



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

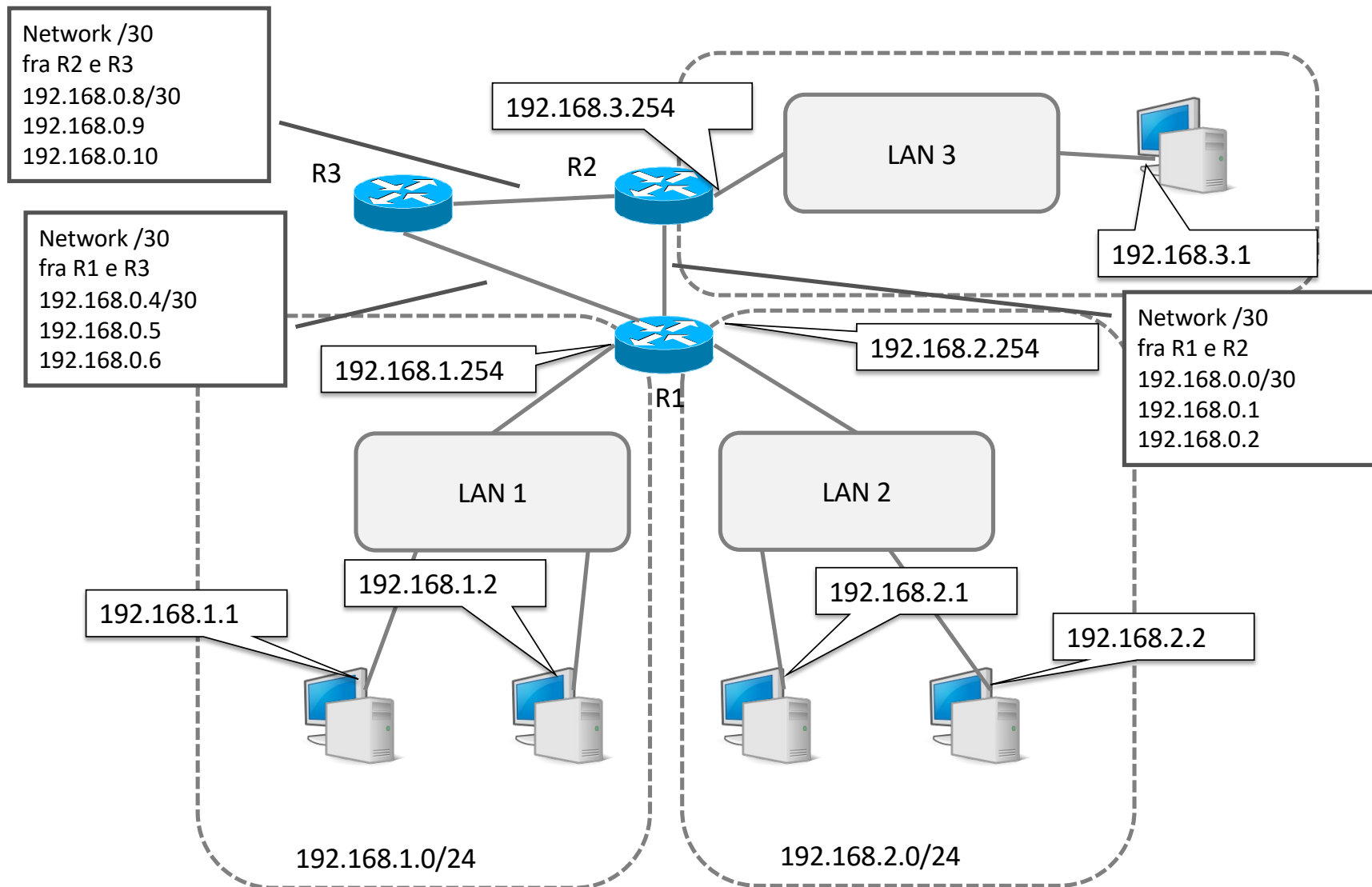
Esempio configurazione OSPF

Franco Callegati

2023

Scenario

- Semplice topologie di rete con 3 router collegati ad anello
- Attivazione di OSPF su tutti i router
- Configurazione di una singola area di routing (Area 0)
- Router ID
 - R1 10.0.0.1
 - R2 10.0.0.2
 - R3 10.0.0.3



