

Protocolo RIP y OSPF

PROTOCOLO DE ENRUTAMIENTO
DINÁMICO RIP y OSPF

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CONTENIDO

- INTRODUCCION AL PROTOCOLO RIP
- FORMATO DEL PROTOCOLO RIP
- CONFIGURACIÓN DE RIPv1/RIPv2
- INTRODUCCIÓN AL PROTOCOLO OSPFv2
- FORMATO DEL PROTOCOLO OSPFv2
- CONFIGURACIÓN DE OSPFv2
- CONFIGURACIÓN RIPv2/OSPFv2



INTRODUCCIÓN AL PROTOCOLO RIP

RFC 1058 *Routing Information Protocol*, Junio 1988

RFC 1723 *RIP version 2*, Noviembre 1994

CLASIFICACIÓN DE LOS PROTOCOLOS

Protocolos de gateway interiores

Protocolos de Gateway Exteriores

Protocolos de enrutamiento
por vector de distancia

Protocolos de enrutamiento
de estado de enlace

Vector de ruta

Con clase

RIP

IGRP

EGP

Sin clase

RIPv2

EIGRP

OSPFv2

IS-IS

BGPv4

IPv6

RIPng

EIGRP for IPv6

OSPFv3

IS-IS for IPv6

BGPv4 for IPv6

Información de CCNA-CISCO

INTRODUCCION AL PROTOCOLO RIP

- **RIP presenta dos versiones: RIPv1 y RIPv2**
 - ▶ **RIPv1** → Es un protocolo de enrutamiento con clase.
 - ▶ **RIPv2** → Es un protocolo de enrutamiento sin clase.
- **RIP utiliza el algoritmo Vector Distancia.**
- **RIP utiliza como métrica el número de saltos**
 - ▶ Máximo número de saltos en un trayecto (*path*) es 15.
Mayores a 15 saltos es inalcanzable.
- **RIP difunde su tabla de enrutamiento completa a cada router vecino en intervalos de 30 segundos**
 - ▶ Dirección MAC=FF FF FF FF FF FF



RIPv1 – vs – RIPv2

- **RIPv1 envía sus actualizaciones en broadcast en la dirección IP 255.255.255.255**
- **RIPv2 envía sus actualizaciones en multicast en la dirección IP 224.0.0.9**
- **RIPv2 permite autenticación: texto plano o cifrado MD5.**
- **RIPv1 y RIPv2 se encapsulan en UDP.**
 - En puerto utilizado es el 520.

RIP es capaz de equilibrar las cargas hasta en seis rutas de igual costos, siendo cuatro rutas la cantidad por defecto.



TEMPORIZACION DEL PROTOCOLO RIP

- **RIP emplea temporizadores para mejorar su rendimiento.**

- ▶ **Routing-update timer** → Inicialmente 30 seg.
Intervalo entre las actualizaciones de tabla de enrutamiento.
- ▶ **Route-timeout timer** → ó Hold down en 180 seg.
Cada entrada tiene un *route-timeout* asociado.
Cuando expira, la ruta es señalada como inválida y la métrica configura con 16; pero no es borrada de la tabla de enrutamiento.
- ▶ **Route-flush timer** → Inicialmente en 240 seg
Cuando expira el *route-timeout*, se borrará la entrada de la tabla de enrutamiento cuando expira el *route-flush* timer.

ACTUALIZACIONES SINCRONIZADAS

- **Cuando los routers envían actualizaciones al mismo tiempo, se puede producir colisiones, retardos y gran consumo de ancho de banda.**

- ▶ El envío de actualizaciones al mismo tiempo se denomina sincronización de actualizaciones.
- ▶ RIP puede experimentar problemas ya que envía actualizaciones periódicas.

- **Cual es la solución.**

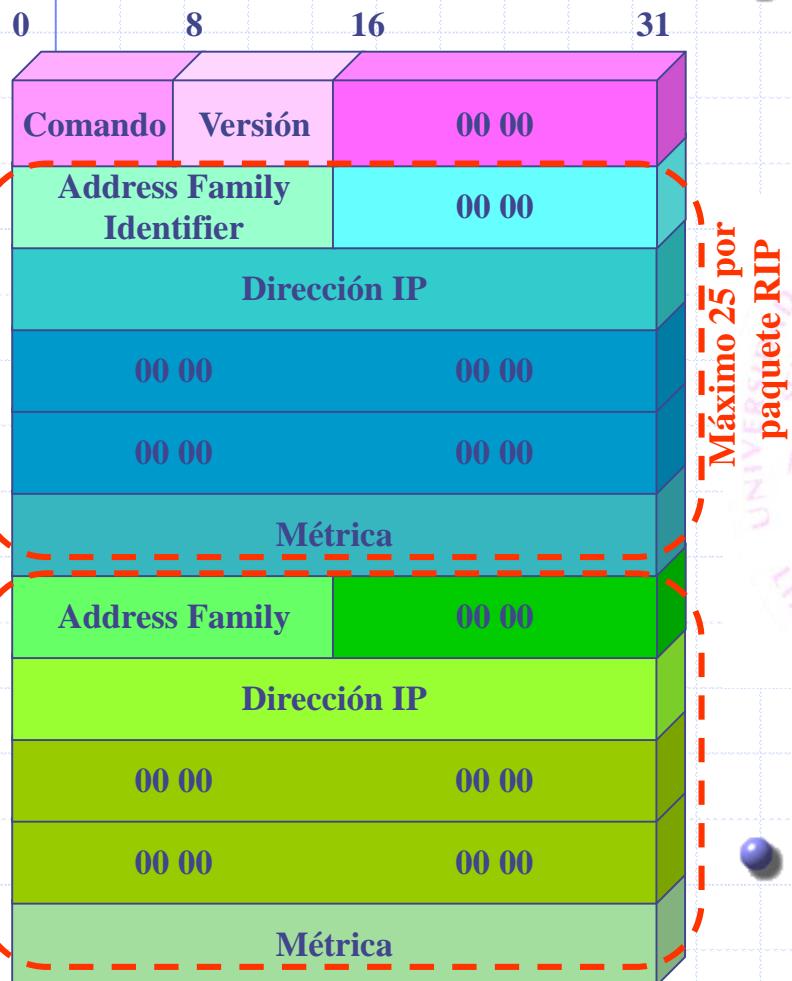
- ▶ Para evitar la sincronización de actualizaciones, se considera la variable RIP_JITTER (usado por el IOS de cisco); cuyo valor fluctúa entre 0% a 15%. De este modo el intervalo de actualización varía entre 25 a 30 seg. en lugar de los 30 seg.



FORMATO DEL PROTOCOLO RIP

FORMATO DEL PROTOCOLO RIPv1

RIPv1



- **Comando:** Indica si el paquete RIP es de requerimiento o respuesta.

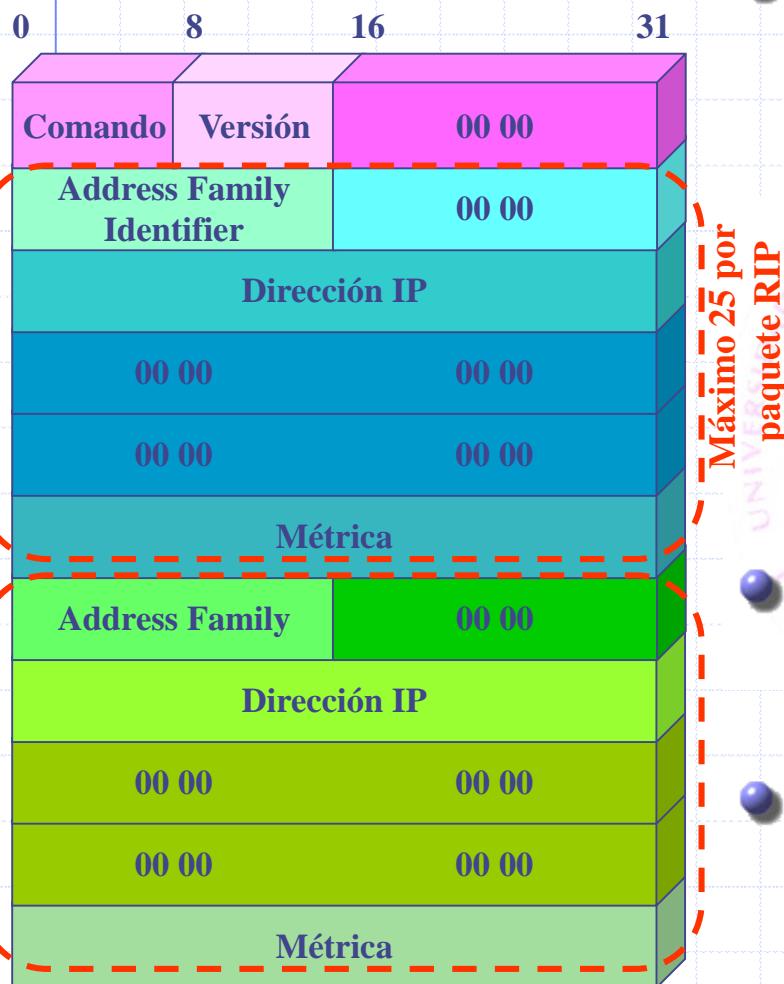
- **Requerimiento (1)** pregunta a un router por el envío total o parcial de su tabla de enrutamiento.

- **Respuesta (2)** puede ser una actualización de enrutamiento no solicitada o en respuesta a un requerimiento.

- **Version:** Indica versión del protocolo RIP. Está en 1.

FORMATO DEL PROTOCOLO RIPv1

RIPv1



- Address Family Identifier AFI.***

- Especifica la familia de dirección usada. RIP está diseñado para llevar información de enrutamiento de varios tipos de protocolos.
- AFI está en **2 para IP**.

- Dirección IP: Indica la dirección IP de entrada.***

- Métrica: Indica cuantos routers atraviesa RIP.***

- El valor está entre 1 a 15.

FORMATO DEL PROTOCOLO RIPv2

<http://www.rfc-editor.org/rfc/pdfrfc/rfc2453.txt.pdf>

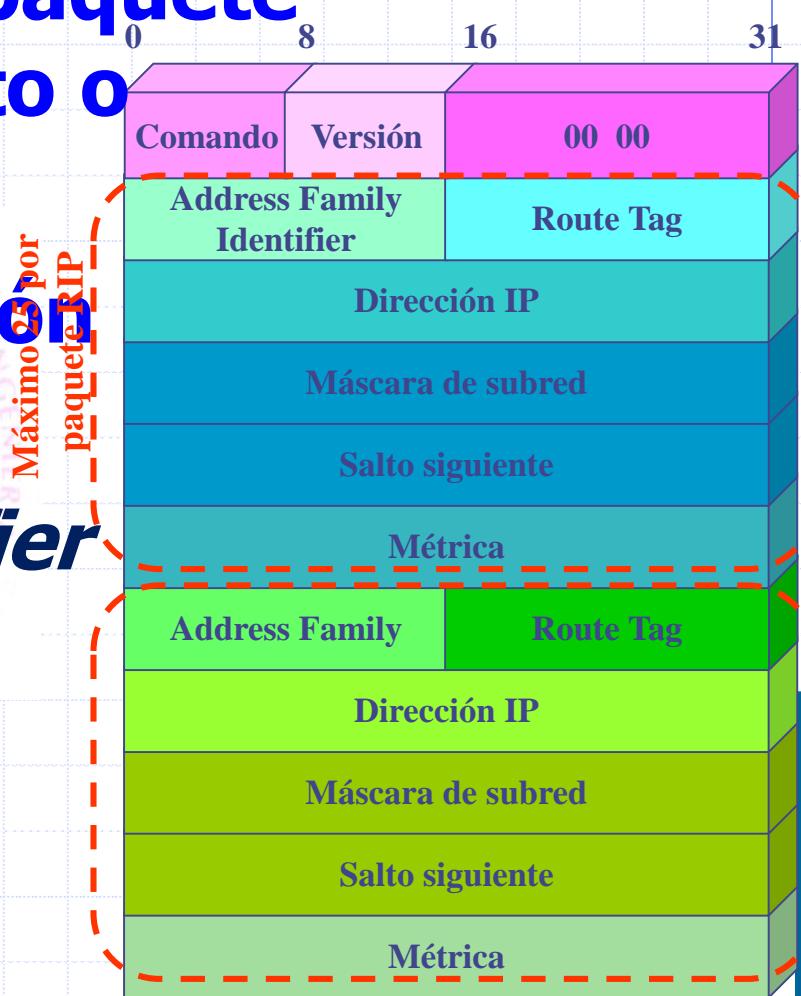
• **Comando:** Indica si el paquete RIPv2

RIP es de requerimiento o respuesta.

• **Version:** Indica la versión del protocolo RIP.

• **Address Family Identifier AFI:**

- ▶ Es similar al RIPv1, con una excepción
- ▶ Si el AFI de la primera entrada está en FFFFh, el resto de las entradas contiene información de autenticación.



FORMATO DEL PROTOCOLO RIPv2

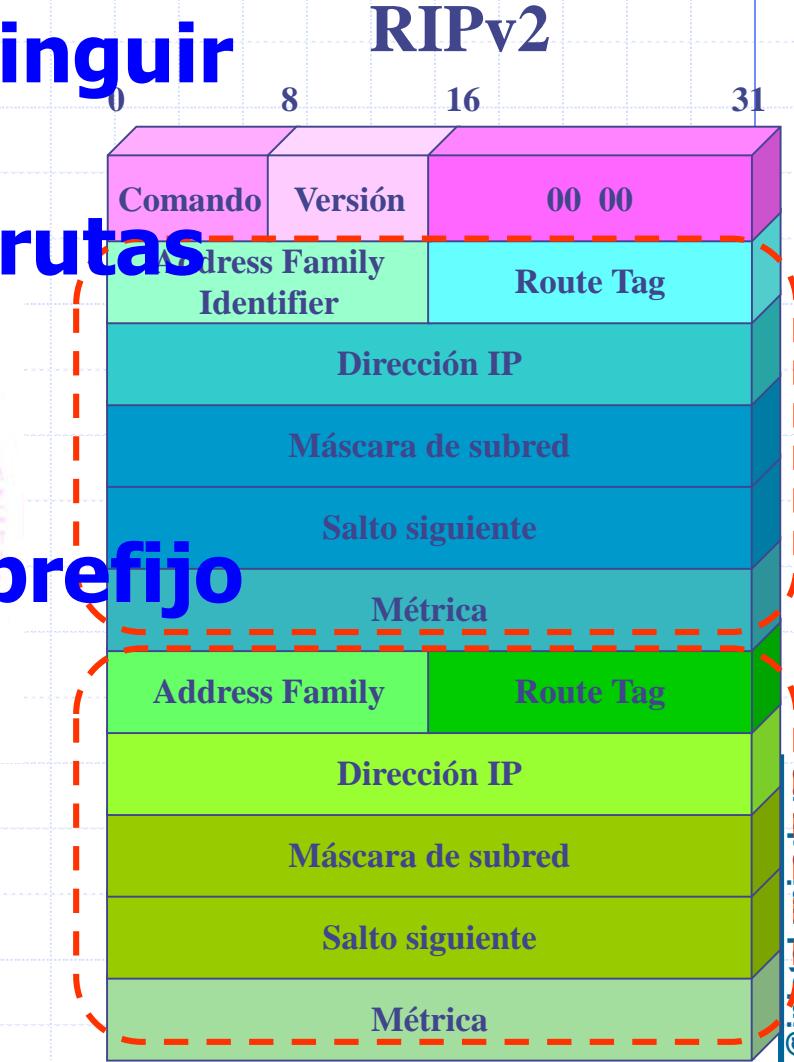
<http://www.rfc-editor.org/rfc/pdfrfc/rfc2453.txt.pdf>

- **Route tag:** Permite distinguir entre rutas internas (reconocida por RIP) y rutas externas (por otros Protocolos EGP).

- **Dirección IP:** Indica el prefijo de red de entrada.

- **Máscara de Subred:** Contiene la máscara de subred de entrada.

- **Métrica:** Cuantos routers atraviesa RIP.

