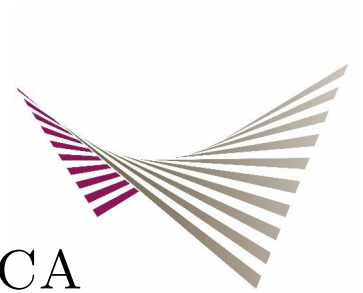


ESCOLA POLITÈCNICA
SUPERIOR



XARXES I COMUNICACIONS

PRÀCTICA 1

RIP, OSPF & BGP

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1 Objectius

L'objectiu principal d'aquesta pràctica és implementar els protocols apresos a classe per a encaminament intern i extern. Per fer l'encaminament intern, utilitzarem els protocols **RIP** i **OSPF**. Per a l'encaminament extern farem ús del protocol **BGP**.

2 RIP

És un protocol de porta d'enllaç interna o IGP (Internal Gateway Protocol) utilitzat pels routers (encaminadors), encara que també poden actuar en equips, per intercanviar informació sobre de xarxes IP.

2.1 Topologia de la xarxa

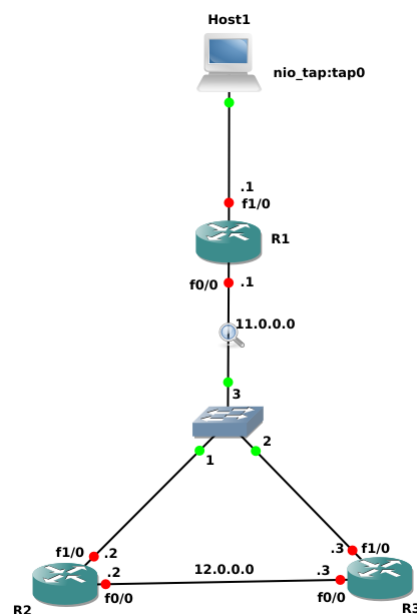


Figura 1: Topologia de la xarxa a efectuar l'exercici

Per a la realització de aquest exercici utilitzarem encaminadors **Cisco c7200**

3 OSPF

És un protocol d'encaminament d'estat d'enllaç considerat de porta d'enllaç interna. Utilitza codi obert i envia els paquets primer pel camí més curt. Fa ús de l'algorisme SPF que es basa principalment en el valor de l'amplada de banda de les connexions.

