1	824	0x80000001	0x00F61C

```
Summary Net Link States (Area 0)
```

Link ID	ADV Router	Age	Seq#	Checksum
10.0.23.0	2.2.2.2	710	0x80000001	0x0031D8
10.0.23.0	3.3.3.3	50 (DNA)	0x80000001	0x0013F2
10.0.34.0	3.3.3.3	50 (DNA)	0x80000001	0x009961
192.168.20.1	2.2.2.2	828	0x80000001	0x00BEF6
192.168.20.1	3.3.3.3	50 (DNA)	0x80000001	0x0005A2
192.168.21.1	2.2.2.2	340	0x80000001	0x001892
192.168.21.1	3.3.3.3	50 (DNA)	0x80000001	0x00951B
192.168.22.1	3.3.3.3	50 (DNA)	0x80000001	0x00EEB6

Toate rutele care tranziteaza virtual link sunt marcate cu DNA (Do-not-age)