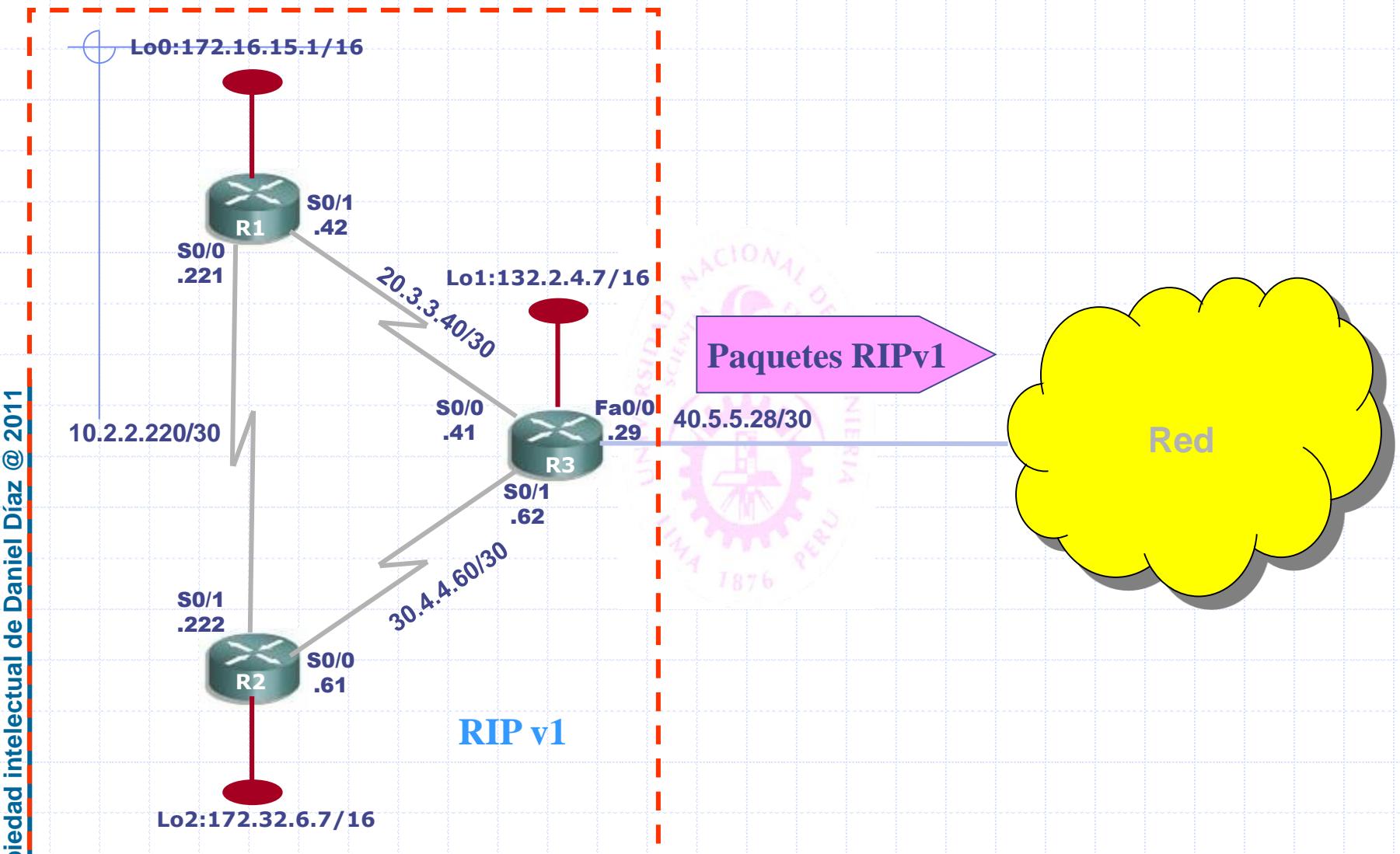




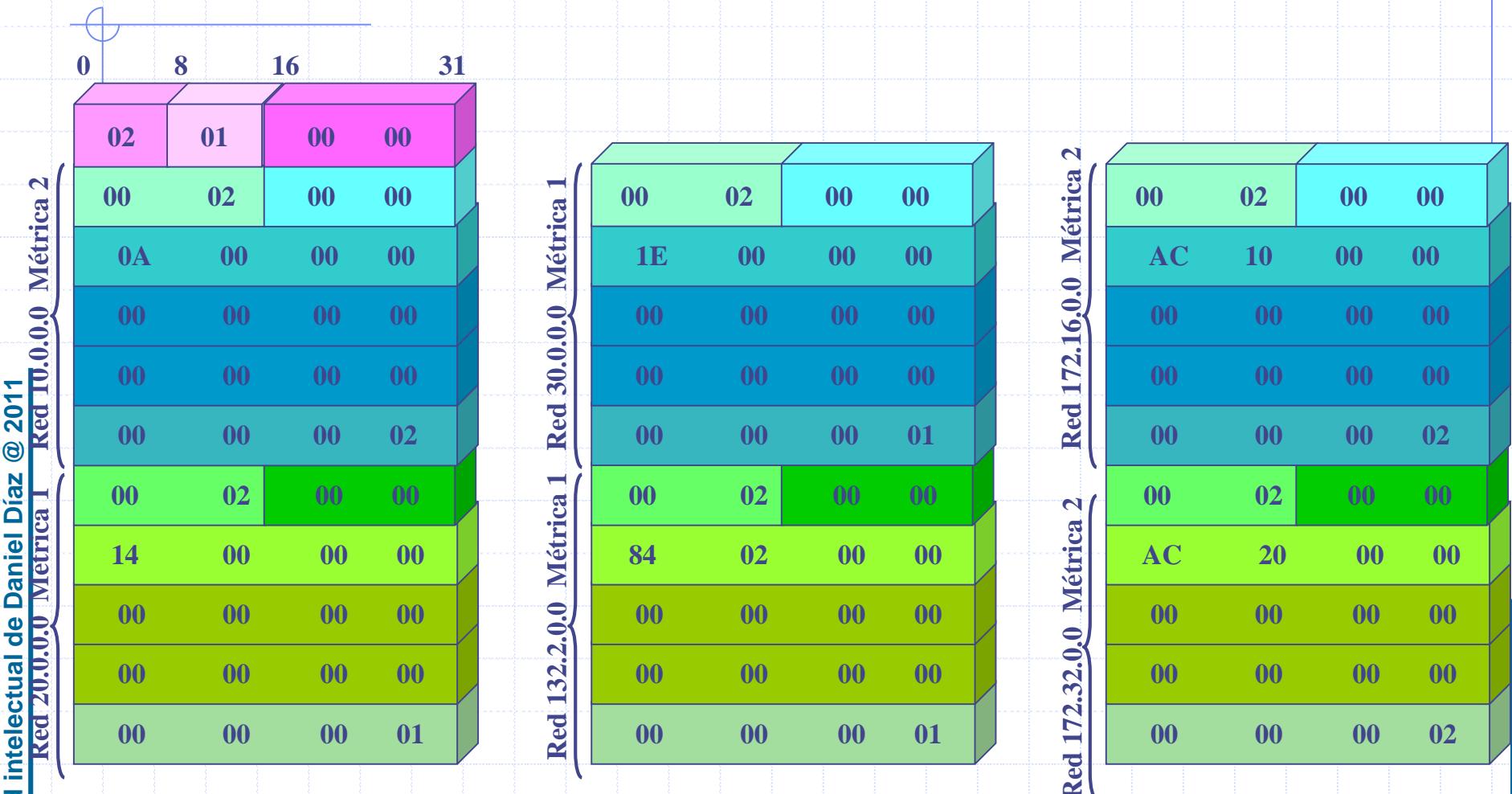
ENCAPSULAMIENTO DEL PROTOCOLO RIPv2



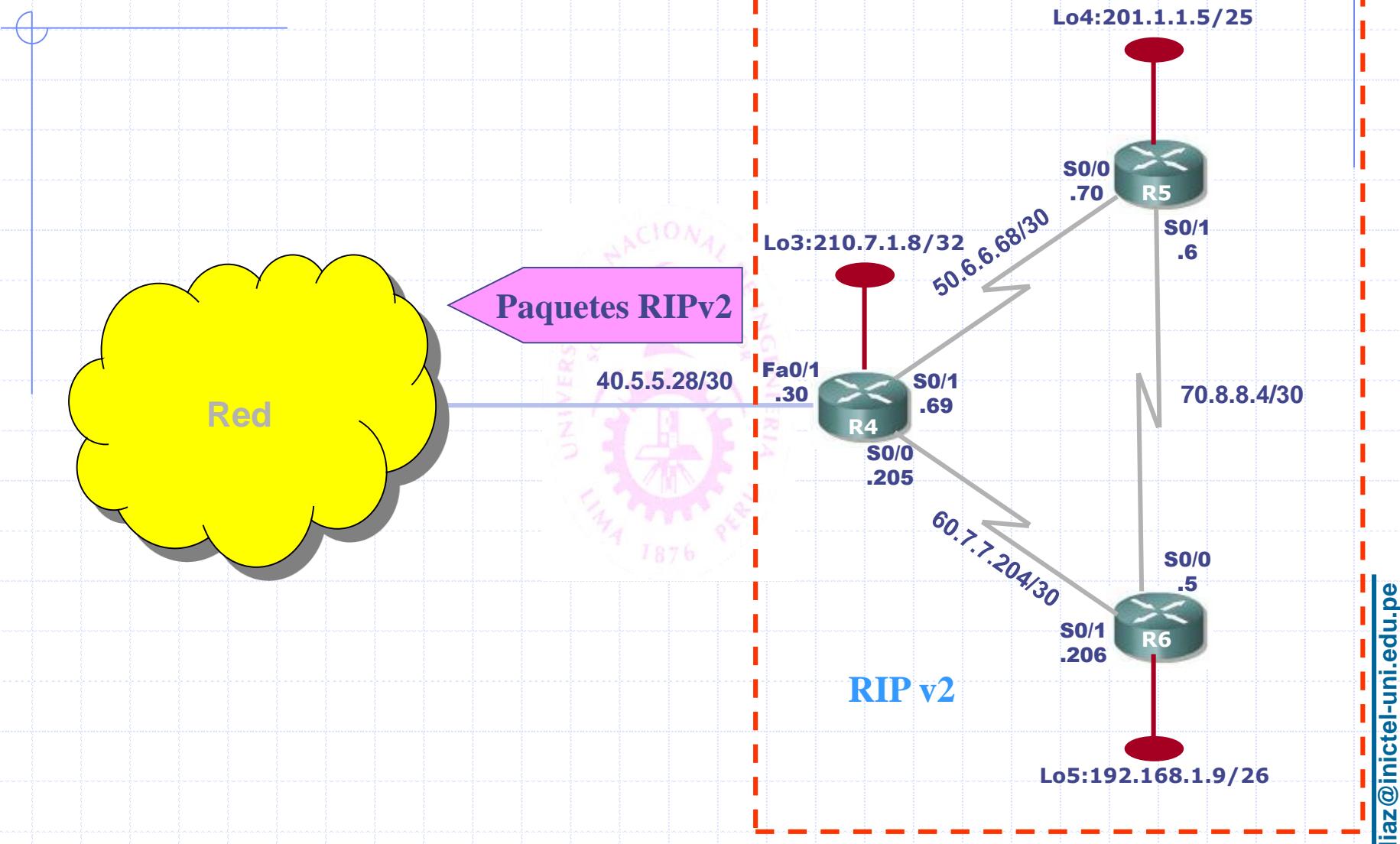
ANALISIS DEL PROTOCOLO RIPv1



ANALISIS DEL PROTOCOLO RIPv1



ANALISIS DEL PROTOCOLO RIPv2



ANALISIS DEL PROTOCOLO RIPv2

	0	8	16	31
Propiedad intelectual de Daniel Díaz @ 2011	02	02	00	00
Red 60.7.7.204 Métrica 1	00	02	00	00
Red 50.6.6.68 Métrica 1	32	06	06	44
	FF	FF	FF	FC
	00	00	00	00
	00	00	00	01
	00	02	00	00
Red 192.168.1.0 Métrica 2	3C	07	07	CC
Red 70.8.8.4 Métrica 2	FF	FF	FF	FC
Red 210.7.1.8 Métrica 1	00	00	00	00
Red 201.1.1.0 Métrica 2	00	00	00	01

	00	02	00	00
Propiedad intelectual de Daniel Díaz @ 2011	00	08	08	04
Red 60.7.7.204 Métrica 1	FF	FF	FF	FC
Red 50.6.6.68 Métrica 1	00	00	00	00
Red 70.8.8.4 Métrica 2	00	00	00	02
Red 192.168.1.0 Métrica 2	00	02	00	00
Red 210.7.1.8 Métrica 1	C0	A8	01	00
Red 201.1.1.0 Métrica 2	FF	FF	FF	C0
Red 210.7.1.8 Métrica 1	00	00	00	00
Red 201.1.1.0 Métrica 2	00	00	00	02

	00	02	00	00
Propiedad intelectual de Daniel Díaz @ 2011	00	02	00	00
Red 60.7.7.204 Métrica 1	C9	01	01	00
Red 50.6.6.68 Métrica 1	FF	FF	FF	80
Red 70.8.8.4 Métrica 2	00	00	00	00
Red 192.168.1.0 Métrica 2	00	00	00	02
Red 210.7.1.8 Métrica 1	00	02	00	00
Red 201.1.1.0 Métrica 2	D8	07	01	08
Red 210.7.1.8 Métrica 1	FF	FF	FF	FF
Red 201.1.1.0 Métrica 2	00	00	00	00
Red 210.7.1.8 Métrica 1	00	00	00	01



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Enrutamiento Dinámico: RIP y OSPF



CONFIGURACIÓN DE RIPv1/RIPv2

CONFIGURACION BASICA

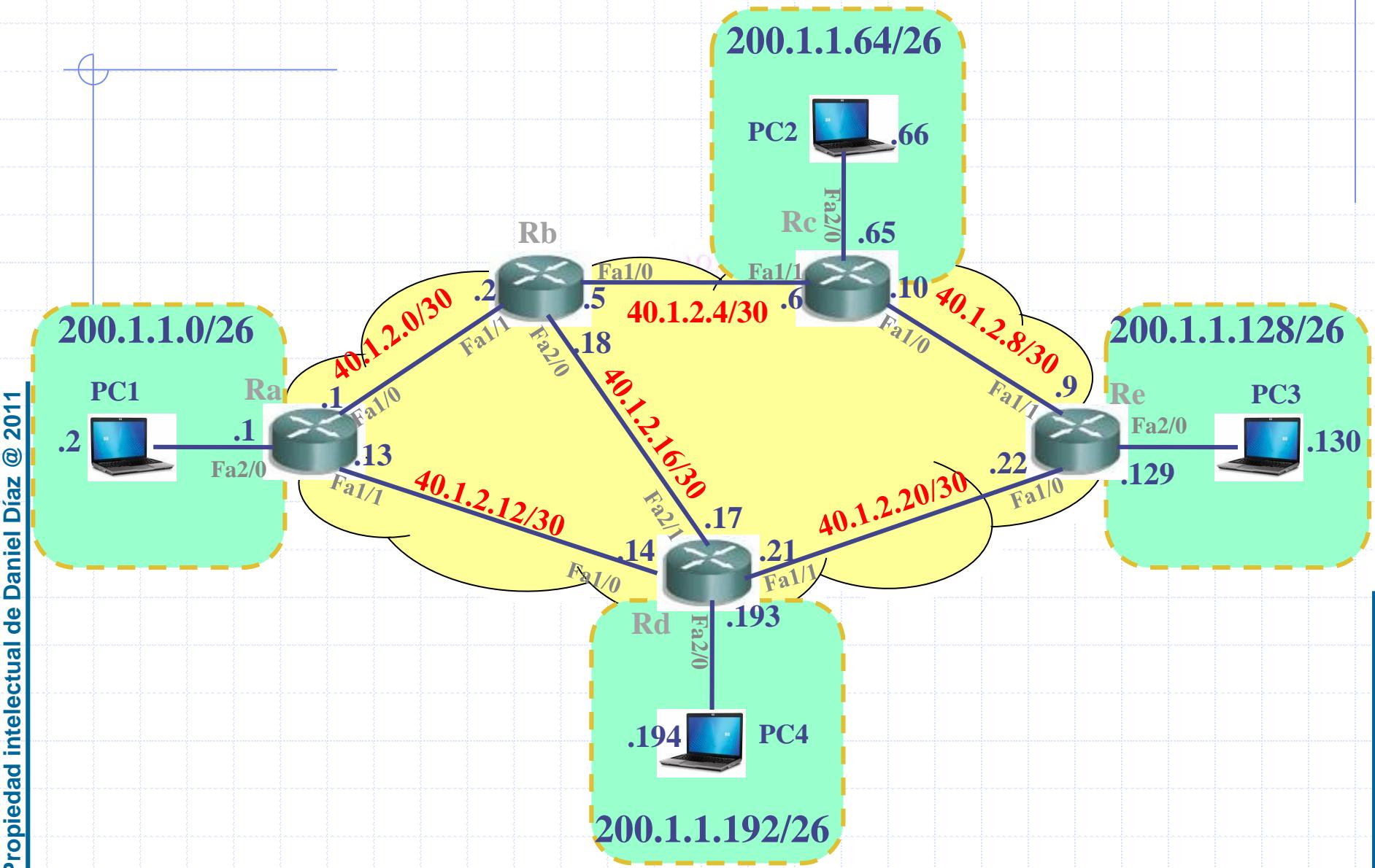
• Configurar RIPv1:

- ▶ Activar el protocolo RIPv1:
`router rip`
- ▶ Anunciar redes:
`network <dirección de red>`

• Configurar RIPv2 en R4

- ▶ Activar el protocolo RIPv2:
`router rip`
- ▶ Especificar la versión 2:
`version 2`
- ▶ Anunciar redes:
`network <dirección de red>`

EJEMPLO DE CONFIGURACIÓN RIPv2



EJEMPLO DE CONFIGURACIÓN RIPv2

- Tablas de enrutamiento inicial:

- ▶ Router Ra

```
Ra#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

200.1.1.0/26 is subnetted, 1 subnets

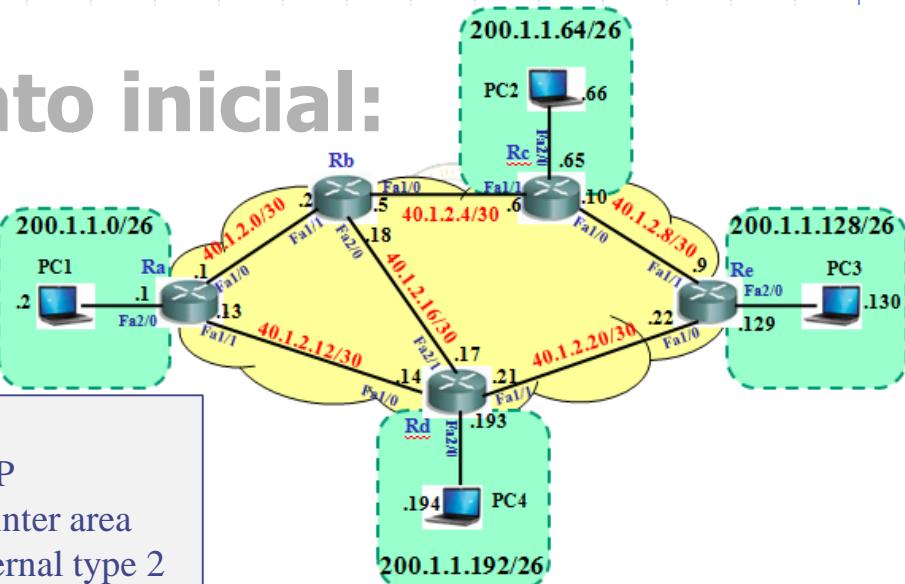
C 200.1.1.0 is directly connected, FastEthernet2/0

40.0.0.0/30 is subnetted, 2 subnets

C 40.1.2.12 is directly connected, FastEthernet1/1

C 40.1.2.0 is directly connected, FastEthernet1/0

Ra#



EJEMPLO DE CONFIGURACIÓN RIPv2

- Tablas de enrutamiento inicial:

► Router Rb

```
Rb#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

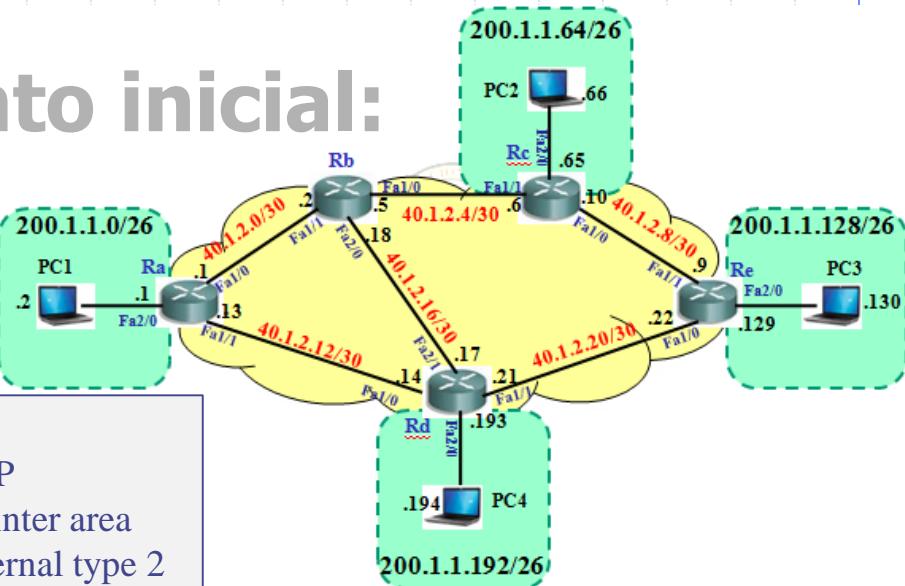
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

40.0.0.0/30 is subnetted, 3 subnets

- C 40.1.2.0 is directly connected, FastEthernet1/1
- C 40.1.2.4 is directly connected, FastEthernet1/0
- C 40.1.2.16 is directly connected, FastEthernet2/0

Rb#



EJEMPLO DE CONFIGURACIÓN RIPv2

- Tablas de enrutamiento inicial:

- ▶ Router **Rc**

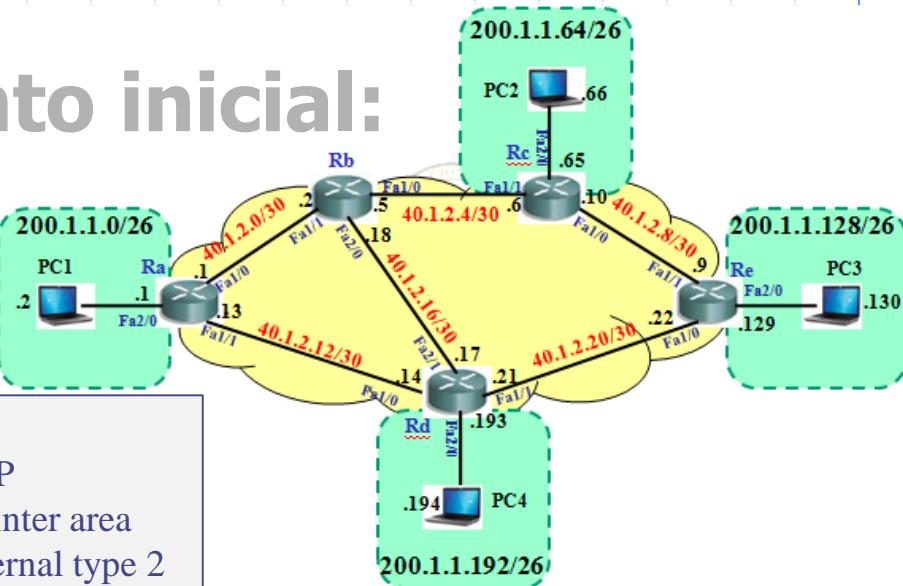
```
Rc#show ip route
```

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

- 200.1.1.0/26 is subnetted, 1 subnets
 - C 200.1.1.64 is directly connected, FastEthernet2/0
 - 40.0.0.0/30 is subnetted, 2 subnets
 - C 40.1.2.8 is directly connected, FastEthernet1/0
 - C 40.1.2.4 is directly connected, FastEthernet1/1
- Rc#



EJEMPLO DE CONFIGURACIÓN RIPv2

- Tablas de enrutamiento inicial:

- ▶ Router Rd

Rd#show ip route

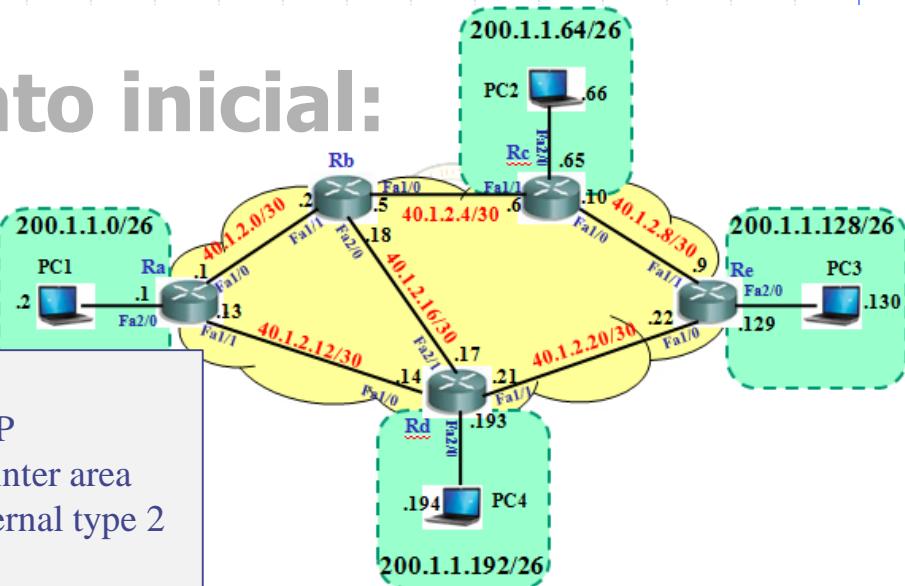
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

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

- 200.1.1.0/26 is subnetted, 1 subnets
- C 200.1.1.192 is directly connected, FastEthernet2/0
- 40.0.0.0/30 is subnetted, 3 subnets
- C 40.1.2.12 is directly connected, FastEthernet1/0
- C 40.1.2.16 is directly connected, FastEthernet2/1
- C 40.1.2.20 is directly connected, FastEthernet1/1

Rd#



EJEMPLO DE CONFIGURACIÓN RIPv2

- Tablas de enrutamiento inicial:

- ▶ Router Re

```
Re#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

200.1.1.0/26 is subnetted, 1 subnets

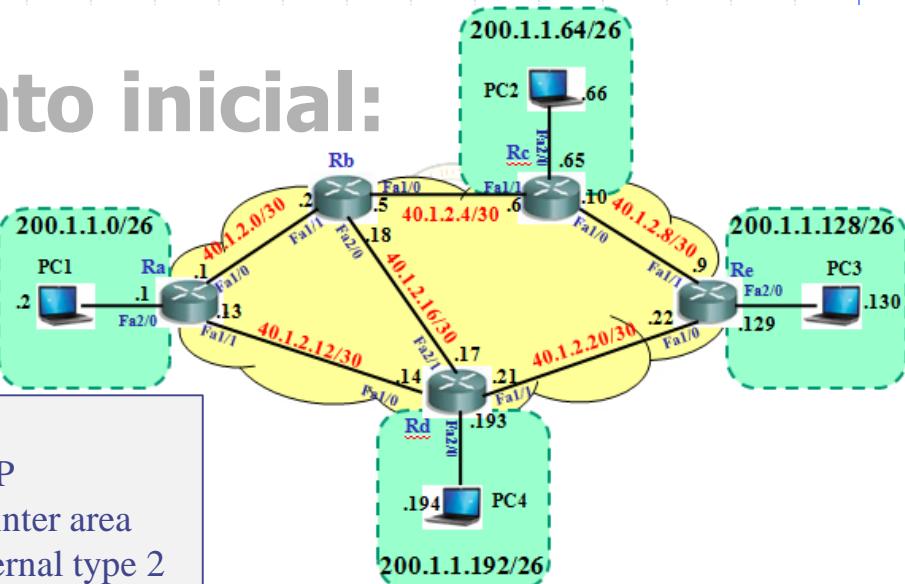
C 200.1.1.128 is directly connected, FastEthernet2/0

40.0.0.0/30 is subnetted, 2 subnets

C 40.1.2.8 is directly connected, FastEthernet1/1

C 40.1.2.20 is directly connected, FastEthernet1/0

Re#



EJEMPLO DE CONFIGURACIÓN RIPv2

Configurando RIPv2: Routers Ra y Rb

Ra>

```
Ra>enable
```

```
Ra#configure terminal
```

Enter configuration commands, one per line. End with CNTL/Z.