3.1 Topologia de la xarxa

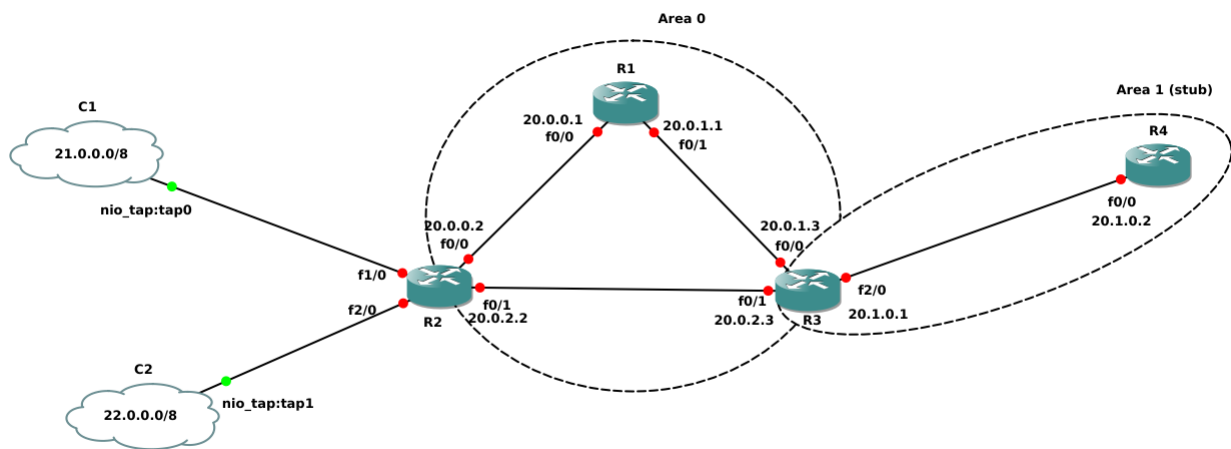


Figura 2: Topologia de la xarxa a efectuar l'exercici

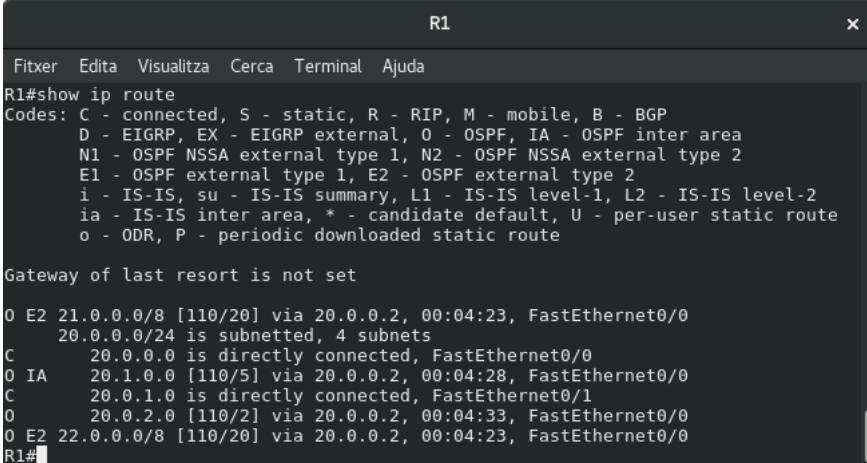
Per a la realització de aquest exercici utilitzarem encaminadors **Cisco c7200**. També hem de utilitzar les següents xarxes:

Instead of:	Use:
10.0.0.0/24	X.0.0.0/24
10.0.1.0/24	X.0.1.0/24
10.0.2.0/24	X.0.2.0/24
10.1.0.0/24	X.1.0.0/24
11.0.0.0/8	(X+1).0.0.0/8
12.0.0.0/8	(X+2).0.0.0/8

Taula 1: Xarxes a utilitzar en l'exercici OSPF

3.2 Imatges de la base de dades OSPF de cada encaminador

3.2.1 Encaminador R1



```

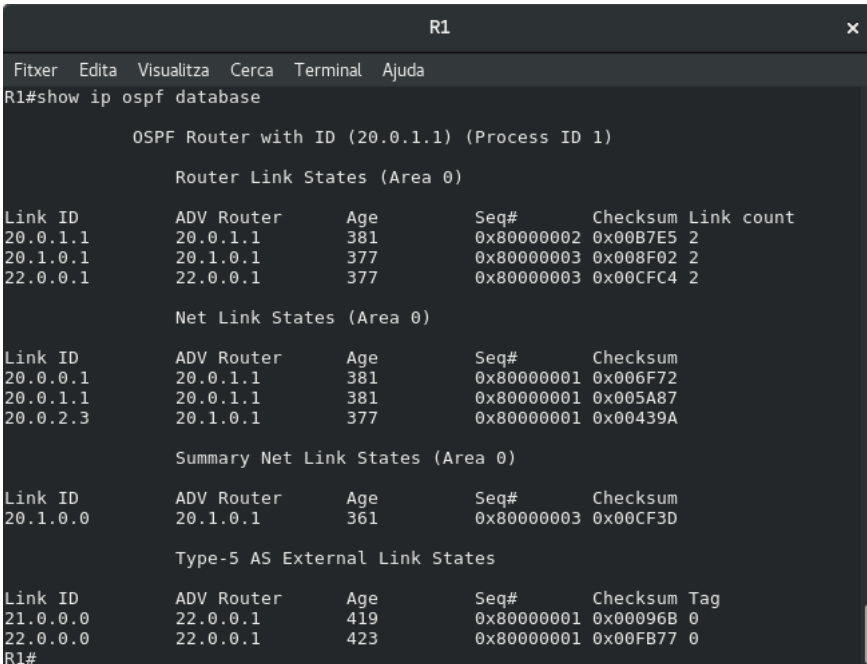
R1
Fitxer  Edita  Visualitza  Cerca  Terminal  Ajuda
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external 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

O E2 21.0.0.0/8 [110/20] via 20.0.0.2, 00:04:23, FastEthernet0/0
    20.0.0.0/24 is subnetted, 4 subnets
C     20.0.0.0 is directly connected, FastEthernet0/0
O IA   20.1.0.0 [110/5] via 20.0.0.2, 00:04:28, FastEthernet0/0
C     20.0.1.0 is directly connected, FastEthernet0/1
O     20.0.2.0 [110/2] via 20.0.0.2, 00:04:33, FastEthernet0/0
O E2 22.0.0.0/8 [110/20] via 20.0.0.2, 00:04:23, FastEthernet0/0
R1#