Adiacenze

Router_R1#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.0.0.3	1	FULL/DR	00:00:31	192.168.0.6	Vlan4
10.0.0.2	1	FULL/DR	00:00:31	192.168.0.2	FastEthernet0

Router_R3#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.0.0.2	1	FULL/BDR	00:00:35	192.168.0.9	FastEthernet0
10.0.0.1	1	FULL/BDR	00:00:33	192.168.0.5	Vlan1

```
Router_R1#show ip ospf rib
```

```
OSPF local RIB for Process 10
```

```
Codes: * - Best, > - Installed in global RIB
```

```
* 192.168.0.0/30, Intra, cost 1, area 0, Connected  
   via 192.168.0.1, FastEthernet0  
* 192.168.0.4/30, Intra, cost 1, area 0, Connected  
   via 192.168.0.5, Vlan4  
*> 192.168.0.8/30, Intra, cost 2, area 0  
   via 192.168.0.6, Vlan4  
   via 192.168.0.2, FastEthernet0  
* 192.168.1.0/24, Intra, cost 1, area 0, Connected  
   via 192.168.1.254, Vlan1  
*> 192.168.3.0/24, Intra, cost 2, area 0  
   via 192.168.0.2, FastEthernet0
```

Notare che essendo stata definita solamente l'area 0 tutte le rotte figurano intra area

OSPF database

- Contiene l'elenco degli LSA ricevuti
- Gli LSA sono identificati tramite
 - router che li ha inviati
 - Età
- Sono di due tipi
 - Network
 - Identificano le reti elencando i router a loro connesse
 - Router
 - Identificano i router ed elencano le reti a loro connesse
- Si noti che le network vengono classificate come Transit o Stub

```
Router_R1#show ip ospf database
```

OSPF Router with ID (10.0.0.1) (Process ID 10)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.0.0.1	10.0.0.1	1033	0x8000000A	0x0025AF	3
10.0.0.2	10.0.0.2	1834	0x8000000E	0x0006BD	3
10.0.0.3	10.0.0.3	1161	0x80000008	0x00AC8F	2

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.0.2	10.0.0.2	1551	0x80000002	0x003677
192.168.0.6	10.0.0.3	1161	0x80000002	0x001295
192.168.0.10	10.0.0.3	1161	0x80000002	0x00F7AA



```
Router_R1#show ip ospf database network
```

```
OSPF Router with ID (10.0.0.1) (Process ID 10)
```

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

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

```
LS age: 1857
```

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

```
LS Type: Network Links
```

```
Link State ID: 192.168.0.2 (address of Designated Router)
```

```
Advertising Router: 10.0.0.2
```

```
LS Seq Number: 80000002
```

```
Checksum: 0x3677
```

```
Length: 32
```

```
Network Mask: /30
```

```
Attached Router: 10.0.0.2
```

```
Attached Router: 10.0.0.1
```

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

```
LS age: 1467
```

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

```
LS Type: Network Links
```

```
Link State ID: 192.168.0.6 (address of Designated Router)
```

```
Advertising Router: 10.0.0.3
```

```
LS Seq Number: 80000002
```

```
Checksum: 0x1295
```

```
Length: 32
```

```
Network Mask: /30
```

```
Attached Router: 10.0.0.3
```

```
Attached Router: 10.0.0.1
```

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

```
LS age: 1468
```

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

```
LS Type: Network Links
```

```
Link State ID: 192.168.0.10 (address of Designated Router)
```

```
Advertising Router: 10.0.0.3
```

```
LS Seq Number: 80000002
```

```
Checksum: 0xF7AA
```

```
Length: 32
```

```
Network Mask: /30
```

```
Attached Router: 10.0.0.3
```

```
Attached Router: 10.0.0.2
```



```
Router_R1#show ip ospf database router
```

```
OSPF Router with ID (10.0.0.1) (Process ID 10)
```