```
Ra(config)#router rip
```

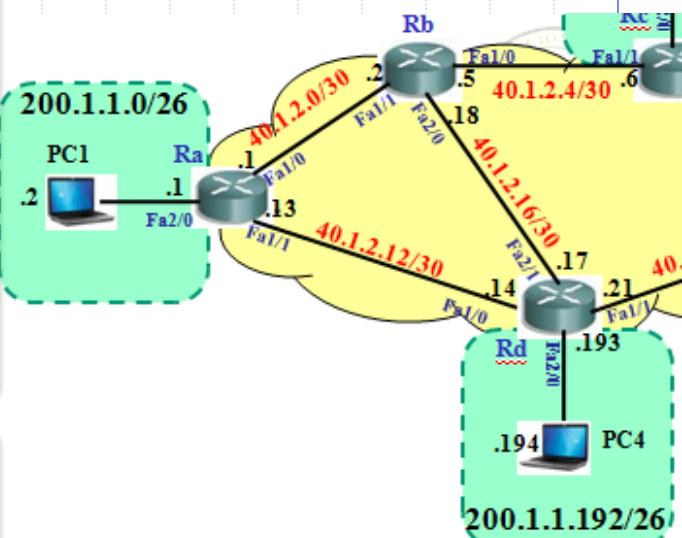
```
Ra(config-router)#version 2
```

```
Ra(config-router)#network 200.1.1.0
```

```
Ra(config-router)#network 40.0.0.0
```

```
Ra(config-router)#exit
```

```
Ra(config)#
```



Rb>

```
Rb>enable
```

```
Rb#configure terminal
```

Enter configuration commands, one per line. End with CNTL/Z.

```
Rb(config)#router rip
```

```
Rb(config-router)#version 2
```

```
Rb(config-router)#network 40.0.0.0
```

```
Rb(config-router)#exit
```

```
Rb(config)#
```

EJEMPLO DE CONFIGURACIÓN RIPv2

Configurando RIPv2: Routers Rc y Rd

Rc>

Rc>enable

Rc#configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Rc(config)#router rip

Rc(config-router)#version 2

Rc(config-router)#network 200.1.1.0

Rc(config-router)#network 40.0.0.0

Rc(config-router)#exit

Rc(config)#

Rd>

Rd>enable

Rd#configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Rd(config)#router rip

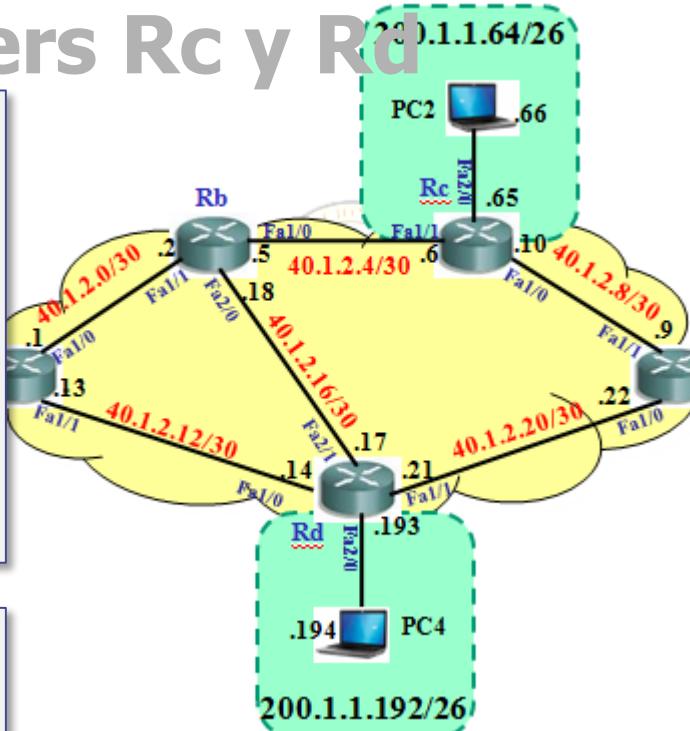
Rd(config-router)#version 2

Rd(config-router)#network 200.1.1.0

Rd(config-router)#network 40.0.0.0

Rd(config-router)#exit

Rd(config)#



EJEMPLO DE CONFIGURACIÓN RIPv2

Configurando RIPv2: Router Re

Re>

Re>enable

Re#configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Re(config)#router rip

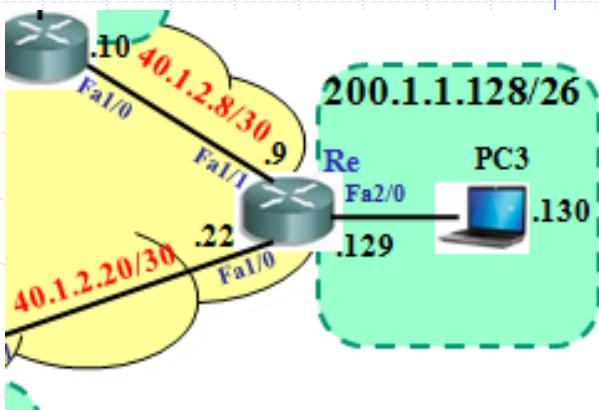
Re(config-router)#version 2

Re(config-router)#network 200.1.1.0

Re(config-router)#network 40.1.2.0.0.0

Re(config-router)#exit

Re(config)#



UN DETALLE: “SUMMARY”

• Desde Ra como llega a 200.1.1.64/26

Ra# 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

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

200.1.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 200.1.1.0/26 is directly connected, FastEthernet2/0

R 200.1.1.0/24 [120/1] via 40.1.2.14, 00:00:25, FastEthernet1/1

40.0.0.0/30 is subnetted, 0 subnets

R 40.1.2.8 [120/2] via 40.1.2.14, 00:00:25, FastEthernet1/1
 [120/2] via 40.1.2.2, 00:00:11, FastEthernet1/0

C 40.1.2.12 is directly connected, FastEthernet1/1

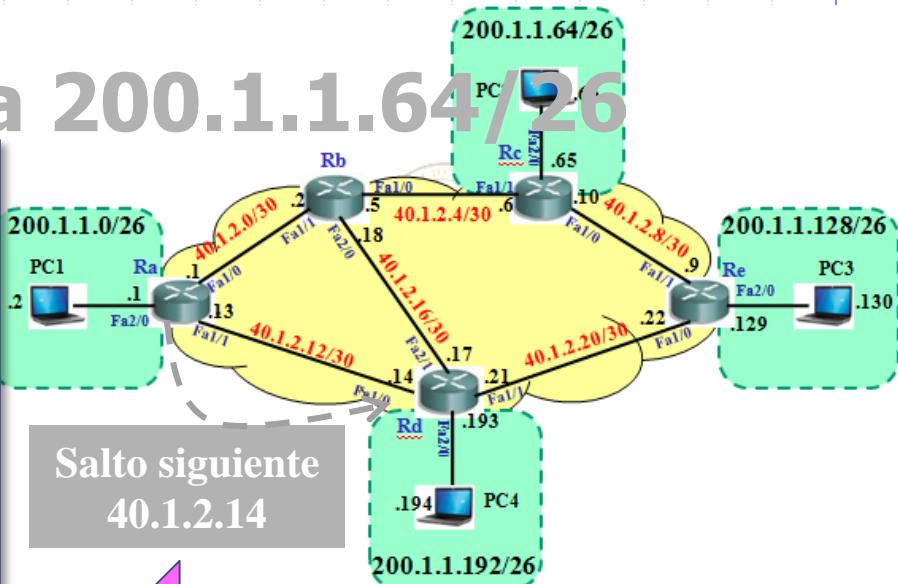
C 40.1.2.0 is directly connected, FastEthernet1/0

R 40.1.2.4 [120/1] via 40.1.2.2, 00:00:11, FastEthernet1/0

R 40.1.2.16 [120/1] via 40.1.2.14, 00:00:25, FastEthernet1/1
 [120/1] via 40.1.2.2, 00:00:11, FastEthernet1/0

R 40.1.2.20 [120/1] via 40.1.2.14, 00:00:25, FastEthernet1/1

Ra#



Aquí se ve a las redes
200.1.1.64, 200.1.1.128
y 200.1.1.192 como si
fuera la red 200.1.1.0

Ra#clear ip route *
Borra la tabla de enrutamiento.

UN DETALLE: “SUMMARY”

• Desde Rd como llega a 200.1.1.0/26

Rd#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

200.1.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 200.1.1.192/26 is directly connected, FastEthernet2/0

R 200.1.1.0/24 [120/1] via 40.1.2.22, 00:00:05, FastEthernet1/1
[120/1] via 40.1.2.13, 00:00:10, FastEthernet1/0

40.0.0.0/30 is subnetted, 6 subnets

R 40.1.2.8 [120/1] via 40.1.2.22, 00:00:05, FastEthernet1/1

C 40.1.2.12 is directly connected, FastEthernet1/0

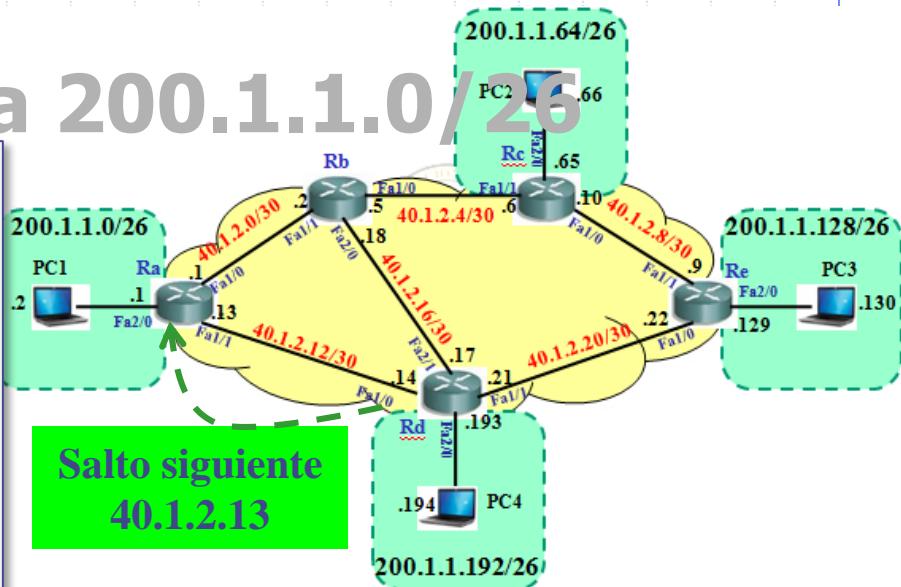
R 40.1.2.0 [120/1] via 40.1.2.18, 00:00:22, FastEthernet2/1
[120/1] via 40.1.2.13, 00:00:10, FastEthernet1/0

R 40.1.2.4 [120/1] via 40.1.2.18, 00:00:22, FastEthernet2/1

C 40.1.2.16 is directly connected, FastEthernet2/1

C 40.1.2.20 is directly connected, FastEthernet1/1

Rd#



Aquí se ve a las redes
200.1.1.0, 200.1.1.64,
y 200.1.1.128 como si
fuera la red 200.1.1.0

POSSIBLE
BUCLE!!



SOLUCIÓN: DESACTIVAR “SUMMARY”

```
Ra>enable
```

```
Ra#configure terminal
```

Enter configuration commands, one per line. End with NTL/Z.

```
Ra(config)#router rip
```

```
Ra(config-router)#no auto-summary
```

```
Ra(config-router)#exit
```

```
Ra(config)#
```

```
Rb>enable
```

```
Rb#configure terminal
```

Enter configuration commands, one per line. End with NTL/Z.

```
Rb(config)#router rip
```

```
Rb(config-router)#no auto-summary
```

```
Rb(config-router)#exit
```

```
Rb(config)#
```

```
Rc>enable
```

```
Rc#configure terminal
```

Enter configuration commands, one per line. End with NTL/Z.

```
Rc(config)#router rip
```

```
Rc(config-router)#no auto-summary
```

```
Rc(config-router)#exit
```

```
Rc(config)#
```

```
Rd>enable
```

```
Rd#configure terminal
```

Enter configuration commands, one per line. End with NTL/Z.

```
Rd(config)#router rip
```

```
Rd(config-router)#no auto-summary
```

```
Rd(config-router)#exit
```

```
Rd(config)#
```

```
Re>enable
```

```
Re#configure terminal
```

Enter configuration commands, one per line. End with NTL/Z.

```
Re(config)#router rip
```

```
Re(config-router)#no auto-summary
```

```
Re(config-router)#exit
```

```
Re(config)#
```

ANALIZANDO NUEVAMENTE Ra"

• Desde Ra como llega a 200.1.1.64/26

Ra#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

200.1.1.0/24 is variably subnetted, 5 subnets, 2 masks

```
R 200.1.1.192/26 [120/1] via 40.1.2.14, 00:00:00, FastEthernet1/1
R 200.1.1.128/26 [120/2] via 40.1.2.14, 00:00:00, FastEthernet1/1
R 200.1.1.64/26 [120/2] via 40.1.2.2, 00:00:10, FastEthernet1/0
```

C 200.1.1.0/26 is directly connected, FastEthernet2/0

```
R 200.1.1.0/24 [120/2] via 40.1.2.14, 00:00:00, FastEthernet1/1
```

40.0.0.0/30 is subnetted, 6 subnets

```
R 40.1.2.8 [120/2] via 40.1.2.14, 00:00:00, FastEthernet1/1
[120/2] via 40.1.2.2, 00:00:10, FastEthernet1/0
```

C 40.1.2.12 is directly connected, FastEthernet1/1

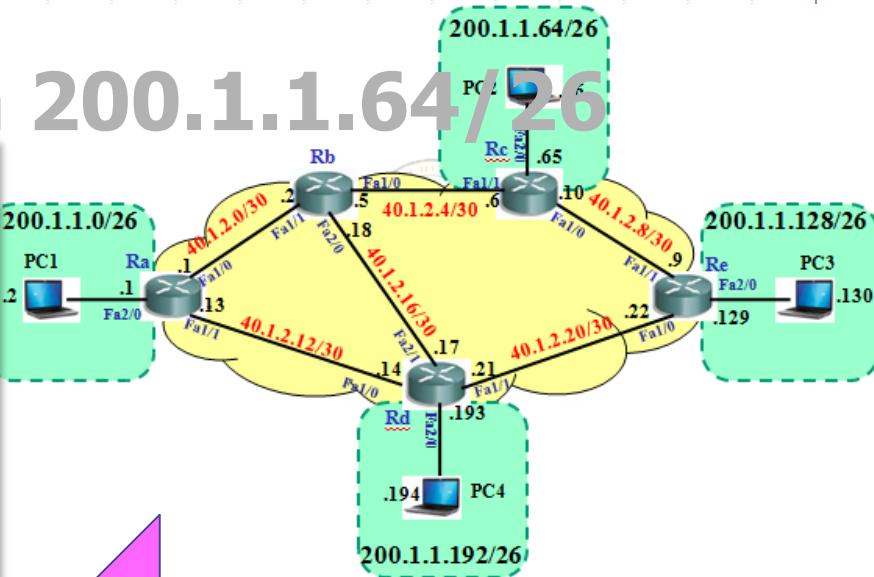
C 40.1.2.0 is directly connected, FastEthernet1/0

```
R 40.1.2.4 [120/1] via 40.1.2.2, 00:00:10, FastEthernet1/0
```

```
R 40.1.2.16 [120/1] via 40.1.2.14, 00:00:00, FastEthernet1/1
[120/1] via 40.1.2.2, 00:00:10, FastEthernet1/0
```