```

Figura 3: Comanda *show ip route* en el encaminador R1



```

R1
Fitxer  Edita  Visualitza  Cerca  Terminal  Ajuda
R1#show ip ospf database

        OSPF Router with ID (20.0.1.1) (Process ID 1)

        Router Link States (Area 0)

Link ID        ADV Router    Age          Seq#          Checksum Link count
20.0.1.1       20.0.1.1     381          0x80000002   0x00B7E5  2
20.1.0.1       20.1.0.1     377          0x80000003   0x008F02  2
22.0.0.1       22.0.0.1     377          0x80000003   0x00CFC4  2

        Net Link States (Area 0)

Link ID        ADV Router    Age          Seq#          Checksum
20.0.0.1       20.0.1.1     381          0x80000001   0x006F72
20.0.1.1       20.0.1.1     381          0x80000001   0x005A87
20.0.2.3       20.1.0.1     377          0x80000001   0x00439A

        Summary Net Link States (Area 0)

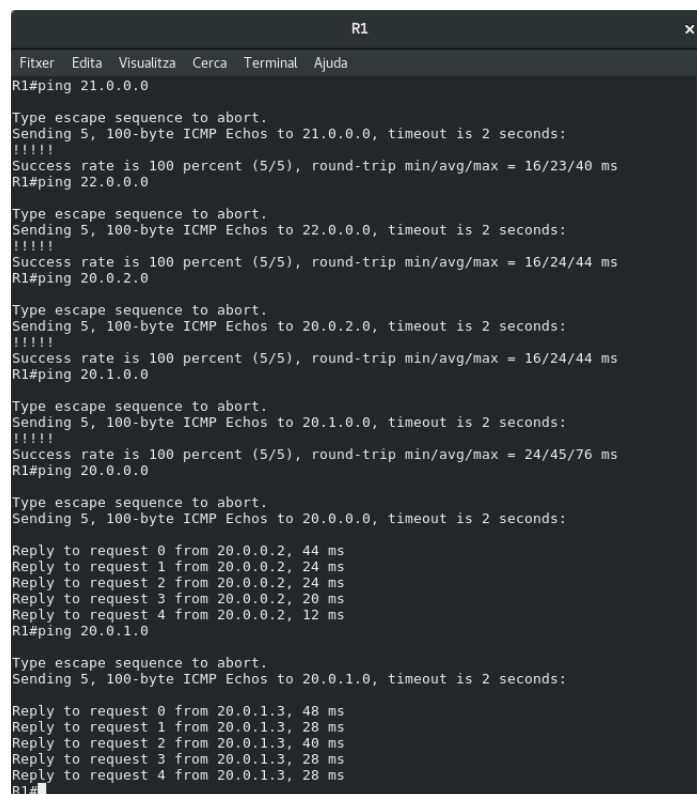
Link ID        ADV Router    Age          Seq#          Checksum
20.1.0.0       20.1.0.1     361          0x80000003   0x00CF3D

        Type-5 AS External Link States

Link ID        ADV Router    Age          Seq#          Checksum Tag
21.0.0.0       22.0.0.1     419          0x80000001   0x00096B  0
22.0.0.0       22.0.0.1     423          0x80000001   0x00FB77  0
R1#

```

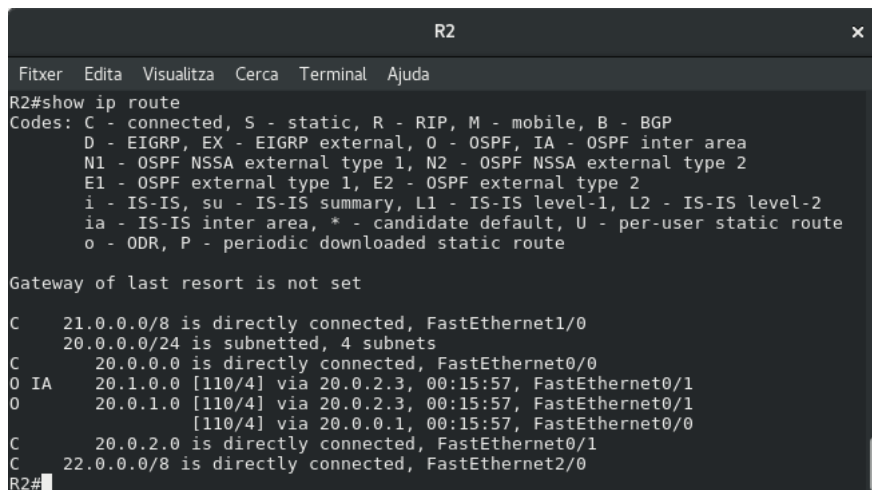
Figura 4: Comanda *show ip ospf database* en el encaminador R1



```
R1
Fitxer Edita Visualitza Cerca Terminal Ajuda
R1#ping 21.0.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 21.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/23/40 ms
R1#ping 22.0.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 22.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/24/44 ms
R1#ping 20.0.2.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.2.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/24/44 ms
R1#ping 20.1.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.1.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/45/76 ms
R1#ping 20.0.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.0.0, timeout is 2 seconds:
Reply to request 0 from 20.0.0.2, 44 ms
Reply to request 1 from 20.0.0.2, 24 ms
Reply to request 2 from 20.0.0.2, 24 ms
Reply to request 3 from 20.0.0.2, 20 ms
Reply to request 4 from 20.0.0.2, 12 ms
R1#ping 20.0.1.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.1.0, timeout is 2 seconds:
Reply to request 0 from 20.0.1.3, 48 ms
Reply to request 1 from 20.0.1.3, 28 ms
Reply to request 2 from 20.0.1.3, 40 ms
Reply to request 3 from 20.0.1.3, 28 ms
Reply to request 4 from 20.0.1.3, 28 ms
R1#
```