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

- Stub:
 - una network connessa ad un solo router e quindi che non può essere attraversata per raggiungere altre destinazioni
- Transit:
 - Una network connessa a due o più router che quindi può essere attraversata per raggiungere altre network

```
LS age: 1446
```

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

```
LS Type: Router Links
```

```
Link State ID: 10.0.0.1
```

```
Advertising Router: 10.0.0.1
```

```
LS Seq Number: 8000000A
```

```
Checksum: 0x25AF
```

```
Length: 60
```

```
Number of Links: 3
```

```
Link connected to: a Stub Network
```

```
(Link ID) Network/subnet number: 192.168.1.0
```

```
(Link Data) Network Mask: 255.255.255.0
```

```
Number of TOS metrics: 0
```

```
TOS 0 Metrics: 1
```

```
Link connected to: a Transit Network
```

```
(Link ID) Designated Router address: 192.168.0.6
```

```
(Link Data) Router Interface address: 192.168.0.5
```

```
Number of TOS metrics: 0
```

```
TOS 0 Metrics: 1
```

```
Link connected to: a Transit Network
```

```
(Link ID) Designated Router address: 192.168.0.2
```

```
(Link Data) Router Interface address: 192.168.0.1
```

```
Number of TOS metrics: 0
```

```
TOS 0 Metrics: 1
```



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



LS age: 229
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.2
Advertising Router: 10.0.0.2
LS Seq Number: 8000000F
Checksum: 0x4BE
Length: 60
Number of Links: 3

Link connected to: a Stub Network
(Link ID) Network/subnet number: 192.168.3.0
(Link Data) Network Mask: 255.255.255.0
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.10
(Link Data) Router Interface address: 192.168.0.9
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.2
(Link Data) Router Interface address: 192.168.0.2
Number of TOS metrics: 0
TOS 0 Metrics: 1



LS age: 5

Options: (No TOS-capability, DC)

LS Type: Router Links

Link State ID: 10.0.0.3

Advertising Router: 10.0.0.3

LS Seq Number: 80000008

Checksum: 0xAC8F

Length: 48

Number of Links: 2

Link connected to: a Transit Network

(Link ID) Designated Router address: 192.168.0.10

(Link Data) Router Interface address: 192.168.0.10

Number of TOS metrics: 0

TOS 0 Metrics: 1

Link connected to: a Transit Network

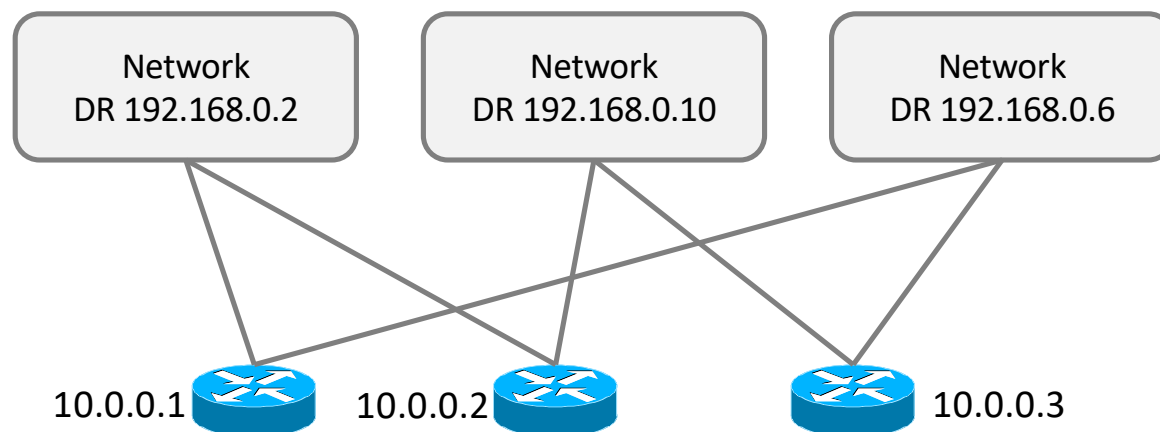
(Link ID) Designated Router address: 192.168.0.6