```
R 40.1.2.20 [120/1] via 40.1.2.14, 00:00:06, FastEthernet1/1
```

Ra#



Aquí se ve a las redes
200.1.1.64, 200.1.1.128
y 200.1.1.192 de manera
independiente!!!!.

ANALIZANDO TABLAS DE ENRUTAMIENTO

• Tabla de enrutamiento del Rb:

Rb# 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

200.1.1.0/26 is subnetted, 4 subnets

R 200.1.1.192 [120/1] via 40.1.2.17, 00:00:14, FastEthernet2/0

R 200.1.1.128 [120/2] via 40.1.2.17, 00:00:14, FastEthernet2/0
[120/2] via 40.1.2.6, 00:00:10, FastEthernet1/0

R 200.1.1.64 [120/1] via 40.1.2.6, 00:00:10, FastEthernet1/0

R 200.1.1.0 [120/1] via 40.1.2.1, 00:00:12, FastEthernet1/1

40.0.0.0/30 is subnetted, 6 subnets

R 40.1.2.8 [120/1] via 40.1.2.6, 00:00:10, FastEthernet1/0

R 40.1.2.12 [120/1] via 40.1.2.17, 00:00:14, FastEthernet2/0
[120/1] via 40.1.2.1, 00:00:12, FastEthernet1/1

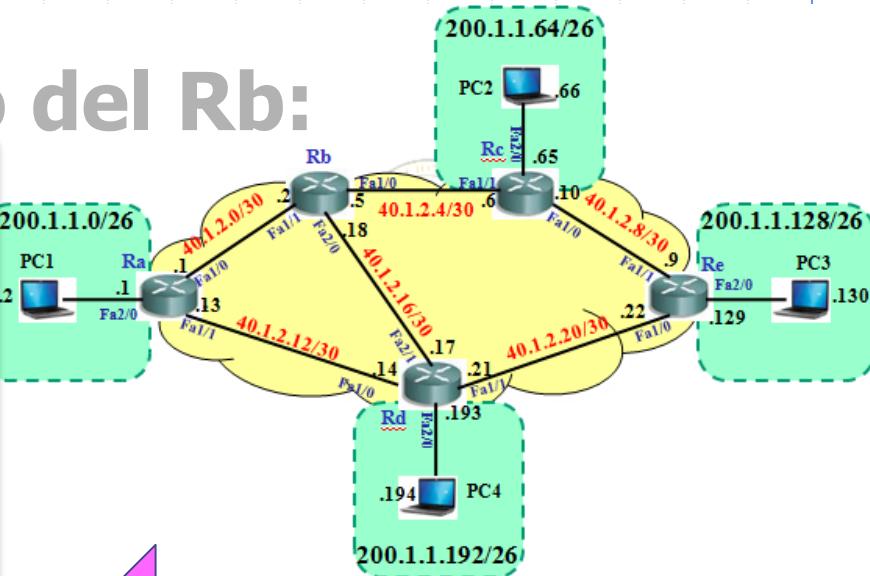
C 40.1.2.0 is directly connected, FastEthernet1/1

C 40.1.2.4 is directly connected, FastEthernet1/0

C 40.1.2.16 is directly connected, FastEthernet2/0

R 40.1.2.20 [120/1] via 40.1.2.17, 00:00:17, FastEthernet2/0

Rb#



La redes LAN están detalladas.
Se observa el balanceo de carga hacia: 200.1.1.128

ANALIZANDO TABLAS DE ENRUTAMIENTO

• Tabla de enrutamiento del Rc:

Rc#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

200.1.1.0/26 is subnetted, 4 subnets

R 200.1.1.192 [120/2] via 40.1.2.9, 00:00:12, FastEthernet1/0
 [120/2] via 40.1.2.5, 00:00:24, FastEthernet1/1

R 200.1.1.128 [120/1] via 40.1.2.9, 00:00:12, FastEthernet1/0

C 200.1.1.64 is directly connected, FastEthernet2/0

R 200.1.1.0 [120/2] via 40.1.2.5, 00:00:24, FastEthernet1/1
 40.0.0.0/30 is subnetted, 6 subnets

C 40.1.2.8 is directly connected, FastEthernet1/0

R 40.1.2.12 [120/2] via 40.1.2.9, 00:00:12, FastEthernet1/0
 [120/2] via 40.1.2.5, 00:00:24, FastEthernet1/1

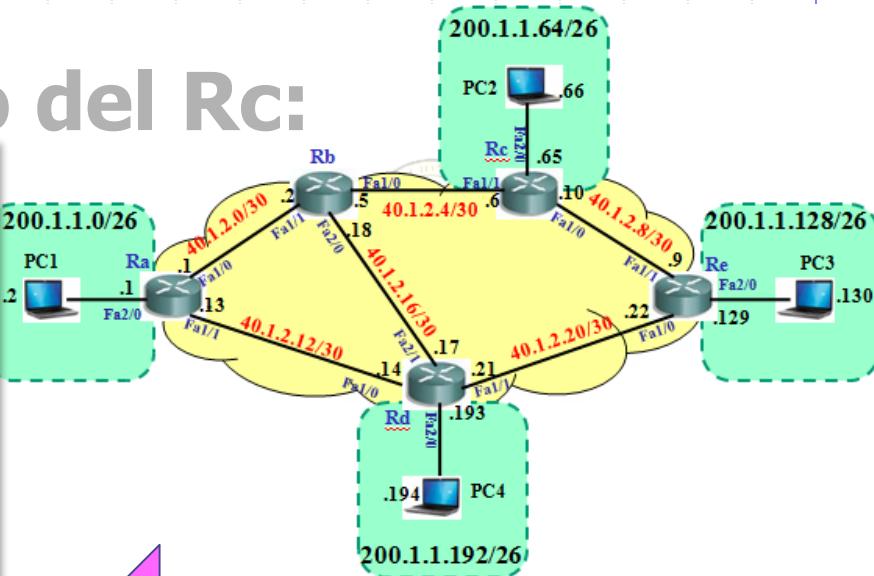
R 40.1.2.0 [120/1] via 40.1.2.5, 00:00:24, FastEthernet1/1

C 40.1.2.4 is directly connected, FastEthernet1/1

R 40.1.2.16 [120/1] via 40.1.2.5, 00:00:24, FastEthernet1/1

R 40.1.2.20 [120/1] via 40.1.2.9, 00:00:13, FastEthernet1/0

Rc#



La redes LAN están detalladas.
 Se observa el balanceo de carga hacia: 200.1.1.192

ANALIZANDO TABLAS DE ENRUTAMIENTO

• Tabla de enrutamiento del Rd:

Rd#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

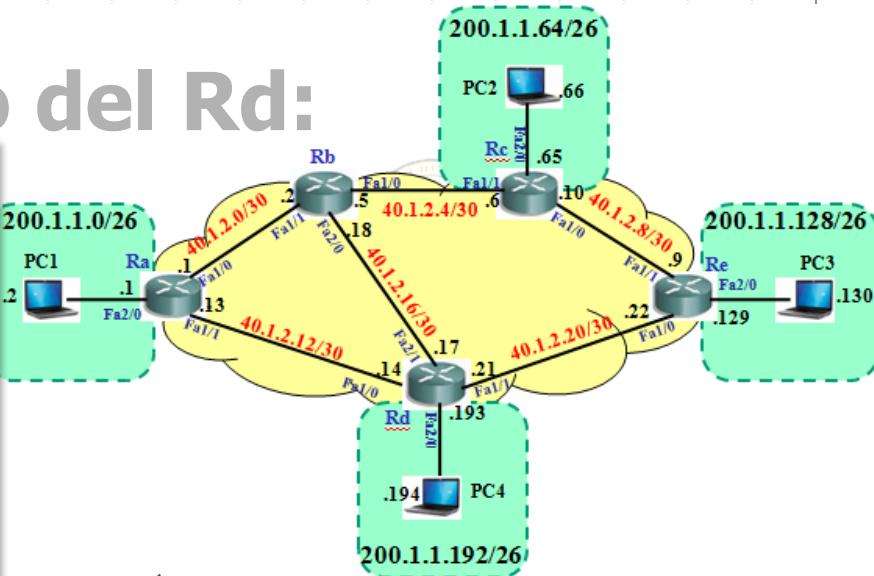
Gateway of last resort is not set

200.1.1.0/26 is subnetted, 4 subnets

- C 200.1.1.192 is directly connected, FastEthernet2/0
- R 200.1.1.128 [120/1] via 40.1.2.22, 00:00:00, FastEthernet1/1
- R 200.1.1.64 [120/2] via 40.1.2.22, 00:00:00, FastEthernet1/1
[120/2] via 40.1.2.18, 00:00:00, FastEthernet2/1
- R 200.1.1.0 [120/1] via 40.1.2.13, 00:00:24, FastEthernet1/0

40.0.0.0/30 is subnetted, 6 subnets

- R 40.1.2.8 [120/1] via 40.1.2.22, 00:00:00, FastEthernet1/1
 - C 40.1.2.12 is directly connected, FastEthernet1/0
 - R 40.1.2.0 [120/1] via 40.1.2.18, 00:00:00, FastEthernet2/1
[120/1] via 40.1.2.13, 00:00:24, FastEthernet1/0
 - R 40.1.2.4 [120/1] via 40.1.2.18, 00:00:00, FastEthernet2/1
 - C 40.1.2.16 is directly connected, FastEthernet2/1
 - C 40.1.2.20 is directly connected, FastEthernet1/1
- Rd#



La redes LAN están detalladas.
Se observa el balanceo de carga hacia: 200.1.1.64

ANALIZANDO TABLAS DE ENRUTAMIENTO

• Tabla de enrutamiento del Re:

Re#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

200.1.1.0/26 is subnetted, 4 subnets

R 200.1.1.192 [120/1] via 40.1.2.21, 00:00:22, FastEthernet1/0

C 200.1.1.128 is directly connected, FastEthernet2/0

R 200.1.1.64 [120/1] via 40.1.2.10, 00:00:27, FastEthernet1/1

R 200.1.1.0 [120/2] via 40.1.2.21, 00:00:22, FastEthernet1/0

40.0.0.0/30 is subnetted, 6 subnets

C 40.1.2.8 is directly connected, FastEthernet1/1

R 40.1.2.12 [120/1] via 40.1.2.21, 00:00:22, FastEthernet1/0

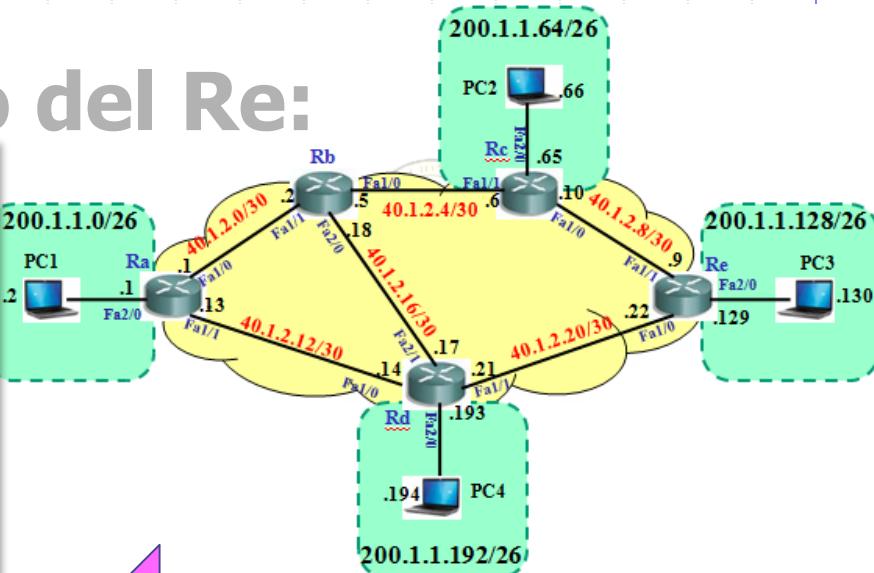
R 40.1.2.0 [120/2] via 40.1.2.21, 00:00:22, FastEthernet1/0
[120/2] via 40.1.2.10, 00:00:27, FastEthernet1/1

R 40.1.2.4 [120/1] via 40.1.2.10, 00:00:27, FastEthernet1/1

R 40.1.2.16 [120/1] via 40.1.2.21, 00:00:22, FastEthernet1/0

C 40.1.2.20 is directly connected, FastEthernet1/0

Re#



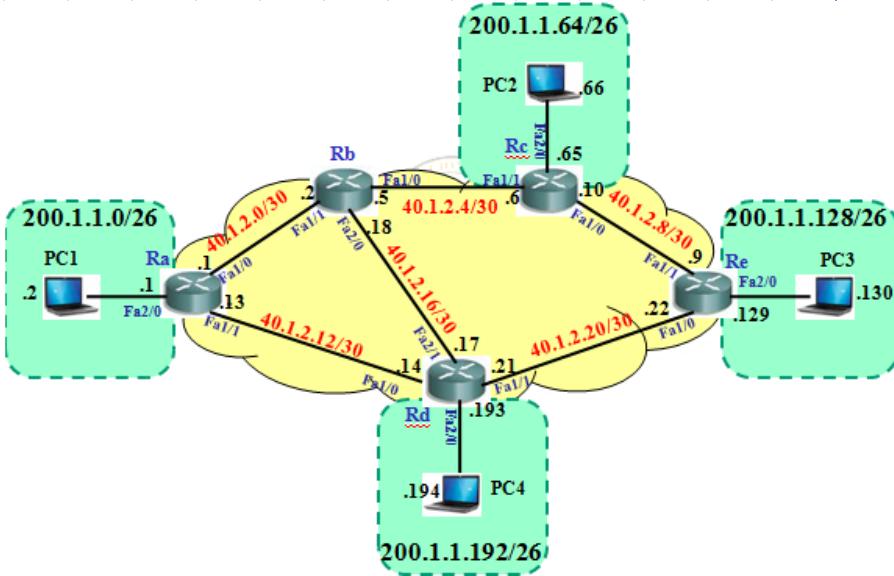
La redes LAN están detalladas.

COMANDOS DE ANÁLISIS DE RED CON RIP

• show ip protocols

► Muestra el protocolo de enrutamiento configurado.

```
Dynamips(2): Rb, Console port
Rb#show ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 13 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface      Send   Recv  Triggered RIP  Key-chain
    FastEthernet1/0  2       2
    FastEthernet1/1  2       2
    FastEthernet2/0  2       2
Automatic network summarization is not in effect Auto resumen desactivado
Maximum path: 4
Routing for Networks:
  40.0.0.0
Routing Information Sources:
  Gateway        Distance      Last Update
  40.1.2.1          120      00:00:16
  40.1.2.6          120      00:00:12
  40.1.2.17         120      00:00:19
Distance: (default is 120)
Rb#
```



► Si es RIP, permite ver la mayoría de sus parámetros (temporizadores, etc).

INTERFAZ PASIVA

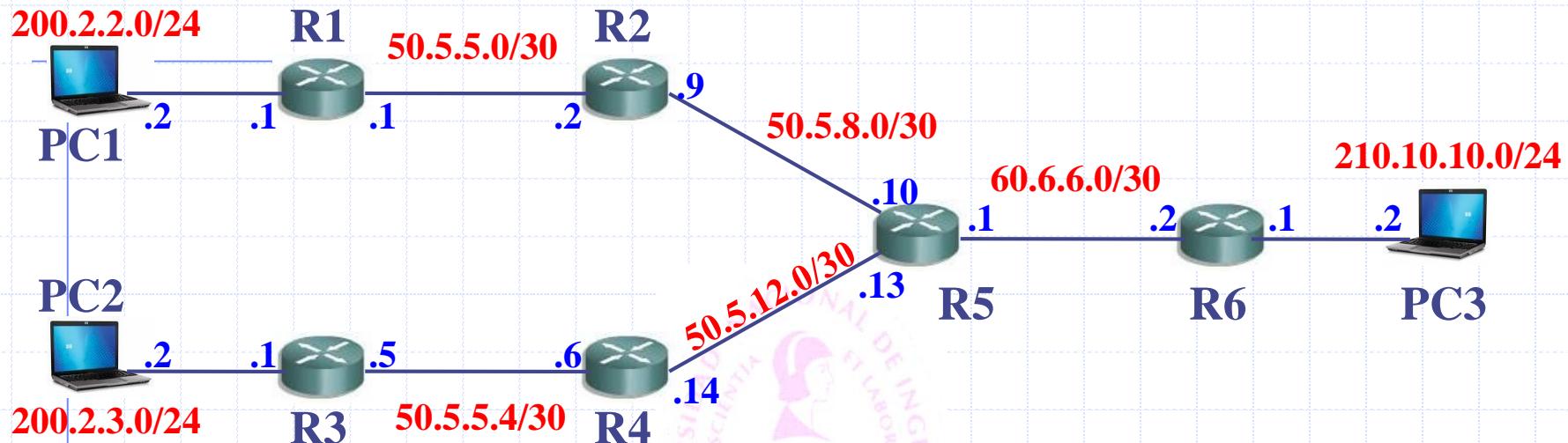
- Se debe anunciar la red 200.1.1.0 donde está el servidor, para que sea accedido externamente.
- No se debe enviar al servidor actualizaciones. **Para que??**

```
R1(config)# router rip
R1(config-router)# version 2
R1(config-router)# network 200.1.1.0
R1(config-router)# network 22.2.2.220
R1(config-router)# network 20.3.3.40
R1(config-router)# passive-interface fastethernet 0/0
R1(config-router)# exit
R1(config)#
```



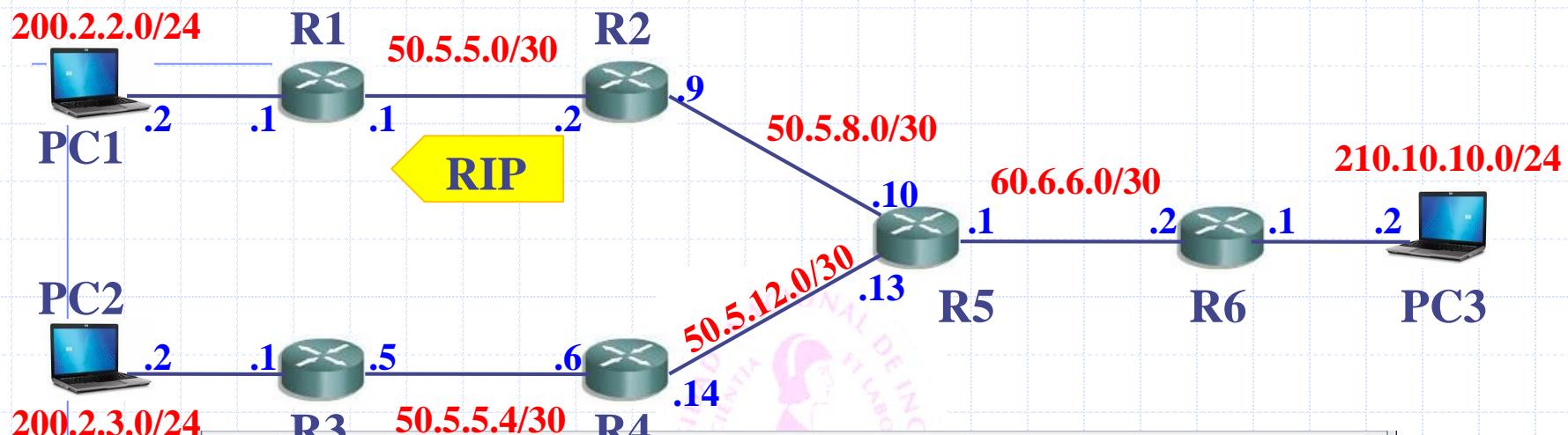
R1#debug ip rip ; permite ver actualizaciones según se genere.

PROPAGACIÓN DE RUTA POR DEFECTO



R5	R4	R3	R2	
R	R	R	C	R1#show ip route
R	R	R	C	50.0.0.0/30 is subnetted, 4 subnets
C	R	R	R	C 50.5.5.0 is directly connected, FastEthernet0/1
C	C	R	R	R 50.5.5.4 [120/3] via 50.5.5.2, 00:00:11, FastEthernet0/1
R	R	R	R	R 50.5.5.8 [120/1] via 50.5.5.2, 00:00:11, FastEthernet0/1
R	R	R	R	R 50.5.5.12 [120/2] via 50.5.5.2, 00:00:11, FastEthernet0/1
R	R	C	R	R 210.10.10.0/24 [120/3] via 50.5.5.2, 00:00:11, FastEthernet0/1
C	R	R	R	C 200.2.2.0/24 is directly connected, FastEthernet0/0
R	R	R	R	R 200.2.3.0/24 [120/4] via 50.5.5.2, 00:00:11, FastEthernet0/1
R	R	R	R	R 60.0.0.0/8 [120/2] via 50.5.5.2, 00:00:11, FastEthernet0/1
R5	R4	R3	R2	R1#

PROPAGACIÓN DE RUTA POR DEFECTO

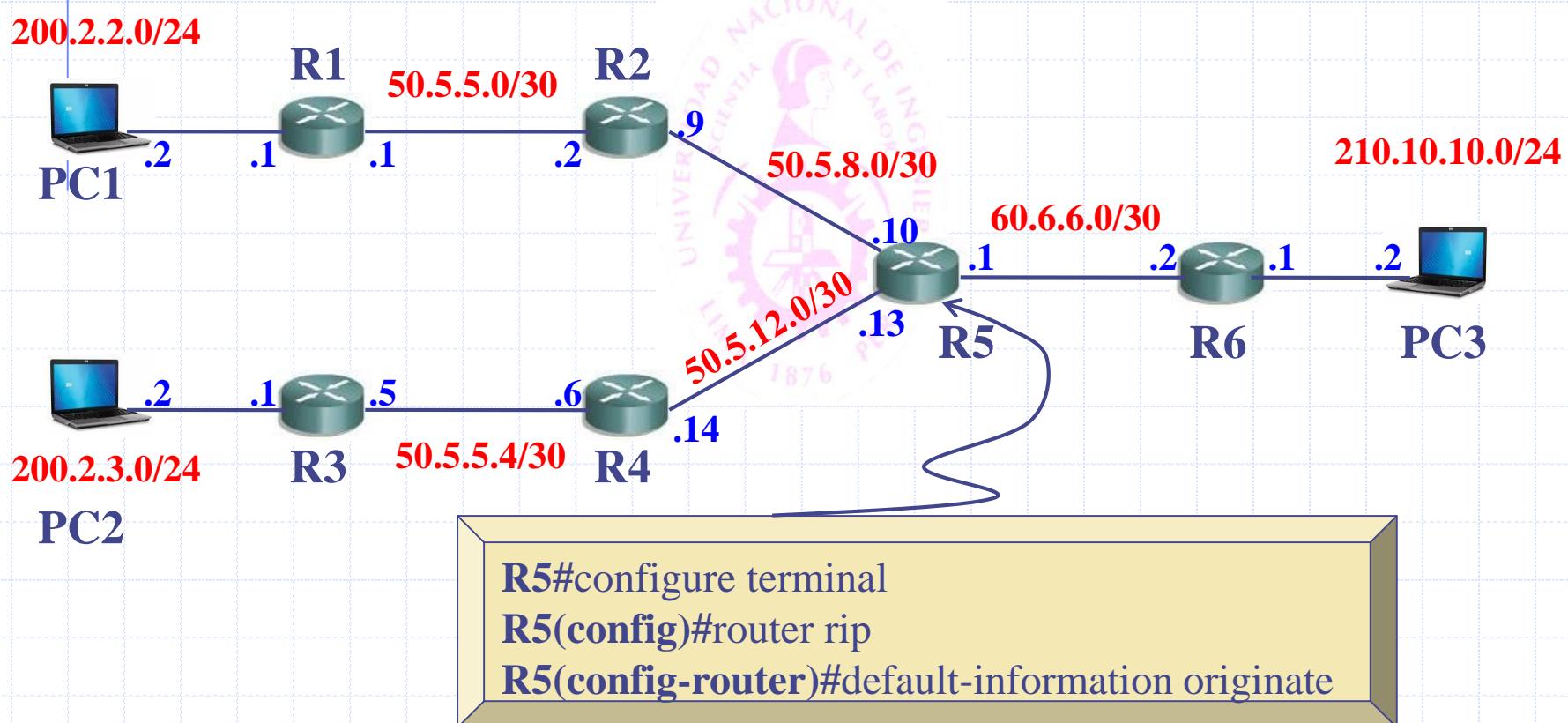


No.	Time	Source	Destination	Protocol	Info
428	1346.24800	50.5.5.2	224.0.0.9	RIPv2	Response
429	1349.33900	50.5.5.1	224.0.0.9	RIPv2	Response
Redes anunciadas					
<ul style="list-style-type: none"> ▪ Ethernet II, Src: ca:01:13:ac:00:08 (ca:01:13:ac:00:08), Dst: IPv4mcast_00:00:09 (01:00:5e:00:00:09) ▪ Internet Protocol, src: 50.5.5.2 (50.5.5.2), Dst: 224.0.0.9 (224.0.0.9) ▪ User Datagram Protocol, Src Port: router (520), Dst Port: router (520) ▪ Routing Information Protocol <ul style="list-style-type: none"> Command: Response (2) Version: RIPv2 (2) Routing Domain: 0 IP Address: 50.5.5.4, Metric: 3 IP Address: 50.5.5.8, Metric: 1 IP Address: 50.5.5.12, Metric: 2 IP Address: 60.0.0.0, Metric: 2 IP Address: 200.2.3.0, Metric: 4 IP Address: 210.10.10.0, Metric: 3 					
<pre>0000 01 00 5e 00 00 09 ca 01 13 ac 00 08 08 00 45 c0 .^. .E. 0010 00 98 00 00 00 00 02 11 a0 85 32 05 05 02 e0 00 2..... 0020 00 09 02 08 02 08 00 84 5c 79 02 02 00 00 00 02 \V..... 0030 00 00 32 05 05 04 ff ff ff fc 00 00 00 00 00 00 00 2... 0040 00 03 00 02 00 00 32 05 05 08 ff ff ff fc 00 00 2... 0050 00 00 00 00 00 01 00 02 00 00 32 05 05 0c ff ff 2... 0060 ff fc 00 00 00 00 00 00 02 00 02 00 00 3c 00 2... 0070 00 00 ff 00 00 00 00 00 00 00 00 00 00 02 00 02 <... 0080 00 00 c8 02 03 00 ff ff 00 00 00 00 00 00 00 00 00 ... 0090 00 04 00 02 00 00 d2 0a 0a 00 ff ff ff 00 00 00 00 ... 00a0 00 00 00 00 00 03 </pre>					
<input type="radio"/> What type of RIP Command is this (rip.com...) Packets: 435 Displayed: 435 Marked: 0 Load time: 0:00.007 Profile: Default					

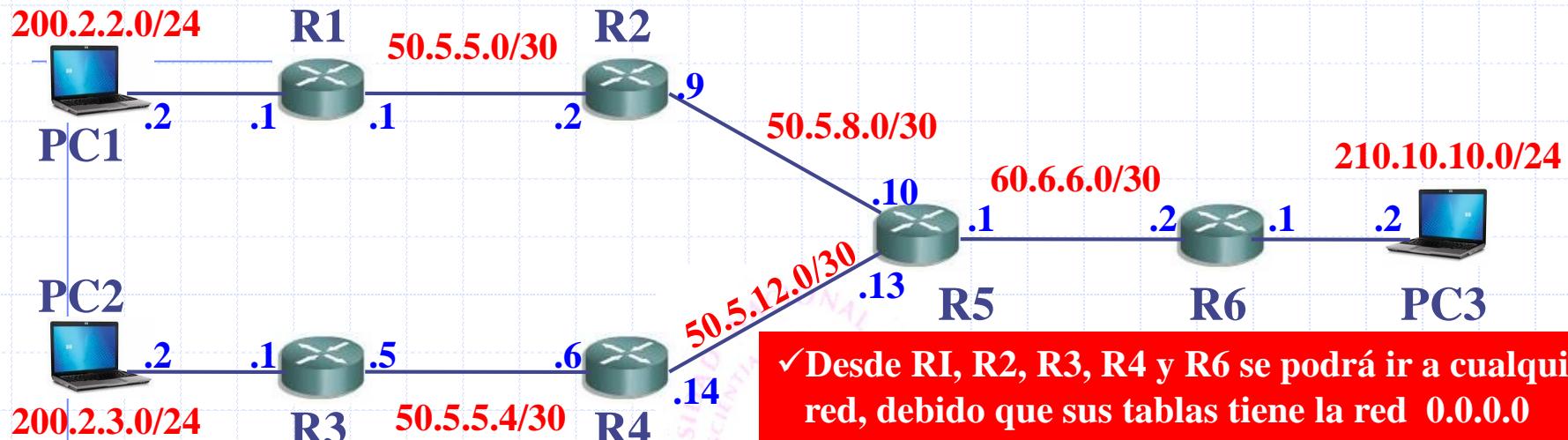
PROPAGACIÓN DE RUTA POR DEFECTO

- default-information originate

- ▶ Permite que el router propague la ruta estática por defecto, en actualizaciones RIP.



PROPAGACIÓN DE RUTA POR DEFECTO



R2#	R1#	R4#	R3#
C	C	R	R3# show ip route
R	R	C	50.0.0.0/30 is
C	R	C	50.5.5.0 [120/1]
R	R	R	50.5.5.4 is
R	R	C	50.5.5.8 [120/1]
R	R	R	50.5.5.12 [120/1]
R	R	R	210.10.10.0/24
R	R	R	200.2.2.0/24
R	R	R	200.2.3.0/24
R*	R*	R*	R 60.0.0.0/8 [120/1]
R2#	R1#	R4#	R* 0.0.0.0/0 [120/1]
R1#	R4#	R3#	R* 0.0.0.0/0 [120/1]

R6# show ip route

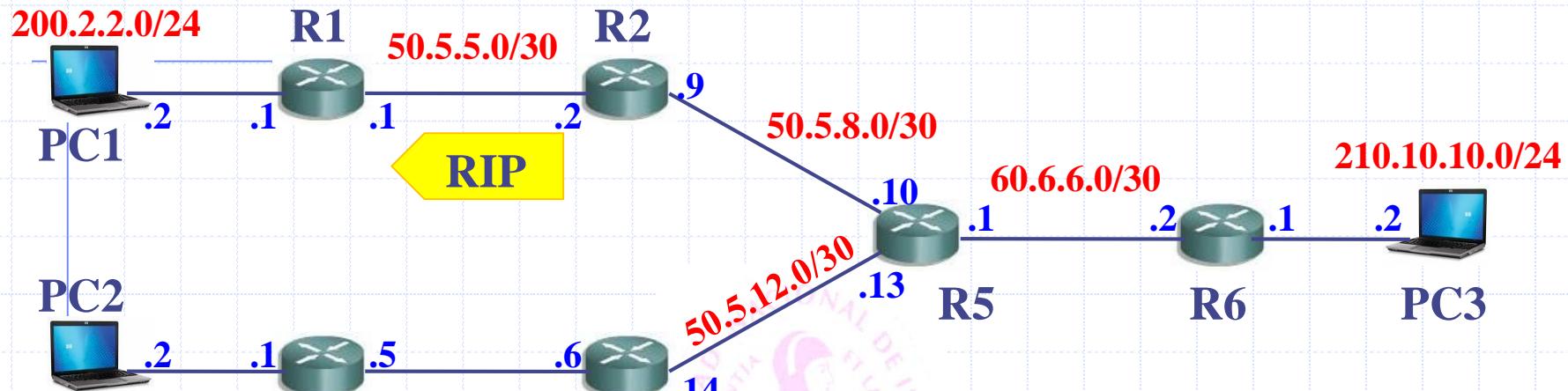
```