Figura 5: Prova de connectivitat a la xarxa des de l'encaminador R1

3.2.2 Encaminador R2

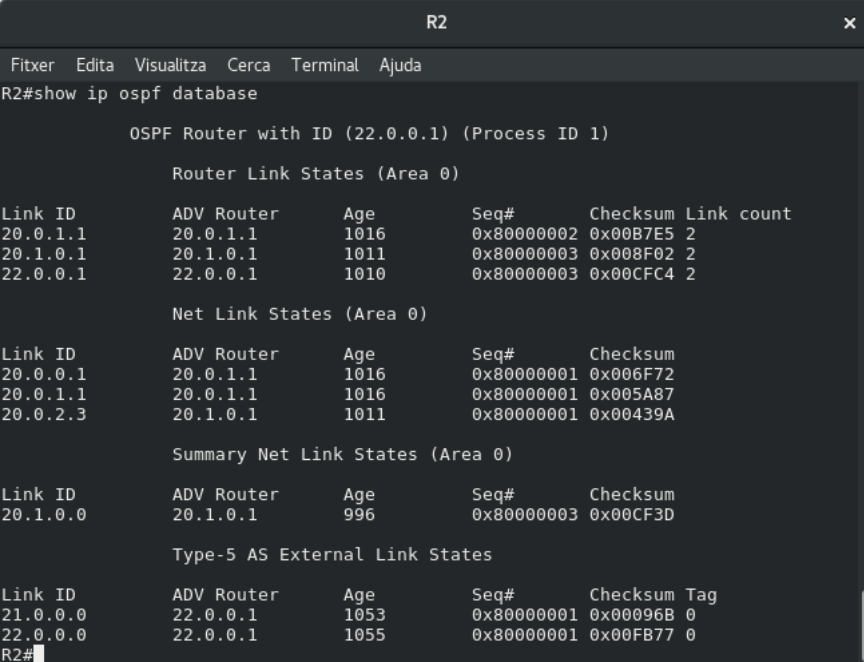


```
R2
Fitxer Edita Visualitza Cerca Terminal Ajuda
R2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external 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

C    21.0.0.0/8 is directly connected, FastEthernet1/0
C    20.0.0.0/24 is subnetted, 4 subnets
C      20.0.0.0 is directly connected, FastEthernet0/0
O IA  20.1.0.0 [110/4] via 20.0.2.3, 00:15:57, FastEthernet0/1
O      20.0.1.0 [110/4] via 20.0.2.3, 00:15:57, FastEthernet0/1
      [110/4] via 20.0.0.1, 00:15:57, FastEthernet0/0
C      20.0.2.0 is directly connected, FastEthernet0/1
C    22.0.0.0/8 is directly connected, FastEthernet2/0
R2#
```

Figura 6: Comanda *show ip route* en el encaminador R2



```

R2
Fitxer  Edita  Visualitza  Cerca  Terminal  Ajuda
R2#show ip ospf database

        OSPF Router with ID (22.0.0.1) (Process ID 1)

        Router Link States (Area 0)

Link ID        ADV Router    Age          Seq#          Checksum Link count
20.0.1.1       20.0.1.1      1016        0x80000002   0x00B7E5  2
20.1.0.1       20.1.0.1      1011        0x80000003   0x008F02  2
22.0.0.1       22.0.0.1      1010        0x80000003   0x00CFC4  2

        Net Link States (Area 0)

Link ID        ADV Router    Age          Seq#          Checksum
20.0.0.1       20.0.1.1      1016        0x80000001   0x006F72
20.0.1.1       20.0.1.1      1016        0x80000001   0x005A87
20.0.2.3       20.1.0.1      1011        0x80000001   0x00439A

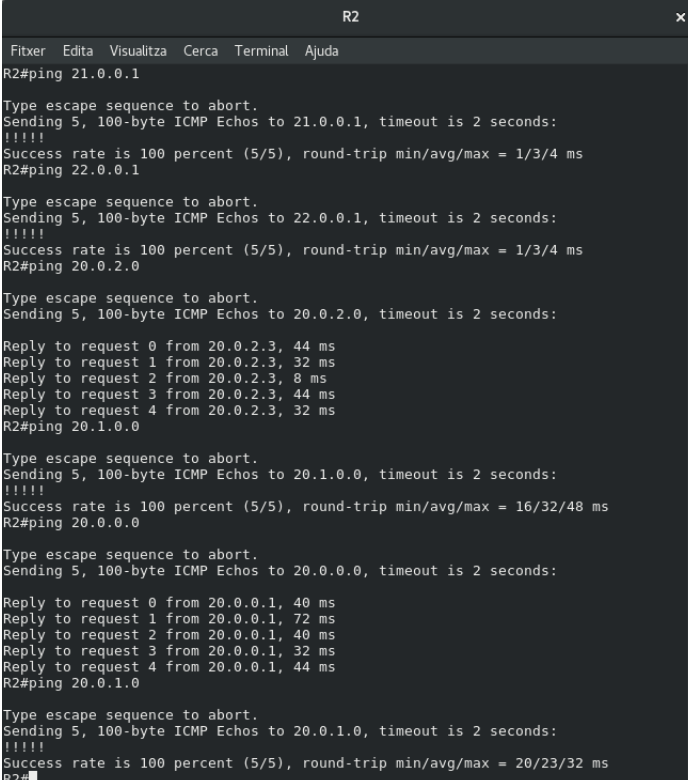
        Summary Net Link States (Area 0)

Link ID        ADV Router    Age          Seq#          Checksum
20.1.0.0       20.1.0.1      996         0x80000003   0x00CF3D

        Type-5 AS External Link States

Link ID        ADV Router    Age          Seq#          Checksum Tag
21.0.0.0       22.0.0.1      1053        0x80000001   0x00096B  0
22.0.0.0       22.0.0.1      1055        0x80000001   0x00FB77  0
R2#