(Link Data) Router Interface address: 192.168.0.6

Number of TOS metrics: 0

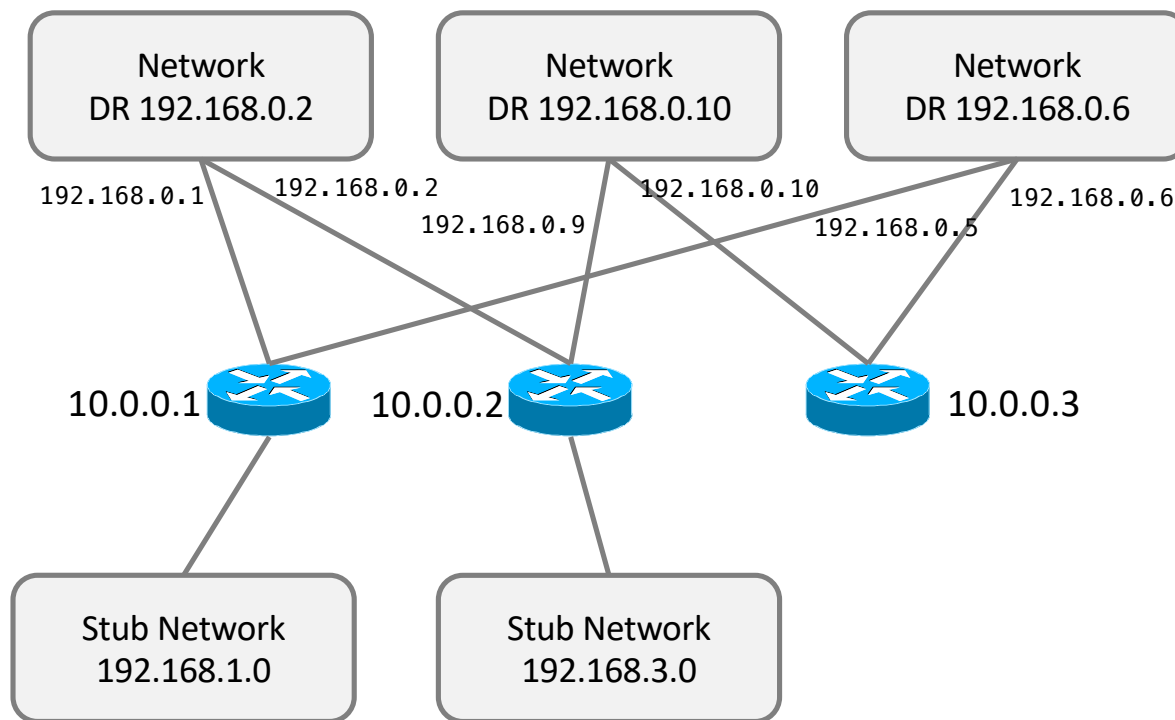
TOS 0 Metrics: 1

Dal punto di vista di R1



Partendo dai network link state

Dal punto di vista di R1



Aggiungendo i router link state



Router_R3#show ip ospf database

OSPF Router with ID (10.0.0.3) (Process ID 10)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.0.0.1	10.0.0.1	1145	0x8000000D	0x007CCF	2
10.0.0.2	10.0.0.2	153	0x80000015	0x00D662	2
10.0.0.3	10.0.0.3	1286	0x80000009	0x00AA90	2

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.0.2	10.0.0.2	1705	0x80000003	0x003478
192.168.0.6	10.0.0.3	1286	0x80000003	0x001096
192.168.0.10	10.0.0.3	1286	0x80000003	0x00F5AB

Router_R3#show ip ospf database summary

OSPF Router with ID (10.0.0.3) (Process ID 10)

Summary Net Link States (Area 0)

Routing Bit Set on this LSA

LS age: 1224

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

LS Type: Summary Links(Network)