R 50.0.0.0/8 [120/1] via 60.6.6.1, 00:00:04, FastEthernet0/1
C 210.10.10.0/24 is directly connected, FastEthernet0/0
R 200.2.2.0/24 [120/3] via 60.6.6.1, 00:00:04, FastEthernet0/1
R 200.2.3.0/24 [120/3] via 60.6.6.1, 00:00:04, FastEthernet0/1
    60.0.0.0/30 is subnetted, 1 subnets
C 60.6.6.0 is directly connected, FastEthernet0/1
R* 0.0.0.0/0 [120/1] via 60.6.6.1, 00:00:04, FastEthernet0/1

```

Observar que R5 falta adicionar: *no-auto-summary*
 De allí que aparezca en R1, R2, R3 y R4: 60.0.0.0/8

PROPAGACIÓN DE RUTA POR DEFECTO



Propiedad intelectual de Daniel Díaz @ 2011

Ruta por defecto → **Redes anunciadas**

Yellow dashed box highlights the default route information in the Wireshark capture:

No.	Time	Source	Destination	Protocol	Info
9	25.529000	50.5.5.2	224.0.0.9	RIPv2	Response
10	31.578000	ca:01:13:ac:00:08	Capture Device ID: 1	CDP/VTP/DTP/PAgP/UDL CDP	Device ID: 1

Yellow box highlights the default route information in the captured traffic:

- Frame 9: 186 bytes on wire (1488 bits), 186 bytes captured (1488 bits)
- Ethernet II, Src: ca:01:13:ac:00:08 (ca:01:13:ac:00:08), Dst: IPv4mcast_00:00:00:00:00:00 (224.0.0.9)
- Internet Protocol, Src: 50.5.5.2 (50.5.5.2), Dst: 224.0.0.9 (224.0.0.9)
- User Datagram Protocol, Src Port: router (520), Dst Port: router (520)
- Routing Information Protocol
 - Command: Response (2)
 - Version: RIPv2 (2)
 - Routing Domain: 0
 - IP Address: 0.0.0.0, Metric: 2
 - IP Address: 50.5.5.4, Metric: 3
 - IP Address: 50.5.5.8, Metric: 1
 - IP Address: 50.5.5.12, Metric: 2
 - IP Address: 60.0.0.0, Metric: 2
 - IP Address: 200.2.3.0, Metric: 4
 - IP Address: 210.10.10.0, Metric: 3

Red box highlights the default route entry in the routing table:

IP Address: 0.0.0.0, Metric: 2
Address Family: IP (2)
Route Tag: 0
IP Address: 0.0.0.0 (0.0.0.0)
Netmask: 0.0.0.0 (0.0.0.0)
Next Hop: 0.0.0.0 (0.0.0.0)
Metric: 2
IP Address: 50.5.5.4, Metric: 3

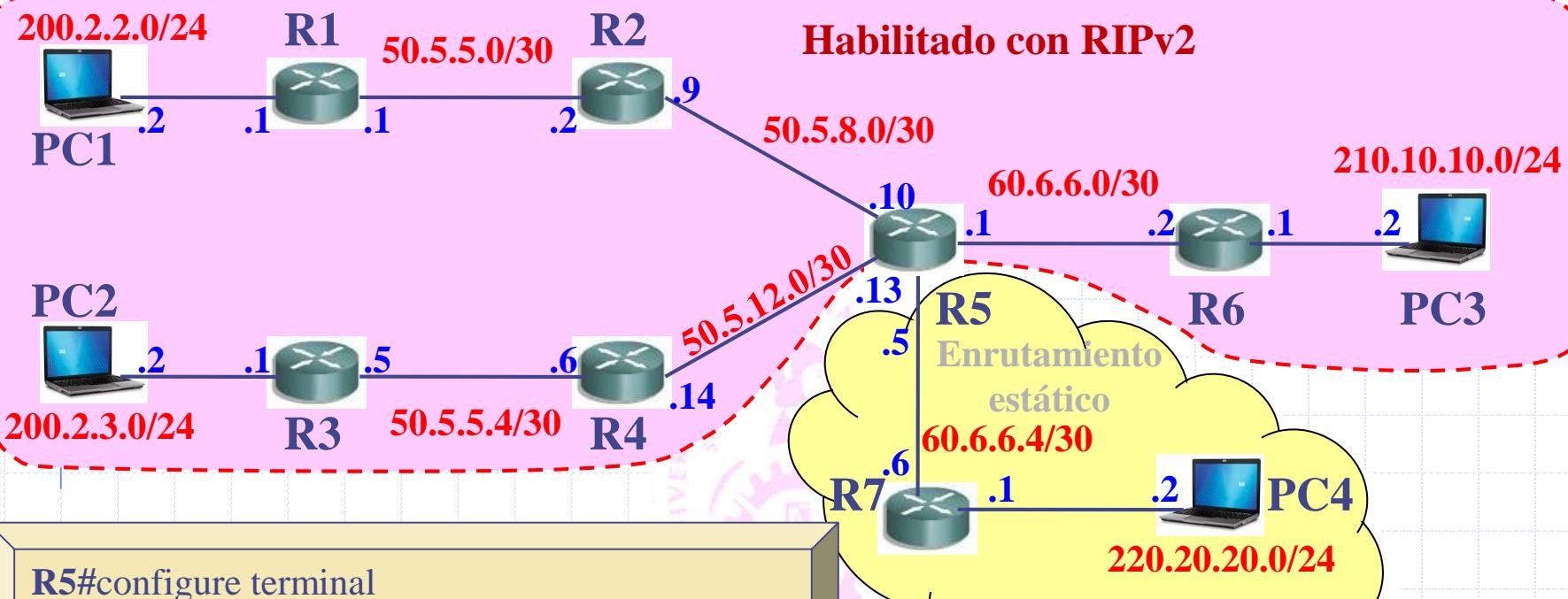
Red box highlights the MAC address in the captured traffic:

0010 00 ac 00 00 00 02 11 a0 71 32 05 05 02 e0 00
0020 00 09 02 08 02 08 00 98 5c 4d 02 00 00 00 02
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 02 00 02 00 00 32 05 05 04 ff ff fc 00 00
0050 00 00 00 00 00 03 00 02 00 00 32 05 05 08 ff ff
0060 ff fc 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 05 0c ff ff fc 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 3c 00 00 00 ff 00 00 00 00 00 00 00 00 00
0090 00 02 00 02 00 c8 02 03 00 ff ff ff 00 00 00 00
00a0 00 00 00 00 04 00 02 00 d2 0a 0a 00 ff ff 00 00
00b0 ff 00 00 00 00 00 00 00 00 00 00 00 00 00 03 00

Red box highlights the MAC address in the captured traffic:

0010 00 ac 00 00 00 02 11 a0 71 32 05 05 02 e0 00
0020 00 09 02 08 02 08 00 98 5c 4d 02 02 00 00 00 02
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 02 00 02 00 00 32 05 05 04 ff ff ff fc 00 00
0050 00 00 00 00 00 03 00 02 00 00 32 05 05 08 ff ff
0060 ff fc 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 05 0c ff ff fc 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 3c 00 00 00 ff 00 00 00 00 00 00 00 00 00
0090 00 02 00 02 00 c8 02 03 00 ff ff ff 00 00 00 00
00a0 00 00 00 00 04 00 02 00 d2 0a 0a 00 ff ff 00 00
00b0 ff 00 00 00 00 00 00 00 00 00 00 00 00 00 03 00

PROPAGACIÓN DE RUTA POR DEFECTO



```
R5#configure terminal
R5(config)#router rip
R5(config-router)#default-information originate
```

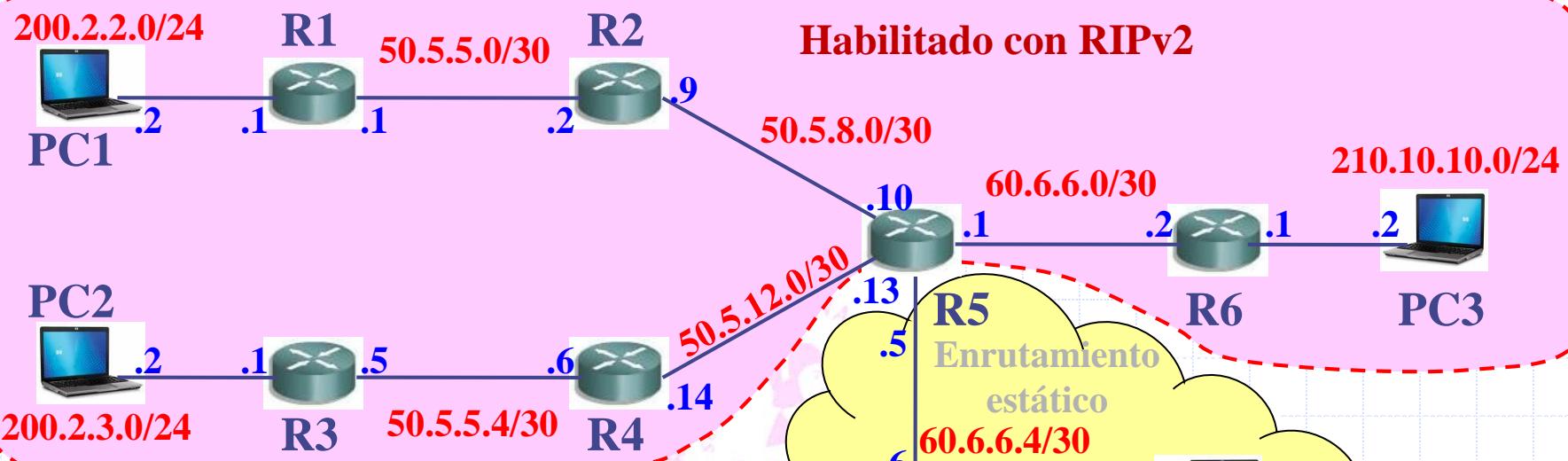
```
R7(config)#ip route 0.0.0.0 0.0.0.0 60.6.6.5
```

```
R5#configure terminal
R5(config)#ip route 220.20.20.0 255.255.255.0 60.6.6.6
R5(config)#exit
```

- ▶ De **R1** a **R6** tienen la ruta por defecto
- ▶ **"Todos"** saben llegar a **R5**

▶ Cuando se llegue a **R5**, la tabla estática indicará **220.20.20.0**.

REDISTRIBUCIÓN ESTÁTICA



► Verifiquemos que esté deshabilitado la propagación de ruta por defecto en el router **R5**:
no default-information originate

► Todos los router tienen: ***no- auto-summary***

Tabla en R7

```
Dynamips(7): R7, Console port
R7#show ip route
C    220.20.20.0/24 is directly connected, FastEthernet0/0
      60.0.0.0/30 is subnetted, 1 subnets
      C        60.6.6.4 is directly connected, FastEthernet0/1
      S*    0.0.0.0/0 [1/0] via 60.6.6.5
R7#
```

REDISTRIBUCIÓN ESTÁTICA

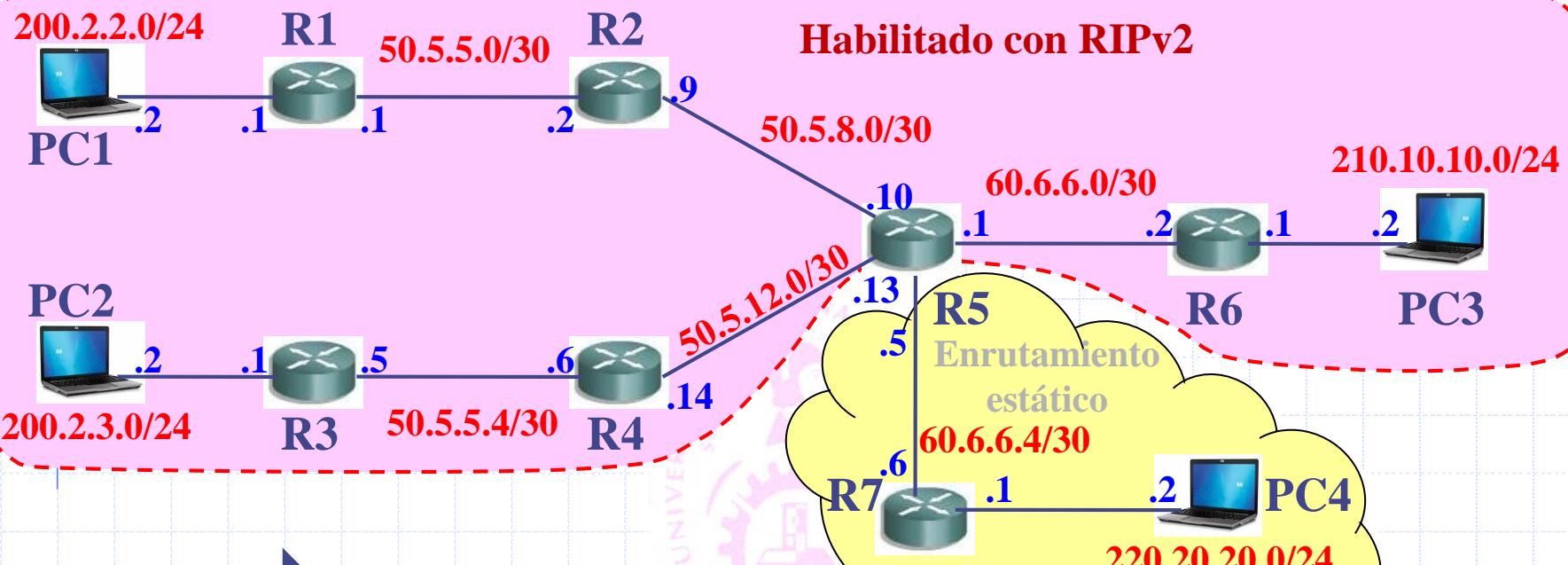


Tabla en R5

Cómo propagar
220.20.20.0 a la red
usando RIP ?