```

Figura 7: Comanda *show ip ospf database* en el encaminador R2


```

R2
Fitxer  Edita  Visualitza  Cerca  Terminal  Ajuda
R2#ping 21.0.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 21.0.0.1, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms
R2#ping 22.0.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 22.0.0.1, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms
R2#ping 20.0.2.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.2.0, timeout is 2 seconds:

Reply to request 0 from 20.0.2.3, 44 ms
Reply to request 1 from 20.0.2.3, 32 ms
Reply to request 2 from 20.0.2.3, 8 ms
Reply to request 3 from 20.0.2.3, 44 ms
Reply to request 4 from 20.0.2.3, 32 ms
R2#ping 20.1.0.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.1.0.0, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/32/48 ms
R2#ping 20.0.0.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.0.0, timeout is 2 seconds:

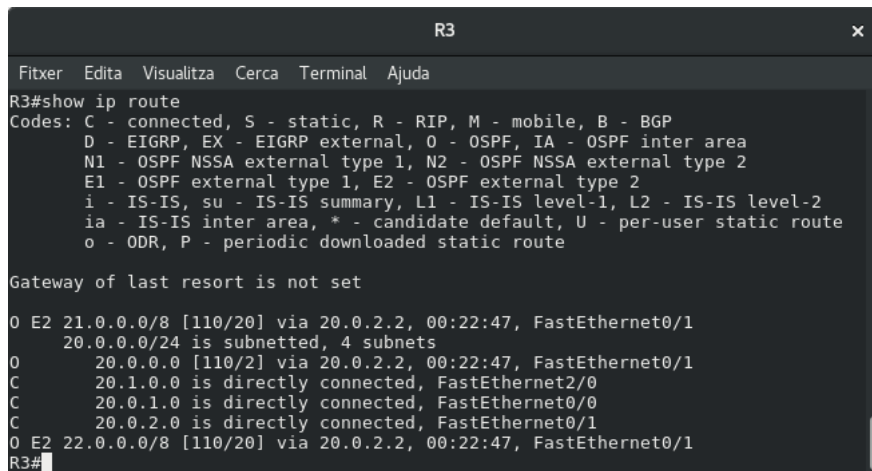
Reply to request 0 from 20.0.0.1, 40 ms
Reply to request 1 from 20.0.0.1, 72 ms
Reply to request 2 from 20.0.0.1, 40 ms
Reply to request 3 from 20.0.0.1, 32 ms
Reply to request 4 from 20.0.0.1, 44 ms
R2#ping 20.0.1.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.1.0, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/23/32 ms
R2#

```

Figura 8: Prova de connectivitat a la xarxa des de l'encaminador R2

3.2.3 Encaminador R3



```

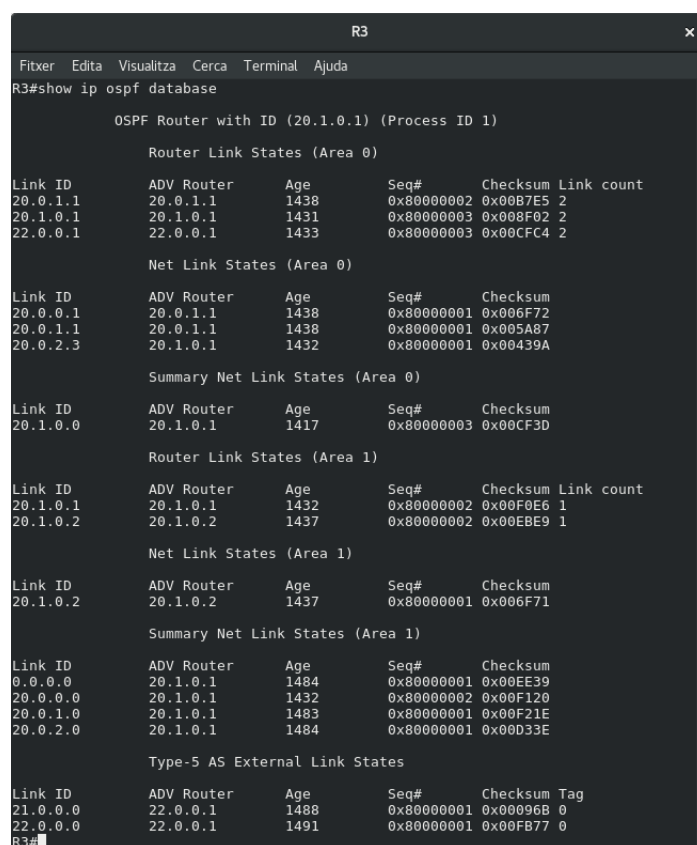
R3#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2
        i - IS-IS, 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

O E2 21.0.0.0/8 [110/20] via 20.0.2.2, 00:22:47, FastEthernet0/1
    20.0.0.0/24 is subnetted, 4 subnets
O     20.0.0.0 [110/2] via 20.0.2.2, 00:22:47, FastEthernet0/1
C     20.1.0.0 is directly connected, FastEthernet2/0
C     20.0.1.0 is directly connected, FastEthernet0/0
C     20.0.2.0 is directly connected, FastEthernet0/1
O E2 22.0.0.0/8 [110/20] via 20.0.2.2, 00:22:47, FastEthernet0/1
R3#