Link State ID: 192.168.1.0 (summary Network Number)

Advertising Router: 10.0.0.1

LS Seq Number: 80000001

Checksum: 0x7650

Length: 28

Network Mask: /24

TOS: 0 Metric: 1

LS age: 190

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

LS Type: Summary Links(Network)

Link State ID: 192.168.3.0 (summary Network Number)

Advertising Router: 10.0.0.2

LS Seq Number: 80000001

Checksum: 0x5A69

Length: 28

Network Mask: /24

TOS: 0 Metric: 1



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Router_R3#show ip ospf database router

OSPF Router with ID (10.0.0.3) (Process ID 10)

Router Link States (Area 0)

Routing Bit Set on this LSA
LS age: 1799
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.1
Advertising Router: 10.0.0.1
LS Seq Number: 8000000D
Checksum: 0x7CCF
Length: 48
Area Border Router
Number of Links: 2

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.6
(Link Data) Router Interface address: 192.168.0.5
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.2
(Link Data) Router Interface address: 192.168.0.1
Number of TOS metrics: 0
TOS 0 Metrics: 1

Routing Bit Set on this LSA
LS age: 102
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.2
Advertising Router: 10.0.0.2
LS Seq Number: 80000017
Checksum: 0xD264
Length: 48
Area Border Router
Number of Links: 2

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.10
(Link Data) Router Interface address: 192.168.0.9
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.2
(Link Data) Router Interface address: 192.168.0.2
Number of TOS metrics: 0
TOS 0 Metrics: 1



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



LS age: 1944
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.3
Advertising Router: 10.0.0.3
LS Seq Number: 80000009
Checksum: 0xAA90
Length: 48
Number of Links: 2

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.10
(Link Data) Router Interface address: 192.168.0.10
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.6
(Link Data) Router Interface address: 192.168.0.6
Number of TOS metrics: 0
TOS 0 Metrics: 1

Router_R3#show ip ospf database network

OSPF Router with ID (10.0.0.3) (Process ID 10)

Net Link States (Area 0)

Routing Bit Set on this LSA
LS age: 745
Options: (No TOS-capability, DC)
LS Type: Network Links
Link State ID: 192.168.0.2 (address of Designated Router)
Advertising Router: 10.0.0.2
LS Seq Number: 80000004
Checksum: 0x3279
Length: 32
Network Mask: /30
 Attached Router: 10.0.0.2
 Attached Router: 10.0.0.1

Routing Bit Set on this LSA
LS age: 134
Options: (No TOS-capability, DC)
LS Type: Network Links
Link State ID: 192.168.0.6 (address of Designated Router)
Advertising Router: 10.0.0.3
LS Seq Number: 80000004
Checksum: 0xE97
Length: 32
Network Mask: /30
 Attached Router: 10.0.0.3
 Attached Router: 10.0.0.1

Routing Bit Set on this LSA
LS age: 135
Options: (No TOS-capability, DC)
LS Type: Network Links
Link State ID: 192.168.0.10 (address of Designated Router)
Advertising Router: 10.0.0.3
LS Seq Number: 80000004
Checksum: 0xF3AC
Length: 32
Network Mask: /30
 Attached Router: 10.0.0.3
 Attached Router: 10.0.0.2



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



Router_R3#show ip route

Codes: 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

Gateway of last resort is not set

```
10.0.0.0/32 is subnetted, 1 subnets
C      10.0.0.3 is directly connected, Loopback0
192.168.0.0/30 is subnetted, 3 subnets
C      192.168.0.8 is directly connected, FastEthernet0
O      192.168.0.0 [110/2] via 192.168.0.9, 01:30:18, FastEthernet0
          [110/2] via 192.168.0.5, 01:30:28, Vlan1
C      192.168.0.4 is directly connected, Vlan1
O IA 192.168.1.0/24 [110/2] via 192.168.0.5, 00:21:37, Vlan1
O IA 192.168.3.0/24 [110/2] via 192.168.0.9, 00:04:24, FastEthernet0
```