```
Dynamips(5): R5, Console port
R5#show ip route
 50.0.0.0/30 is subnetted, 4 subnets
    R 50.5.5.0 [120/1] via 50.5.5.9, 00:00:20, FastEthernet0/1
    R 50.5.5.4 [120/1] via 50.5.5.14, 00:00:13, FastEthernet0/0
    C 50.5.5.8 is directly connected, FastEthernet0/1
    C 50.5.5.12 is directly connected, FastEthernet0/0
  S 220.20.20.0/24 [1/0] via 60.6.6.6
  R 210.10.10.0/24 [120/1] via 60.6.6.2, 00:00:10, FastEthernet1/0
  R 200.2.2.0/24 [120/2] via 50.5.5.9, 00:00:20, FastEthernet0/1
  R 200.2.3.0/24 [120/2] via 50.5.5.14, 00:00:14, FastEthernet0/0
  60.0.0.0/30 is subnetted, 2 subnets
    C 60.6.6.4 is directly connected, FastEthernet1/1
    C 60.6.6.0 is directly connected, FastEthernet1/0
R5#
```

REDISTRIBUCIÓN ESTÁTICA

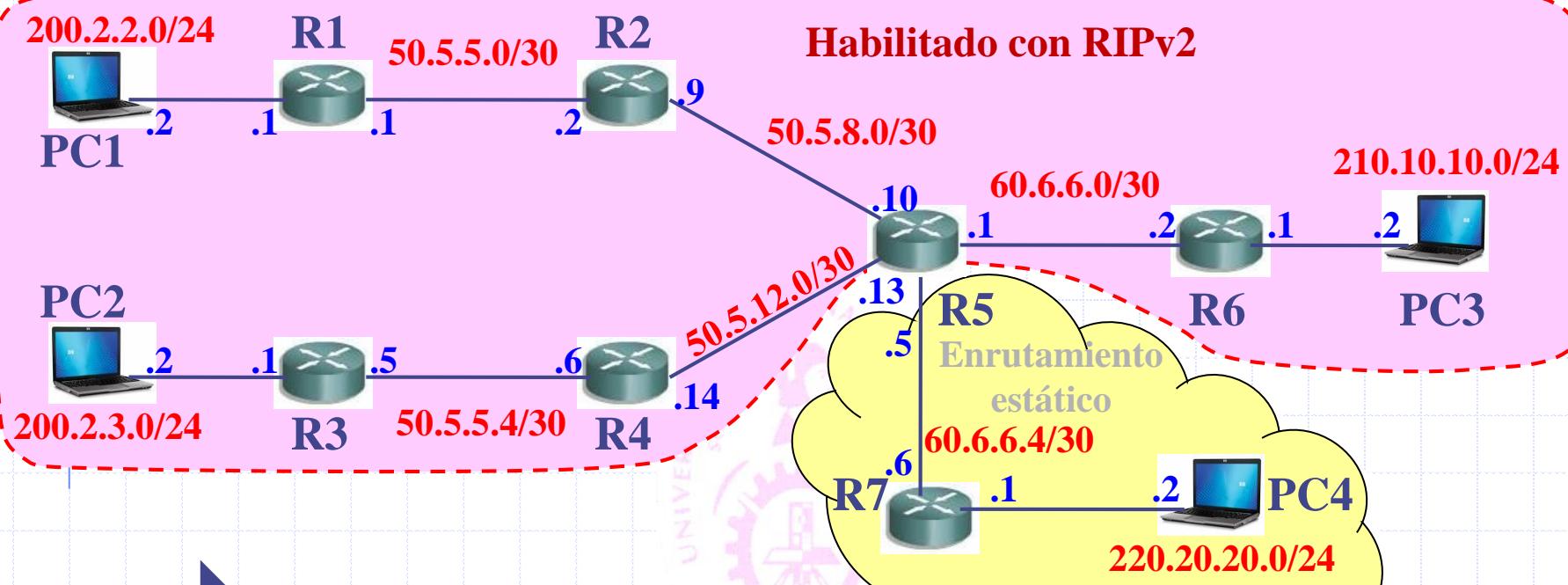


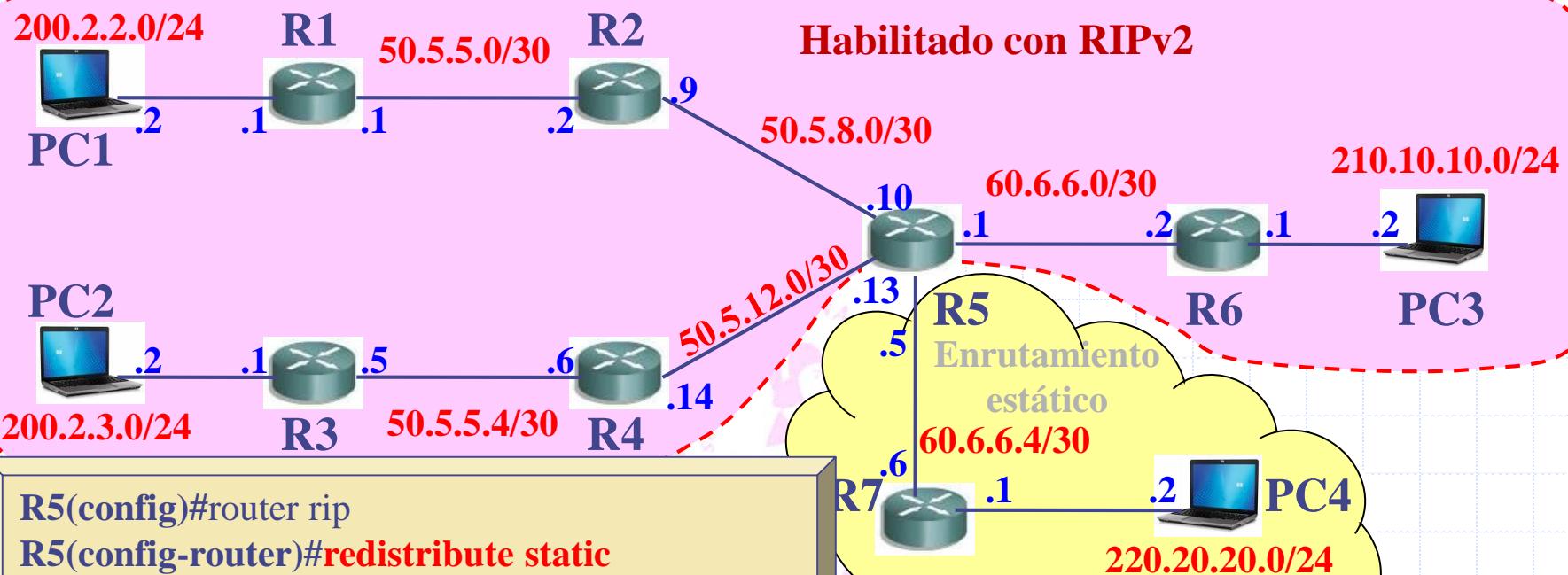
Tabla en R1

```
Dynamips(0): R1, Console port
R1#show ip route
  50.0.0.0/30 is subnetted, 4 subnets
C      50.5.5.0 is directly connected, FastEthernet0/1
R      50.5.5.4 [120/3] via 50.5.5.2, 00:00:19, FastEthernet0/1
R      50.5.5.8 [120/1] via 50.5.5.2, 00:00:19, FastEthernet0/1
R      50.5.5.12 [120/2] via 50.5.5.2, 00:00:19, FastEthernet0/1
R    210.10.10.0/24 [120/3] via 50.5.5.2, 00:00:19, FastEthernet0/1
C    200.2.2.0/24 is directly connected, FastEthernet0/0
R    200.2.3.0/24 [120/4] via 50.5.5.2, 00:00:19, FastEthernet0/1
  60.0.0.0/30 is subnetted, 2 subnets
R      60.6.6.4 [120/2] via 50.5.5.2, 00:00:19, FastEthernet0/1
R      60.6.6.0 [120/2] via 50.5.5.2, 00:00:19, FastEthernet0/1
R1#
```

No sabe como llegar a 220.20.20.0

R5 debe anunciar el link estático 220.20.20.0

REDISTRIBUCIÓN ESTÁTICA



```
R5(config)#router rip
R5(config-router)#redistribute static
```

Se propaga
el prefijo de red
200.20.20.0

Dynamips(0): R1, Console port

```
R1#show ip route
 50.0.0.0/30 is subnetted, 4 subnets
C      50.5.5.0 is directly connected, FastEthernet0/1
R      50.5.5.4 [120/3] via 50.5.5.2, 00:00:23, FastEthernet0/1
R      50.5.5.8 [120/1] via 50.5.5.2, 00:00:23, FastEthernet0/1
R      50.5.5.12 [120/2] via 50.5.5.2, 00:00:23, FastEthernet0/1
R      220.20.20.0/24 [120/2] via 50.5.5.2, 00:00:23, FastEthernet0/1
R      210.10.10.0/24 [120/3] via 50.5.5.2, 00:00:23, FastEthernet0/1
C      200.2.2.0/24 is directly connected, FastEthernet0/0
R      200.2.3.0/24 [120/4] via 50.5.5.2, 00:00:23, FastEthernet0/1
 60.0.0.0/30 is subnetted, 2 subnets
R      60.6.6.4 [120/2] via 50.5.5.2, 00:00:23, FastEthernet0/1
R      60.6.6.0 [120/2] via 50.5.5.2, 00:00:23, FastEthernet0/1
R1#
```

REDISTRIBUCIÓN ESTÁTICA

No.	Time	Source	Destination	Protocol	Info
76	234.785000	50.5.5.2	224.0.0.9	RIPv2	Response
<ul style="list-style-type: none"> + Ethernet II, Src: ca:01:13:ac:00:08 (ca:01:13:ac:00:08), Dst: IPv4mcast_00:00:09 (01:00:5e:00:00:09) + Internet Protocol, Src: 50.5.5.2 (50.5.5.2), Dst: 224.0.0.9 (224.0.0.9) + User Datagram Protocol, Src Port: router (520), Dst Port: router (520) Routing Information Protocol <pre> Command: Response (2) Version: RIPv2 (2) Routing Domain: 0 + IP Address: 50.5.5.4, Metric: 3 + IP Address: 50.5.5.8, Metric: 1 + IP Address: 50.5.5.12, Metric: 2 + IP Address: 60.6.6.0, Metric: 2 + IP Address: 60.6.6.4, Metric: 2 + IP Address: 200.2.3.0, Metric: 4 + IP Address: 210.10.10.0, Metric: 3 + IP Address: 220.20.20.0, Metric: 2 </pre> <pre> 0000 01 00 5e 00 00 09 ca 01 13 ac 00 08 08 00 45 c0 0010 00 c0 00 00 00 00 02 11 a0 5d 32 05 05 02 e0 00 0020 00 09 02 08 02 08 00 ac 24 02 02 02 00 00 00 02 0030 00 00 32 05 05 04 ff ff ff fc 00 00 00 00 00 00 0040 00 03 00 02 00 00 32 05 05 08 ff ff ff fc 00 00 0050 00 00 00 00 00 01 00 02 00 00 32 05 05 0c ff ff 0060 ff fc 00 00 00 00 00 00 00 02 00 02 00 00 3c 06 0070 06 00 ff ff ff fc 00 00 00 00 00 00 00 00 02 00 02 0080 00 00 3c 06 06 04 ff ff ff fc 00 00 00 00 00 00 00 0090 00 02 00 02 00 00 c8 02 03 00 ff ff ff 00 00 00 00 00a0 00 00 00 00 00 04 00 02 00 00 d2 0a 0a 00 ff ff 00b0 ff 00 00 00 00 00 00 00 00 03 00 02 00 00 dc 14 00c0 14 00 ff ff ff 00 00 00 00 00 00 00 00 00 00 02 </pre>					

Redistribución estática

The network diagram illustrates a network topology with seven routers (R1-R7) and four hosts (PC1-PC4). Router R1 is connected to PC1 and R2. Router R2 is connected to R1, R3, and R4. Router R3 is connected to PC2 and R4. Router R4 is connected to R3, R5, and R6. Router R5 is connected to R4, R6, and R7. Router R6 is connected to R5, R7, and PC3. Router R7 is connected to R6 and PC4. Router R1 has a static route to 220.20.20.0/24 via R2. Router R2 has a static route to 220.20.20.0/24 via R1. Router R5 has a static route to 220.20.20.0/24 via R6. Router R6 has a static route to 220.20.20.0/24 via R5. A pink dashed arrow labeled "R2 a R1" points from R2 to R1, indicating the direction of static route redistribution. A red dashed arrow points from R5 to R6, indicating the direction of static route redistribution. Router R1 is highlighted with a pink dashed box and labeled "Habilitado con RIPv2". Router R5 is highlighted with a yellow cloud and labeled "Enrutamiento estático". Router R6 is highlighted with a yellow cloud and labeled "60.6.6.4/30". Router R7 is highlighted with a yellow cloud and labeled "220.20.20.0/24".

QUE SUCEDA EN LOS ROUTER CISCO?

- **CISCO implementa RIPv2 soportando:**

- ▶ Autenticación
- ▶ *Summarization* de rutas
- ▶ VLSM
- ▶ Gestión de clave
- ▶ CIDR

- De manera predeterminada, un router que soporta RIPv2 no recibe paquetes RIPv1

- **CISCO ofrece comandos para RIPv1 y RIPv2**

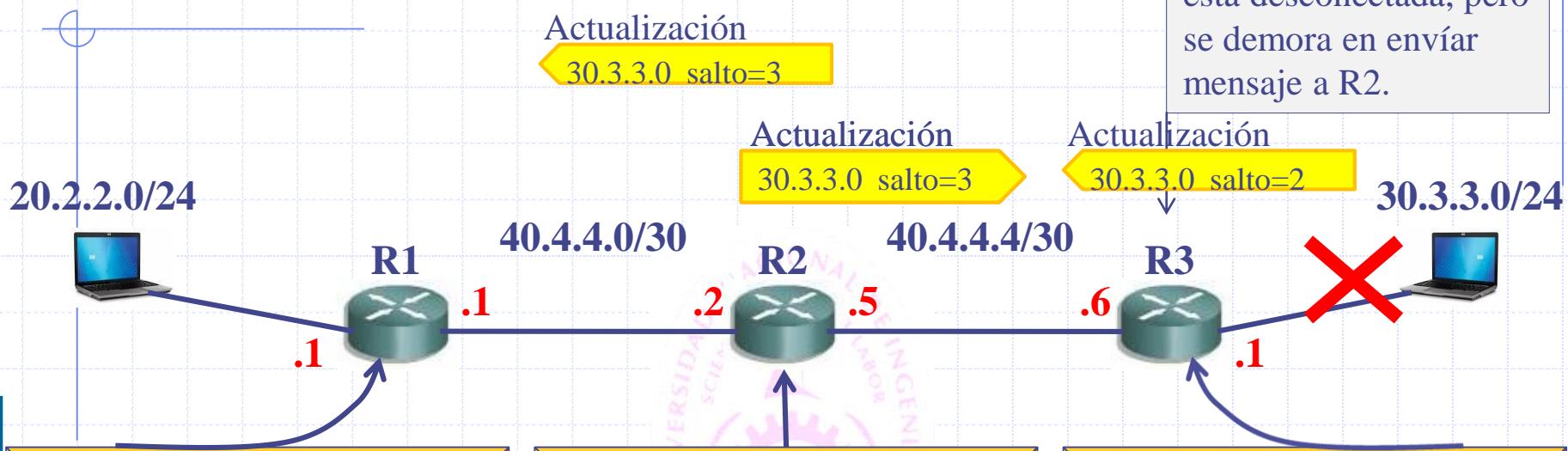
- ▶ **version 1** → recibe y envía paquetes RIPv1
- ▶ **version 2** → recibe y envía paquetes RIPv2

COMANDOS SEND Y RECEIVE

• CISCO ofrece comandos para RIPv1 y RIPv2

- ▶ **ip rip send version 1** → Configura una interfaz para enviar sólo paquetes RIPv1
- ▶ **ip rip send version 2** → Configura una interfaz para enviar sólo paquetes RIPv2
- ▶ **ip rip send version 1 2** → Configura una interfaz para enviar ambos paquetes RIPv1 y RIPv2
- ▶ **ip rip receive version 1** → Configura una interfaz para recibir sólo paquetes RIPv1
- ▶ **ip rip receive version 2** → Configura una interfaz para recibir sólo paquetes RIPv2
- ▶ **ip rip receive version 1 2** →

CUENTA A INFINITO



Propiedad intelectual de Daniel Díaz @ 2011

Red	Interfaz	Salto
20.2.2.0	Directo	0
40.4.4.0	Directo	0
40.4.4.4	40.4.4.2	1
30.3.3.0	40.4.4.2	4

Red	Interfaz	Salto
40.4.4.0	Directo	0
40.4.4.4	Directo	0
20.2.2.0	40.4.4.1	1
30.3.3.0	40.4.4.6	3

Red	Interfaz	Salto
30.3.3.0	40.1.1.5	4
40.4.4.4	Directo	0
40.4.4.0	40.4.4.5	1
20.2.2.0	40.4.4.5	2

► Valor de métrica iría hasta el infinito.

► Para evitar llegar al infinito, se tiene que definir el valor máximo de cuenta. Este valor es el **16**.

R3 detecta que la red está desconectada, pero se demora en enviar mensaje a R2.

CCNA 4.4.1



PING EXTENDIDO:

Lo_0 de router R1 a Lo_5 de router R6