```

Figura 9: Comanda *show ip route* en el encaminador R3



```

R3#show ip ospf database

OSPF Router with ID (20.1.0.1) (Process ID 1)

Router Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum Link count
20.0.1.1     20.0.1.1     1438        0x80000002  0x00B7E5  2
20.1.0.1     20.1.0.1     1431        0x80000003  0x008F02  2
22.0.0.1     22.0.0.1     1433        0x80000003  0x00CFC4  2

Net Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum
20.0.0.1     20.0.1.1     1438        0x80000001  0x006F72
20.0.1.1     20.0.1.1     1438        0x80000001  0x005A87
20.0.2.3     20.1.0.1     1432        0x80000001  0x00439A

Summary Net Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum
20.1.0.0     20.1.0.1     1417        0x80000003  0x00CF3D

Router Link States (Area 1)

Link ID      ADV Router   Age         Seq#         Checksum Link count
20.1.0.1     20.1.0.1     1432        0x80000002  0x00F0E6  1
20.1.0.2     20.1.0.2     1437        0x80000002  0x00EBE9  1

Net Link States (Area 1)

Link ID      ADV Router   Age         Seq#         Checksum
20.1.0.2     20.1.0.2     1437        0x80000001  0x006F71

Summary Net Link States (Area 1)

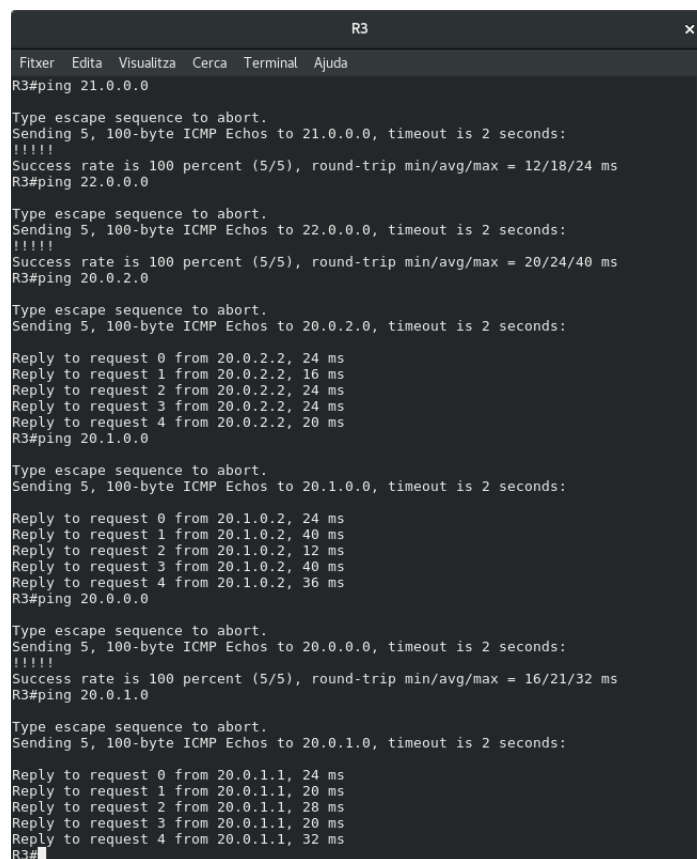
Link ID      ADV Router   Age         Seq#         Checksum
0.0.0.0      20.1.0.1     1484        0x80000001  0x00EE39
20.0.0.0     20.1.0.1     1432        0x80000002  0x00F120
20.0.1.0     20.1.0.1     1483        0x80000001  0x00F21E
20.0.2.0     20.1.0.1     1484        0x80000001  0x00D33E

Type-5 AS External Link States

Link ID      ADV Router   Age         Seq#         Checksum Tag
21.0.0.0     22.0.0.1     1488        0x80000001  0x00096B  0
22.0.0.0     22.0.0.1     1491        0x80000001  0x00FB77  0
R3#