Router_R1#show ip route

Codes: 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

Gateway of last resort is not set

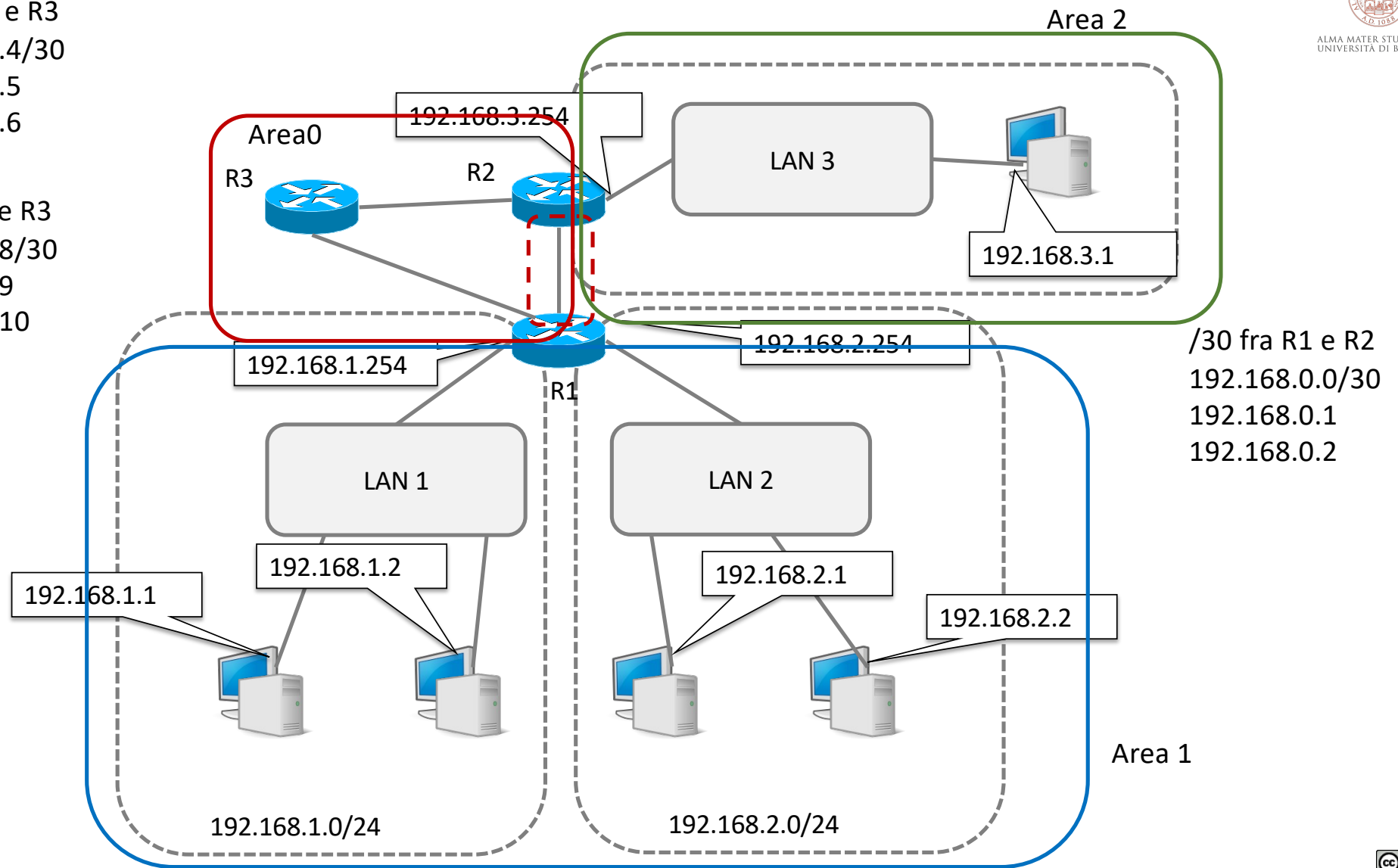
```
10.0.0.0/32 is subnetted, 1 subnets
C      10.0.0.1 is directly connected, Loopback0
192.168.0.0/30 is subnetted, 3 subnets
O      192.168.0.8 [110/2] via 192.168.0.6, 00:29:23, Vlan4
        [110/2] via 192.168.0.2, 00:29:23, FastEthernet0
C      192.168.0.0 is directly connected, FastEthernet0
C      192.168.0.4 is directly connected, Vlan4
C      192.168.1.0/24 is directly connected, Vlan1
O IA 192.168.3.0/24 [110/2] via 192.168.0.2, 00:00:12, FastEthernet0
```