```
fr - HyperTerminal
Archivo Edición Ver Llamar Transferir Ayuda
□ □ X
R1#ping
Protocol [ip]:
Target IP address: 192.168.1.9
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 172.16.15.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.9, timeout is 2 seconds:
Packet sent with a source address of 172.16.15.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms
R1#
R1#
R1#
R1#
R1#
R1#
```

1:05:25 conectado | Autodetect. | 9600 8-N-1 | DESPLAZAR | MAY | NUM | Capturar | Imprimir |



CONFIGURAR AUTENTICACION EN RIPv2



CONFIGURAR AUTENTICACION EN RIPv2

fr - HyperTerminal

Archivo Edición Ver Llamar Transferir Ayuda

R4>enable
Password:
R4#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R4(config)#key chain pepe
R4(config-keychain)#key 1
R4(config-keychain-key)#key-string lima
R4(config-keychain-key)#exit
R4(config-keychain)#exit
R4(config)#
R4(config)#
R4(config)#
R4(config)#interface serial 0/0/1
R4(config-if)#ip rip authentication key-chain pepe
R4(config-if)#ip rip authentication mode md5
R4(config-if)#exit
R4(config)#exit
R4#
R4#
R4#
*Feb 27 22:35:28.379: %SYS-5-CONFIG_I: Configured from console by console
R4#
R4#
R4#_

• Como está la tabla de enrutamiento en R5 ?
• Que pasa si se introduce **key-string inictel**

0:28:02 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir



UNIVERSIDAD NACIONAL DE INGENIERIA

Enrutamiento Dinámico: RIP y OSPF



INTRODUCCIÓN AL PROTOCOLO OSPFv2

ASPECTO BÁSICO DEL PROTOCOLO OSPF

- Definido por la IETF en la RFC 2328, de Abril-98

- ▶ Se encapsula en IP con protocolo=59h.
- ▶ Se define 05 tipos de mensajes.
- ▶ Lectura obligada.

All OSPF protocol packets share a common protocol header that is described in Appendix A. The OSPF packet types are listed below in Table 8. Their formats are also described in Appendix A.

Type	Packet name	Protocol function
1	Hello	Discover/maintain neighbors
2	Database Description	Summarize database contents
3	Link State Request	Database download
4	Link State Update	Database update
5	Link State Ack	Flooding acknowledgment

Table 8: OSPF packet types.

OSPF's Hello protocol uses Hello packets to discover and maintain neighbor relationships. The Database Description and Link State Request packets are used in the forming of adjacencies. OSPF's reliable update mechanism is implemented by the Link State Update and Link State Acknowledgment packets.

Características más importante:

- ▶ Velocidad de convergencia.
- ▶ Soporte de VLSM.
- ▶ Grandes redes IP: Áreas
- ▶ Mejor uso del ancho de banda.
- ▶ Se define “costos”.

CARACTERÍSTICAS DEL PROTOCOLO OSPF

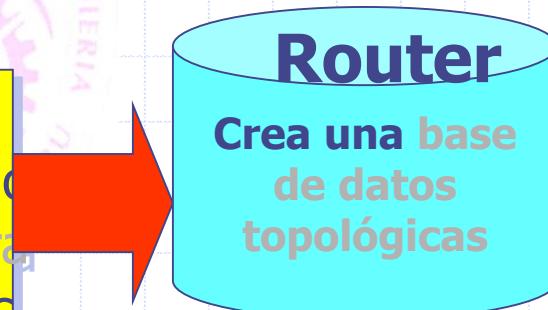
- **Los routers vecinos deben conocerse entre sí**

- ▶ Se hace uso del protocolo HELLO.
- ▶ Se envía periódicamente a la dirección multicast IP 224.0.0.5



- **La clave de OSPF es el intercambio de *estado***

El **estado de enlace** es la descripción de una interfaz y de su relación con los routers vecinos: dirección *IP*, máscara de subred, tipo de red conectada, etc.

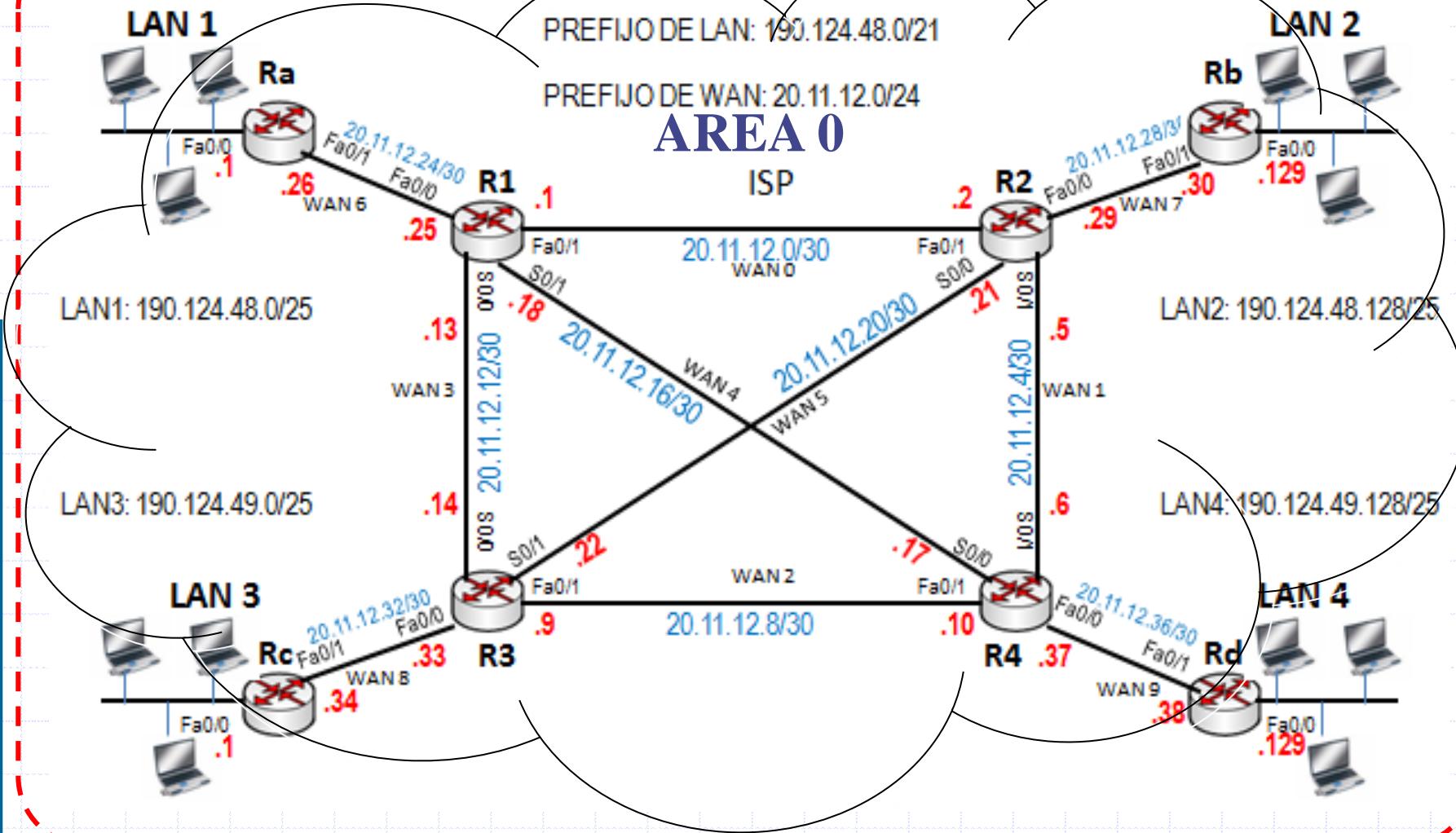


Llamado también Base de datos de Estado de Enlace

- **OSPF origina que cada routers conozca de memoria completa toda la red de su área.**

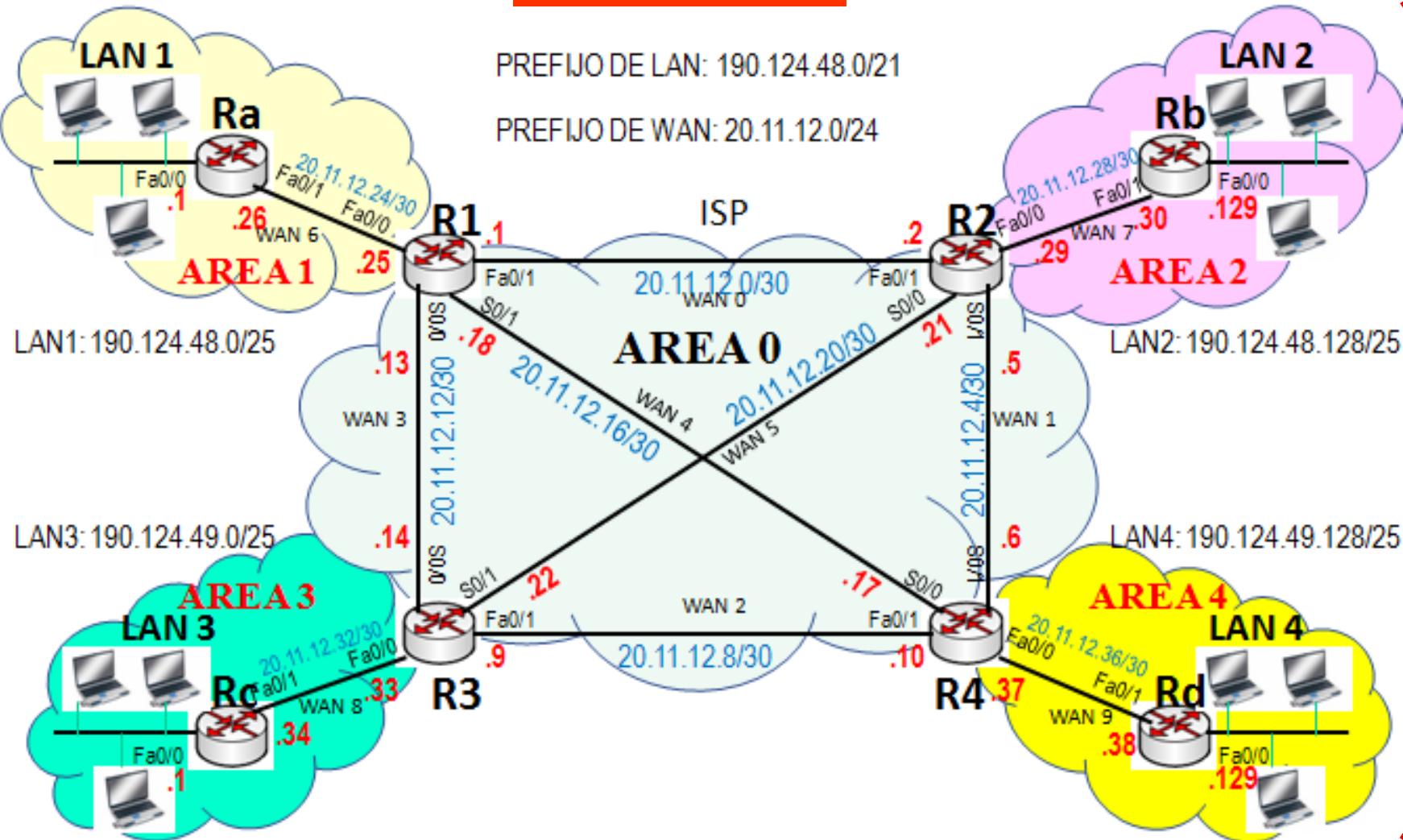
REDES DE ÁREA ÚNICA

SISTEMA AUTÓNOMO



REDES MULTIAREAS

SISTEMA AUTÓNOMO





OBSERVACIONES AL ESTADO DE ENLACE

- Los routers con estado de enlace requieren **memoria y potencia de procesamiento**, que un router con vector-distancia.
- Al inicio del proceso se debe inundar la red con mensaje LSA, puede degradar la red.
- Para reducir la base de datos topológica es necesario dividir la red en áreas.
 - ▶ El **Área 0** es denominada también Área Backbone y en ella conectan las demás áreas.



FORMATO DEL PROTOCOLO OSPFv2

FORMATO DEL PROTOCOLO OSPF

- **El protocolo OSPF está formado por 05 tipos de paquetes:** Se encapsula en

- ▶ **Tipo 1: Hello**

Descubre y mantiene los routers vecinos.

- ▶ **Tipo 2: DataBase Description-DBD**

Describe el contenido de la base de datos de topología.

- ▶ **Tipo 3: Link-State Request-LSR**

Descarga la base de datos (registro).

- ▶ **Tipo 4: Link-State Update-LSU**

Actualiza la base de datos (registro).

- ▶ **Tipo 5: Link-State Acknowledgement**

Cabecera IPv4

Protocolo OSPF



FORMATO DEL PROTOCOLO OSPF

0 8 16 31

• Campo Versión:

- ▶ Indica la versión del protocolo OSPF, Versión 2.

• Campo Tipo:

- ▶ Indica el tipo de mensaje que encapsula OSPF.

• Campo Longitud del paquete:

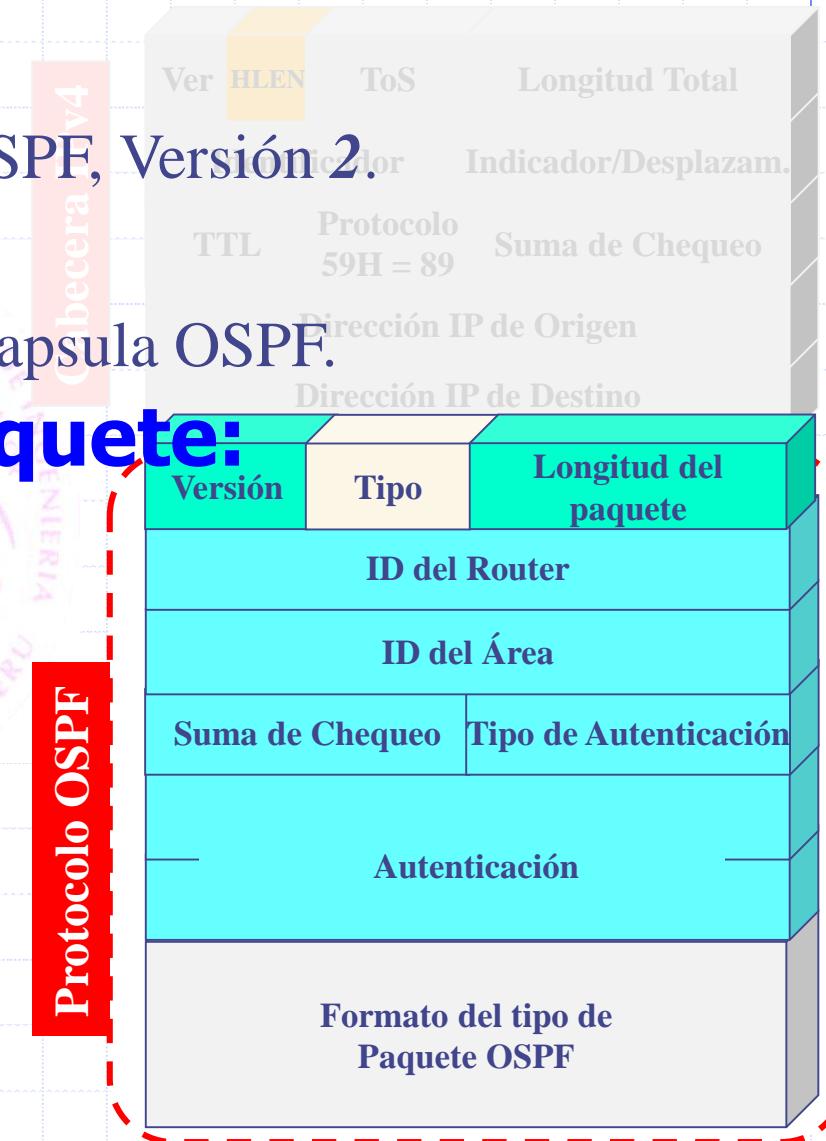
- ▶ Indica longitud del paquete, incluyendo la cabecera OSPF.

• Campo ID del Router:

- ▶ Indica el ID del router que originó en paquete.

• Campo ID del Área:

- ▶ Indica el área a la que pertenece el paquete.



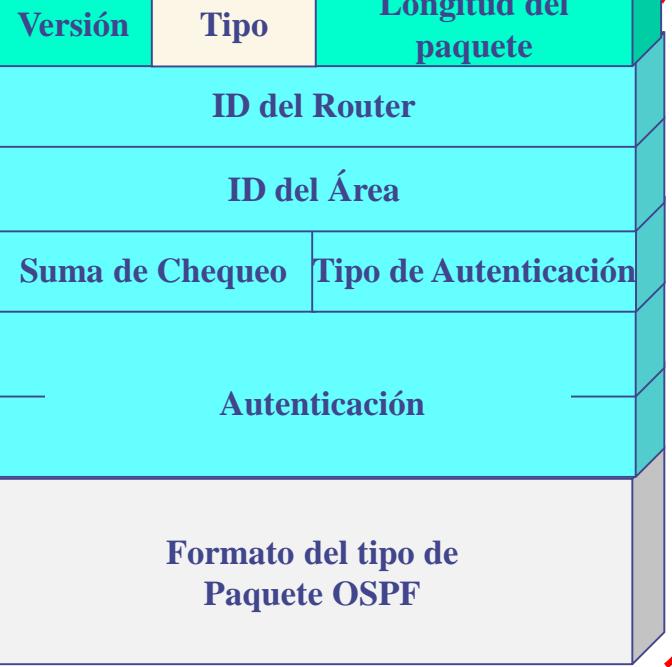
FORMATO DEL PROTOCOLO OSPF

0 8 16 31

Ver HLEN ToS Longitud Total

TTL Protocolo Suma de Chequeo

Dirección IP de Origen



Campo Suma de Chequeo:

- ▶ Verifica todo el contenido del paquete OSPF, excluyendo el campo de autenticación.

Campo Tipo de Autenticación:

- ▶ Indica el esquema de autenticación a usar en el paquete.

Se configura por áreas.

La RFC 2328 define dos tipos de autenticación:

- 0 → Ninguna
- 1 → Password de 64 bits, texto.
- 2 → Autenticación MD5.

Campo Autenticación:

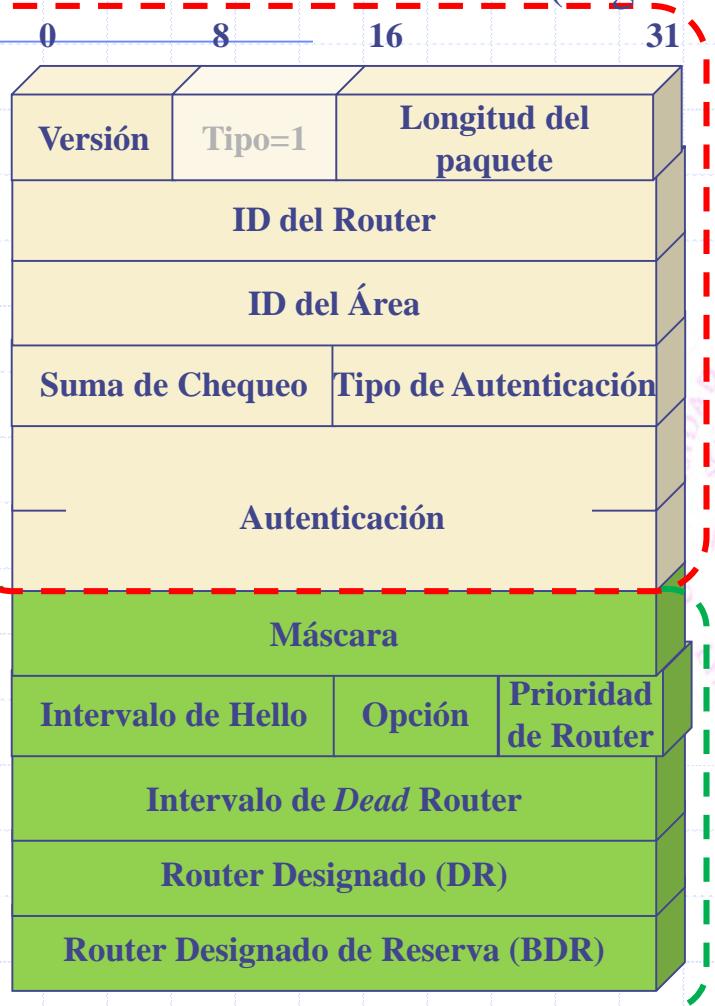
- ▶ Campo de 64 bits, usado para autenticación.

FORMATO DEL PROTOCOLO HELLO

(Pag. 193 de la RFC 2328)

Protocolo OSPF

Protocolo HELLO



router en 40 seg. se considera caído este router.

● **Paquetes Hello son paquetes OSPF tipo 1.**

- ▶ Son enviados periódicamente a todas las interfaces (incluyendo los enlaces virtuales).
- ▶ Establecen y mantienen las relaciones entre los routers vecinos.
- ▶ Por default, en routers CISCO, el paquete Hello se envían cada 10 segundos.
- ▶ Por default, en routers CISCO, si no llega un paquete *Hello* a un

FORMATO DEL PROTOCOLO HELLO

(Pag. 193 de la RFC 2328)

Protocolo HELLO



Campo Máscara.

- ▶ Es la máscara de la red asociada con la interfaz.

Campo Intervalo de Hell

- ▶ Define la frecuencia en seg. con que un router envía un paquete Hello.

Campo de Opción:

DN	O	DC	L	NP	MC	E	No usad o
----	---	----	---	----	----	---	-----------

Campo Prioridad de Router:

- ▶ Usado para la elección de un router DR o BDR
- ▶ Si este campo está en 0, el router nunca será seleccionado como DR o BDR.

FORMATO DEL PROTOCOLO HELLO

(Pag. 193 de la RFC 2328)

Protocolo HELLO



- **Campo *Intervalo Dead Router*:**

- ▶ Número en segundos antes de declarar caído. Por default es cuatro (04) veces del campo de Intervalo de Hello.

- **Campo de *Router Designado*:**

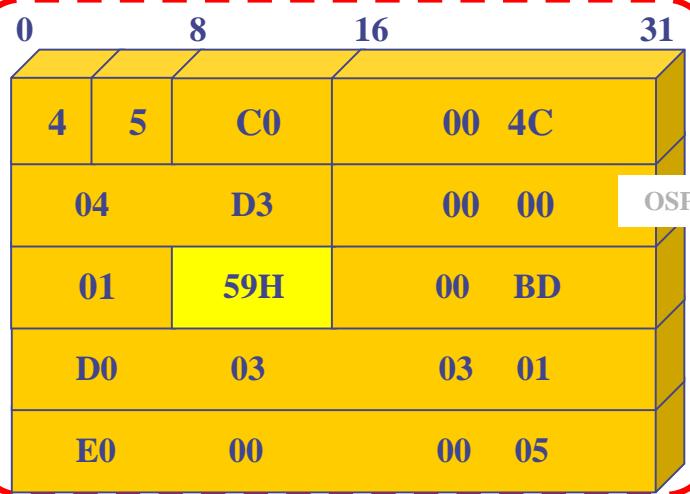
- ▶ Identifica a un router dentro de un sistema autónomo.
Es la dirección IP más alta de sus interfaces.
Es utilizado para seleccionar el router DR.

- **Campo de *Router Designado*:**

- ▶ Es utilizado para seleccionar el router BDR.

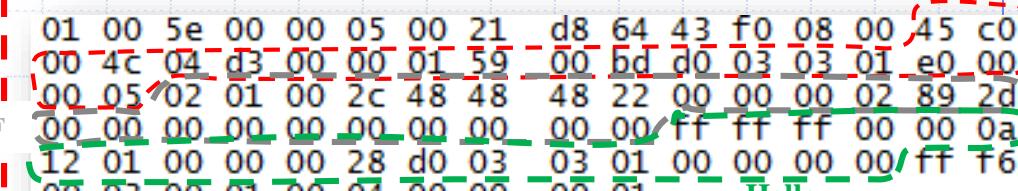
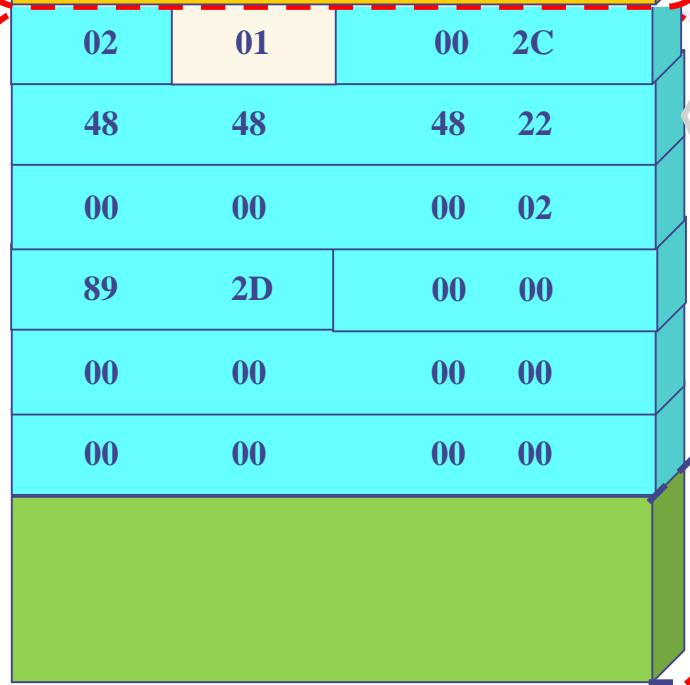
FORMATO DEL PROTOCOLO HELLO

Cabecera IPv4



Propiedad intelectual de Daniel Díaz @ 2011

Protocolo OSPF



Versión 2

Tipo 1 (Hello)

Longitud 2C=44

ID Router 72.72.72.34

ID Area 0.0.0.2

Suma de Chequeo 892D

Máscara 255.255.255.0

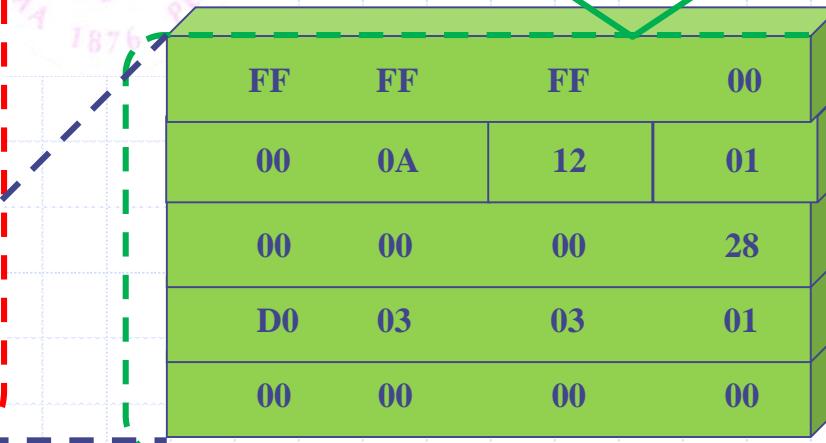
Intervalo de Hello 10 seg.

Prioridad de router 1

Intervalo Dead Router 40 seg.

Router DR 208.3.3.1

Router BDR 0.0.0.0





UNIVERSIDAD NACIONAL DE INGENIERIA

Enrutamiento Dinámico: RIP y OSPF



CONFIGURACION DE OSPFv2

ASPECTOS DE CONFIGURACIÓN (17)

Configuración OSPF:

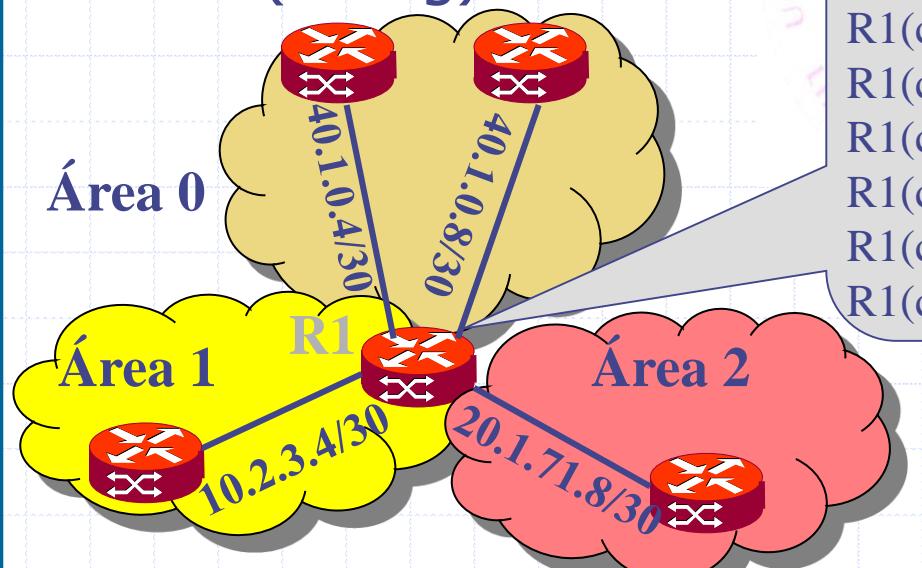
Router# configure terminal

Router(config)# router ospf *process-ID*

Router(config-router)# network *dirección_de_red wildcard*
area *area_ID*

Router(config-router)# exit

Router(config)#



R1# configure terminal

R1(config)# router ospf 1

R1(config-router)# network 10.2.3.4 0.0.0.3 area 1

R1(config-router)# network 20.1.71.8 0.0.0.3 area 2

R1(config-router)# network 40.1.0.4 0.0.0.3 area 0

R1(config-router)# network 40.1.0.8 0.0.0.3 area 0

R1(config)#

ASPECTOS DE CONFIGURACIÓN (2/7)

• Definición de Identificador de Router (ID-Router)

- ▶ Al iniciarse el proceso OSPF en un router, el IOS utiliza la dirección IP activa local más alta como ID del router.
- ▶ Si no existe una interfaz activa, el proceso OSPF no se iniciará.
- ▶ Para asegurar la estabilidad del proceso OSPF, es necesario que el router tenga una interfaz activa en todo momento.
- ▶ La interfaz *loopback* es importante para este objetivo.

• En un router con más de una interfaz loopback la dirección más alta será el ID-Router.

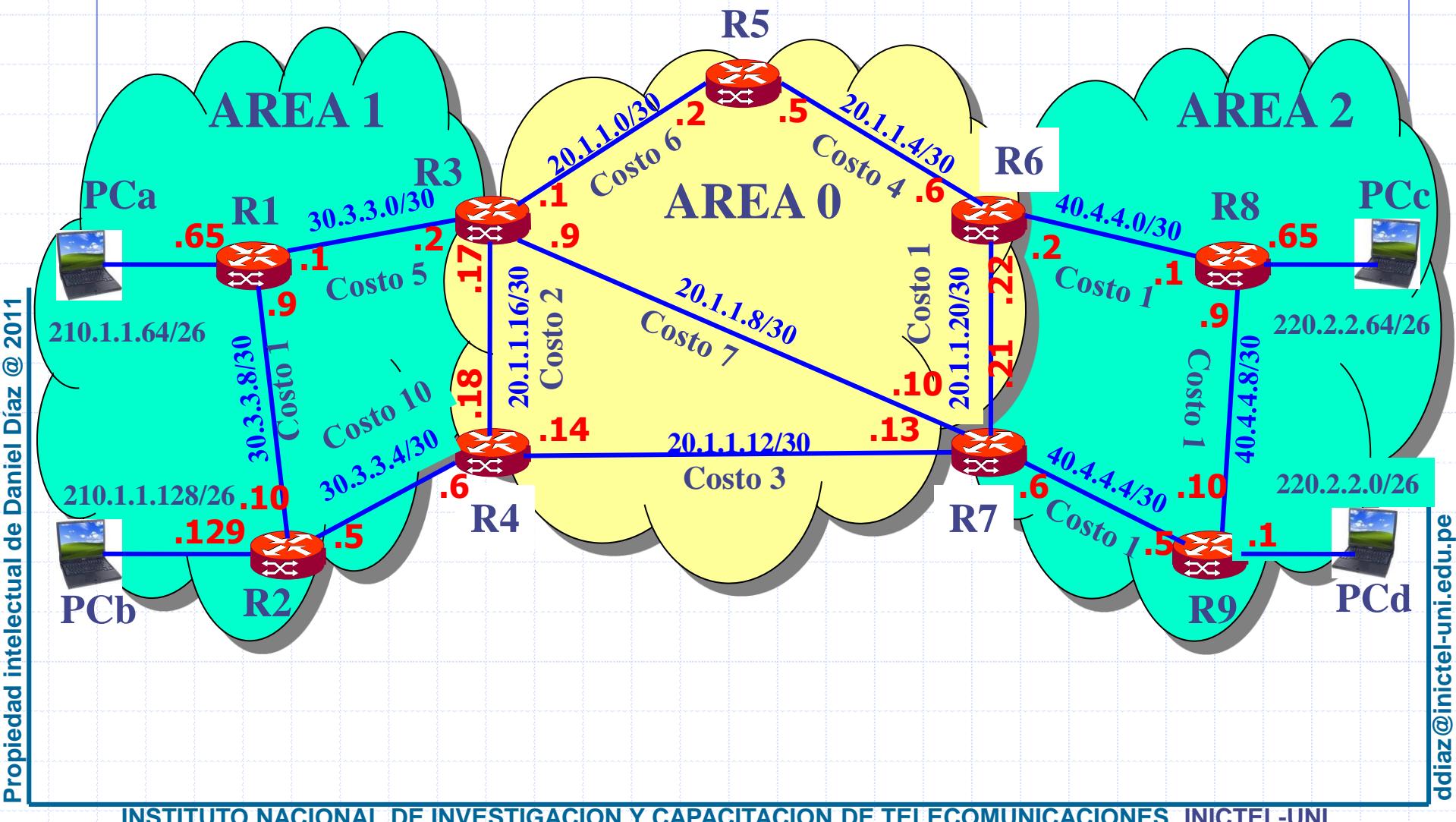
• Selección del Router Designado (DR):

- ▶ La interfaz con mayor prioridad permitirá el router sea DR.
- ▶ Ante iguales prioridades se selecciona el de mayor ID-Router.

ASPECTOS DE CONFIGURACIÓN (3/7)

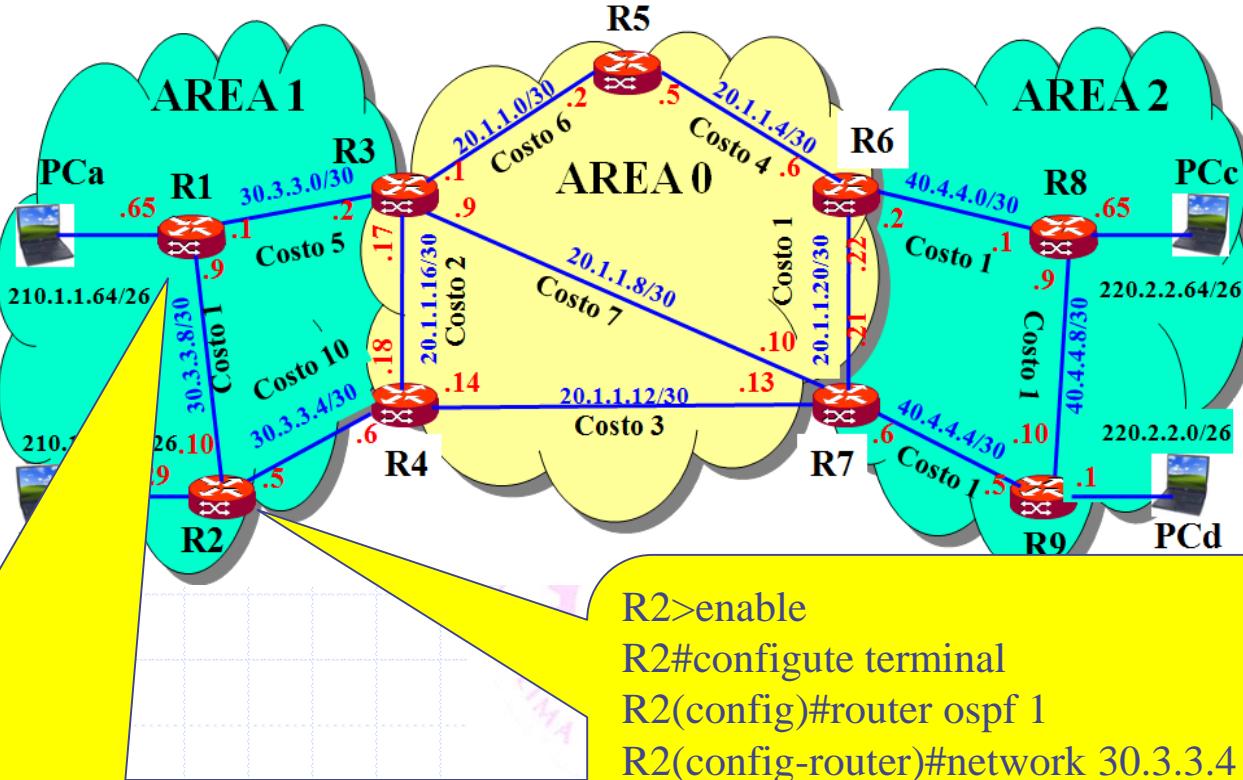
- **Configuración de prioridad en una interfaz:**
Router(config)# interface serial 0/0/0
Router(config-if)# ip priority *número_de_prioridad*
- **Un valor de prioridad puede variar de 0 a 255**
- **Valor 0 de prioridad imposibilita al router que sea elegido DR.**
- **En resumen sobre selección de DR y BDR:**
 - ▶ Mayor prioridad → Router DR.
 - ▶ Segundo valor de prioridad → Router BDR.
 - ▶ Routers con igual prioridad → Será DR el mayor ID-Router

ANÁLISIS DE LA RED MULTIAREA



Enrutamiento Dinámico: RIP y OSPF

CONFIGURACIÓN DE ROUTER CON OSPF

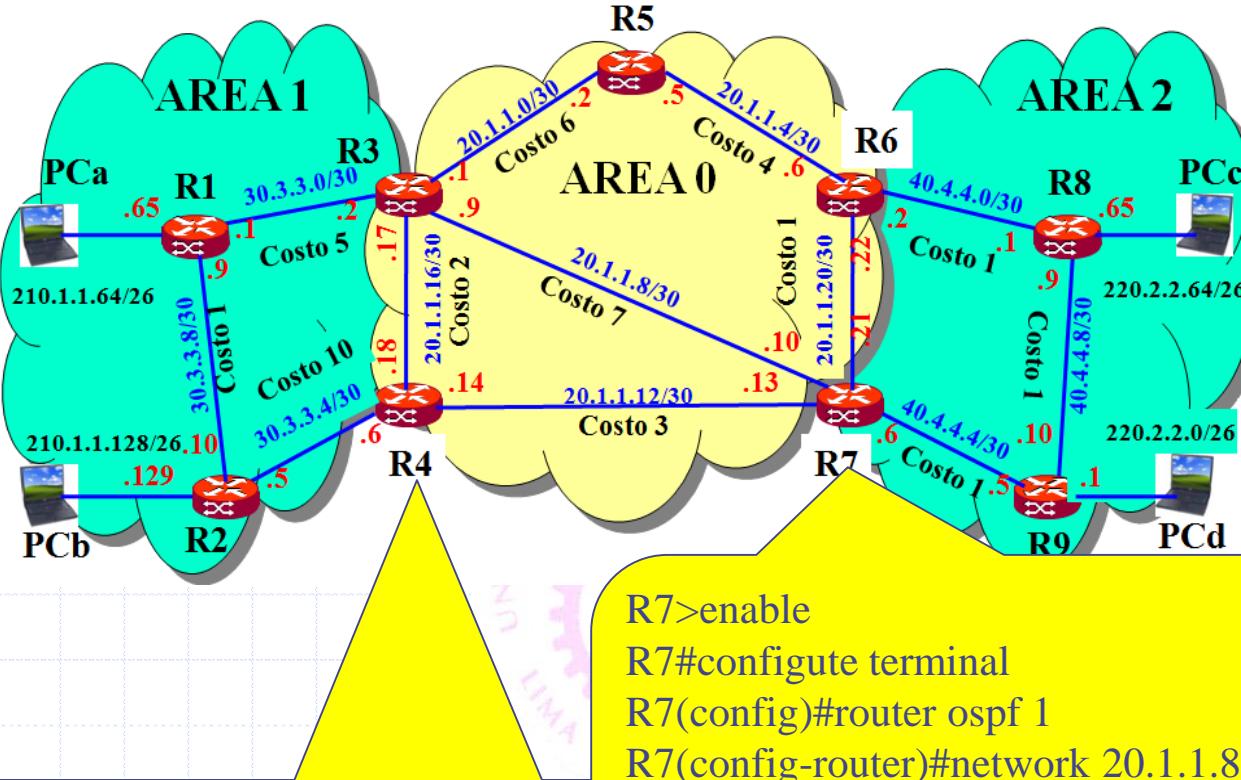