```

Figura 10: Comanda *show ip ospf database* en el encaminador R3



```
R3
Fitxer  Edita  Visualitza  Cerca  Terminal  Ajuda
R3#ping 21.0.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 21.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/18/24 ms
R3#ping 22.0.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 22.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/24/40 ms
R3#ping 20.0.2.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.2.0, timeout is 2 seconds:

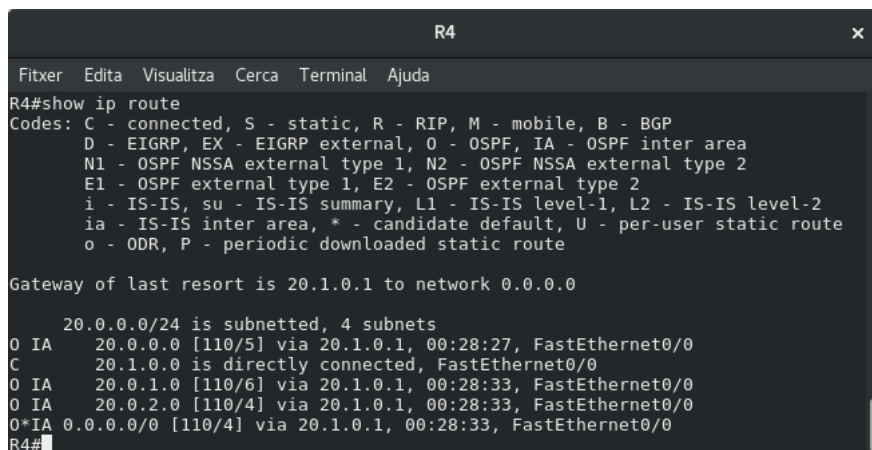
Reply to request 0 from 20.0.2.2, 24 ms
Reply to request 1 from 20.0.2.2, 16 ms
Reply to request 2 from 20.0.2.2, 24 ms
Reply to request 3 from 20.0.2.2, 24 ms
Reply to request 4 from 20.0.2.2, 20 ms
R3#ping 20.1.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.1.0.0, timeout is 2 seconds:

Reply to request 0 from 20.1.0.2, 24 ms
Reply to request 1 from 20.1.0.2, 40 ms
Reply to request 2 from 20.1.0.2, 12 ms
Reply to request 3 from 20.1.0.2, 40 ms
Reply to request 4 from 20.1.0.2, 36 ms
R3#ping 20.0.0.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/21/32 ms
R3#ping 20.0.1.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.1.0, timeout is 2 seconds:

Reply to request 0 from 20.0.1.1, 24 ms
Reply to request 1 from 20.0.1.1, 20 ms
Reply to request 2 from 20.0.1.1, 28 ms
Reply to request 3 from 20.0.1.1, 20 ms
Reply to request 4 from 20.0.1.1, 32 ms
R3#
```

Figura 11: Prova de connectivitat a la xarxa des de l'encaminador R3

3.2.4 Encaminador R4

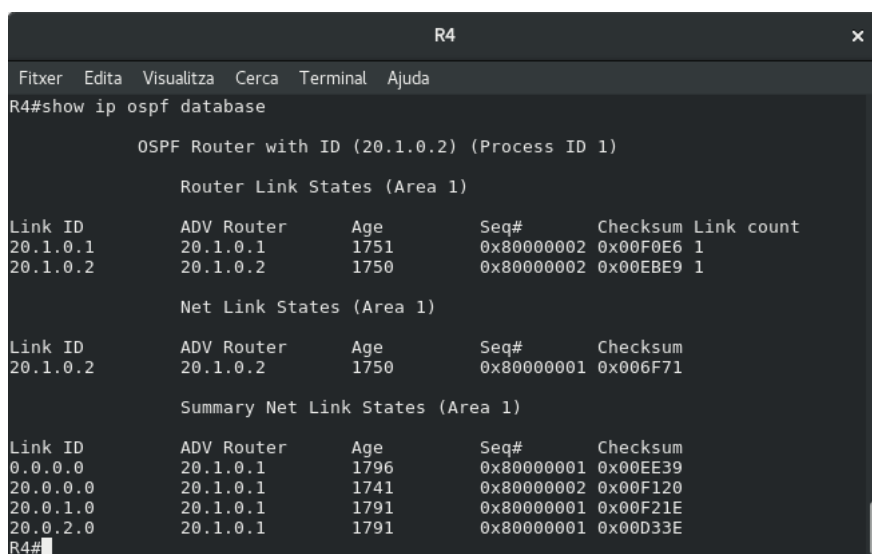


```
R4
Fitxer  Edita  Visualitza  Cerca  Terminal  Ajuda
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external 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 20.1.0.1 to network 0.0.0.0

    20.0.0.0/24 is subnetted, 4 subnets
O IA   20.0.0.0 [110/5] via 20.1.0.1, 00:28:27, FastEthernet0/0
C       20.1.0.0 is directly connected, FastEthernet0/0
O IA   20.0.1.0 [110/6] via 20.1.0.1, 00:28:33, FastEthernet0/0
O IA   20.0.2.0 [110/4] via 20.1.0.1, 00:28:33, FastEthernet0/0
O*IA  0.0.0.0/0 [110/4] via 20.1.0.1, 00:28:33, FastEthernet0/0
R4#
```