Scenario

- Medesima topologia
- Configurazione di quattro aree di routing come da figura
- Router ID
 - R1 10.0.0.1
 - R2 10.0.0.2
 - R3 10.0.0.3

/30 fra R1 e R3
192.168.0.4/30
192.168.0.5
192.168.0.6

/30 fra R2 e R3
192.168.0.8/30
192.168.0.9
192.168.0.10



Router_R1#show ip ospf database router

OSPF Router with ID (10.0.0.1) (Process ID 10)

Router Link States (Area 0)

LS age: 36
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.1
Advertising Router: 10.0.0.1
LS Seq Number: 8000000E
Checksum: 0x7AD0
Length: 48
Area Border Router
Number of Links: 2

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.6
(Link Data) Router Interface address: 192.168.0.5
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.2
(Link Data) Router Interface address: 192.168.0.1
Number of TOS metrics: 0
TOS 0 Metrics: 1

Routing Bit Set on this LSA
LS age: 348
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.2
Advertising Router: 10.0.0.2
LS Seq Number: 80000017
Checksum: 0xD264
Length: 48
Area Border Router
Number of Links: 2

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.10
(Link Data) Router Interface address: 192.168.0.9
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.2
(Link Data) Router Interface address: 192.168.0.2
Number of TOS metrics: 0
TOS 0 Metrics: 1

LS age: 196
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.3
Advertising Router: 10.0.0.3
LS Seq Number: 8000000A
Checksum: 0xA891
Length: 48
Number of Links: 2

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.10
(Link Data) Router Interface address: 192.168.0.10
Number of TOS metrics: 0
TOS 0 Metrics: 1

Link connected to: a Transit Network
(Link ID) Designated Router address: 192.168.0.6
(Link Data) Router Interface address: 192.168.0.6
Number of TOS metrics: 0
TOS 0 Metrics: 1

Router Link States (Area 1)



ALMA MATER STUDIORUM
UNIVERSIT  DI BOLOGNA

LS age: 282
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.0.0.1
Advertising Router: 10.0.0.1
LS Seq Number: 80000002
Checksum: 0xA20D
Length: 36
Area Border Router
Number of Links: 1

Link connected to: a Stub Network
(Link ID) Network/subnet number: 192.168.1.0
(Link Data) Network Mask: 255.255.255.0
Number of TOS metrics: 0
TOS 0 Metrics: 1



Router_R1#show ip ospf database network

OSPF Router with ID (10.0.0.1) (Process ID 10)

Net Link States (Area 0)

Routing Bit Set on this LSA

LS age: 915

Options: (No TOS-capability, DC)

LS Type: Network Links

Link State ID: 192.168.0.2 (address of Designated Router)

Advertising Router: 10.0.0.2

LS Seq Number: 80000004

Checksum: 0x3279

Length: 32

Network Mask: /30

Attached Router: 10.0.0.2

Attached Router: 10.0.0.1

Routing Bit Set on this LSA

LS age: 305

Options: (No TOS-capability, DC)

LS Type: Network Links

Link State ID: 192.168.0.6 (address of Designated Router)

Advertising Router: 10.0.0.3

LS Seq Number: 80000004

Checksum: 0xE97

Length: 32

Network Mask: /30

Attached Router: 10.0.0.3

Attached Router: 10.0.0.1

Routing Bit Set on this LSA

LS age: 305

Options: (No TOS-capability, DC)

LS Type: Network Links

Link State ID: 192.168.0.10 (address of Designated Router)

Advertising Router: 10.0.0.3

LS Seq Number: 80000004

Checksum: 0xF3AC

Length: 32

Network Mask: /30

Attached Router: 10.0.0.3

Attached Router: 10.0.0.2

Router_R1#show ip ospf database summary

OSPF Router with ID (10.0.0.1) (Process ID 10)

Summary Net Link States (Area 0)

LS age: 451
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 192.168.1.0 (summary Network Number)
Advertising Router: 10.0.0.1
LS Seq Number: 80000002
Checksum: 0x7451
Length: 28
Network Mask: /24
TOS: 0 Metric: 1

Routing Bit Set on this LSA
LS age: 513
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 192.168.3.0 (summary Network Number)
Advertising Router: 10.0.0.2
LS Seq Number: 80000003
Checksum: 0x566B
Length: 28
Network Mask: /24
TOS: 0 Metric: 1

Summary Net Link States (Area 1)

LS age: 451
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 192.168.0.0 (summary Network Number)
Advertising Router: 10.0.0.1
LS Seq Number: 80000002
Checksum: 0x6D5C
Length: 28
Network Mask: /30
TOS: 0 Metric: 1

LS age: 453
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 192.168.0.4 (summary Network Number)
Advertising Router: 10.0.0.1
LS Seq Number: 80000002
Checksum: 0x4580
Length: 28
Network Mask: /30
TOS: 0 Metric: 1

LS age: 454
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 192.168.0.8 (summary Network Number)
Advertising Router: 10.0.0.1
LS Seq Number: 80000002
Checksum: 0x2799
Length: 28
Network Mask: /30
TOS: 0 Metric: 2

LS age: 512
Options: (No TOS-capability, DC, Upward)
LS Type: Summary Links(Network)
Link State ID: 192.168.3.0 (summary Network Number)
Advertising Router: 10.0.0.1
LS Seq Number: 80000001
Checksum: 0x6A59
Length: 28
Network Mask: /24
TOS: 0 Metric: 2



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



Router_R2#show ip ospf database summary

OSPF Router with ID (10.0.0.2) (Process ID 10)

Summary Net Link States (Area 0)

Routing Bit Set on this LSA

LS age: 581

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

LS Type: Summary Links(Network)

Link State ID: 192.168.1.0 (summary Network Number)

Advertising Router: 10.0.0.1

LS Seq Number: 80000002

Checksum: 0x7451

Length: 28

Network Mask: /24

TOS: 0 Metric: 1

LS age: 641

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

LS Type: Summary Links(Network)

Link State ID: 192.168.3.0 (summary Network Number)

Advertising Router: 10.0.0.2

LS Seq Number: 80000003

Checksum: 0x566B

Length: 28

Network Mask: /24

TOS: 0 Metric: 1

Summary Net Link States (Area 2)

LS age: 652

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

LS Type: Summary Links(Network)

Link State ID: 192.168.0.0 (summary Network Number)

Advertising Router: 10.0.0.2

LS Seq Number: 80000002

Checksum: 0x6761

Length: 28

Network Mask: /30

TOS: 0 Metric: 1

LS age: 654

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

LS Type: Summary Links(Network)

Link State ID: 192.168.0.4 (summary Network Number)

Advertising Router: 10.0.0.2

LS Seq Number: 80000002

Checksum: 0x497A

Length: 28

Network Mask: /30

TOS: 0 Metric: 2

LS age: 655

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

LS Type: Summary Links(Network)

Link State ID: 192.168.0.8 (summary Network Number)

Advertising Router: 10.0.0.2

LS Seq Number: 80000002

Checksum: 0x17A9

Length: 28

Network Mask: /30

TOS: 0 Metric: 1

LS age: 655

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

LS Type: Summary Links(Network)

Link State ID: 192.168.1.0 (summary Network Number)

Advertising Router: 10.0.0.2

LS Seq Number: 80000002

Checksum: 0x784B

Length: 28

Network Mask: /24

TOS: 0 Metric: 2