Figura 12: Comanda *show ip route* en el encaminador R4



```

R4#show ip ospf database

        OSPF Router with ID (20.1.0.2) (Process ID 1)

        Router Link States (Area 1)

Link ID      ADV Router   Age         Seq#          Checksum Link count
20.1.0.1     20.1.0.1     1751        0x80000002   0x00F0E6 1
20.1.0.2     20.1.0.2     1750        0x80000002   0x00EBE9 1

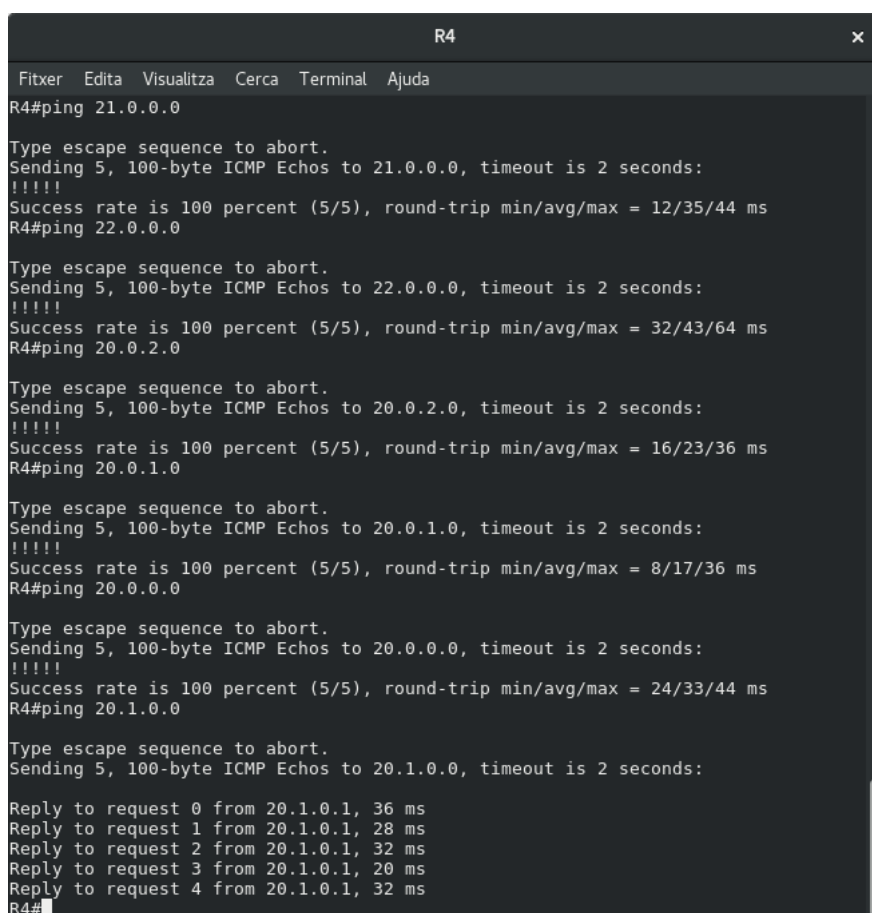
        Net Link States (Area 1)

Link ID      ADV Router   Age         Seq#          Checksum
20.1.0.2     20.1.0.2     1750        0x80000001   0x006F71

        Summary Net Link States (Area 1)

Link ID      ADV Router   Age         Seq#          Checksum
0.0.0.0      20.1.0.1     1796        0x80000001   0x00EE39
20.0.0.0     20.1.0.1     1741        0x80000002   0x00F120
20.0.1.0     20.1.0.1     1791        0x80000001   0x00F21E
20.0.2.0     20.1.0.1     1791        0x80000001   0x00D33E
R4#

```

Figura 13: Comanda *show ip ospf database* en el encaminador R4


```

R4#ping 21.0.0.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 21.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/35/44 ms
R4#ping 22.0.0.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 22.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/43/64 ms
R4#ping 20.0.2.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.2.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/23/36 ms
R4#ping 20.0.1.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.1.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/17/36 ms
R4#ping 20.0.0.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.0.0, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/33/44 ms
R4#ping 20.1.0.0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.1.0.0, timeout is 2 seconds:

Reply to request 0 from 20.1.0.1, 36 ms
Reply to request 1 from 20.1.0.1, 28 ms
Reply to request 2 from 20.1.0.1, 32 ms
Reply to request 3 from 20.1.0.1, 20 ms
Reply to request 4 from 20.1.0.1, 32 ms
R4#

```

Figura 14: Prova de connectivitat a la xarxa des de l'encaminador R4

4 BGP

4.1 Topologia de la xarxa