```
R1>enable
R1#configure terminal
R1(config)#router ospf 1
```

```
R1(config-router)#network 30.3.3.0 0.0.0.3 area 1
R1(config-router)#network 30.3.3.8 0.0.0.3 area 1
R1(config-router)#network 210.1.1.64 0.0.0.63 area 1
R1(config-router)#exit
```

```
R2>enable
R2#configure terminal
R2(config)#router ospf 1
R2(config-router)#network 30.3.3.4 0.0.0.3 area 1
R2(config-router)#network 30.3.3.8 0.0.0.3 area 1
R2(config-router)#network 210.1.1.128 0.0.0.63 area 1
R2(config-router)#exit
```

CONFIGURACIÓN DE ROUTER CON OSPF

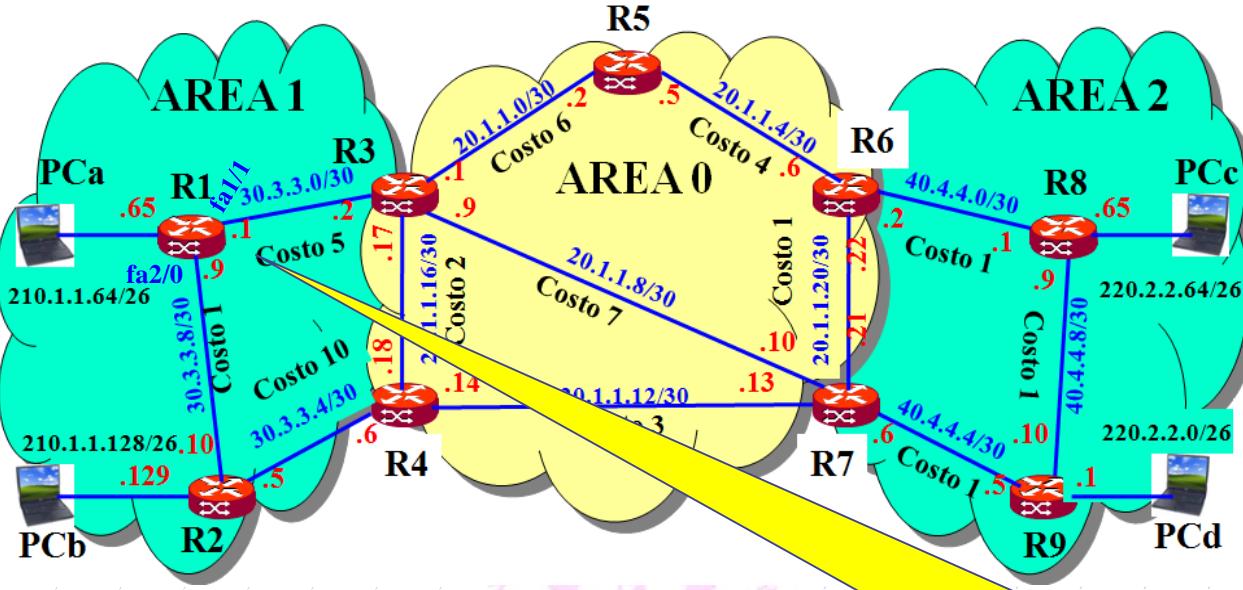


```
R4>enable
R4#configure terminal
R4(config)#router ospf 1
R4(config-router)#network 20.1.1.12 0.0.0.3 area 0
R4(config-router)#network 20.1.1.16 0.0.0.3 area 0
R4(config-router)#network 30.3.3.4 0.0.0.3 area 1
R4(config-router)#exit
```

```
R7>enable
R7#configure terminal
R7(config)#router ospf 1
R7(config-router)#network 20.1.1.8 0.0.0.3 area 0
R7(config-router)#network 20.1.1.12 0.0.0.3 area 0
R7(config-router)#network 20.1.1.20 0.0.0.3 area 0
R7(config-router)#network 40.4.4.4 0.0.0.3 area 2
R7(config-router)#exit
```

Los demás router se configuran de manera similar.

COSTOS OSPF POR DEFAULT



- ▶ Por default, OSPF asigna costo asociado al ancho de banda:

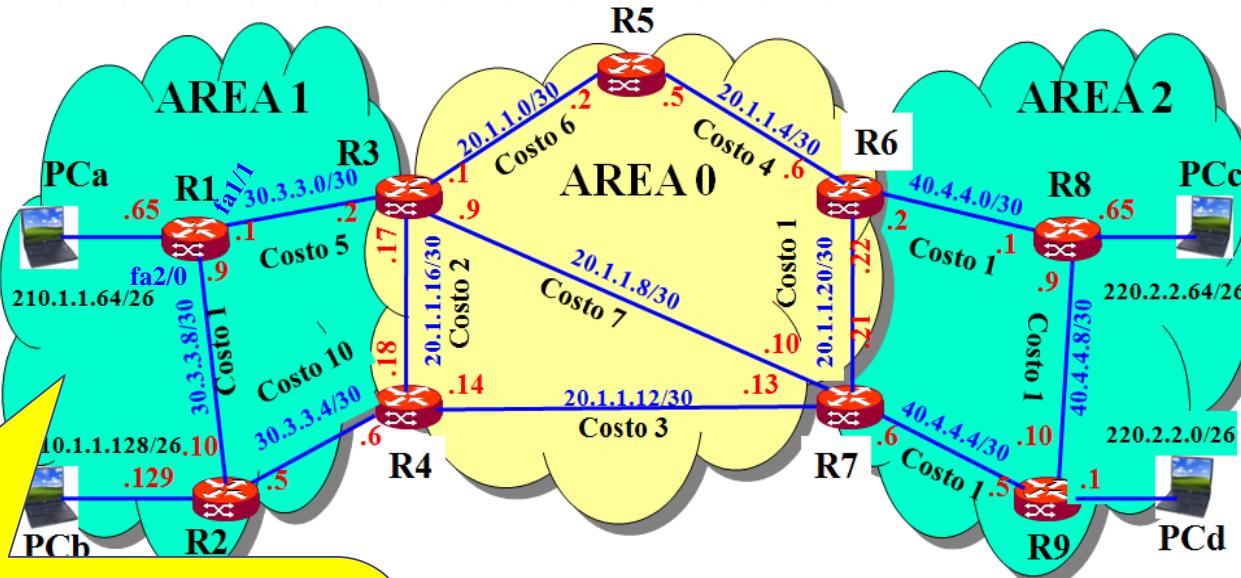
$$\text{costo} = 10^8 / (\text{Ancho de banda})$$

```
R1>enable
R1#configure terminal
R1(config)#interface fastethernet 2/0
R1(config-if)#bandwidth 100 000
```

Expresado en 1000

- ▶ Se puede usar el comando **bandwidth** para cambiar el denominador de la fórmula

CONFIGURACIÓN DE COSTOS OSPF



```
R1>enable
R1#configure terminal
R1(config)#interface fastethernet 1/1
R1(config-if)#ip ospf cost 5
R1(config-router)#exit
R1(config)#interface fastethernet 2/0
R1(config-if)#ip ospf cost 1
R1(config-router)#exit
```

Los demás router se configuran de manera similar.

Para observar el costo de una interfaz:
show ip ospf interface fastethernet 1/1

Dynamips(4): R1, Console port

```
R1#show ip ospf interface fastethernet 1/1
FastEthernet1/1 is up, line protocol is up
  Internet Address 30.3.3.1/30, Area 1
  Process ID 1, Router ID 210.1.1.65, Network Type BROADCAST, (Cost: 5)
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 210.1.1.65, Interface address 30.3.3.1
```



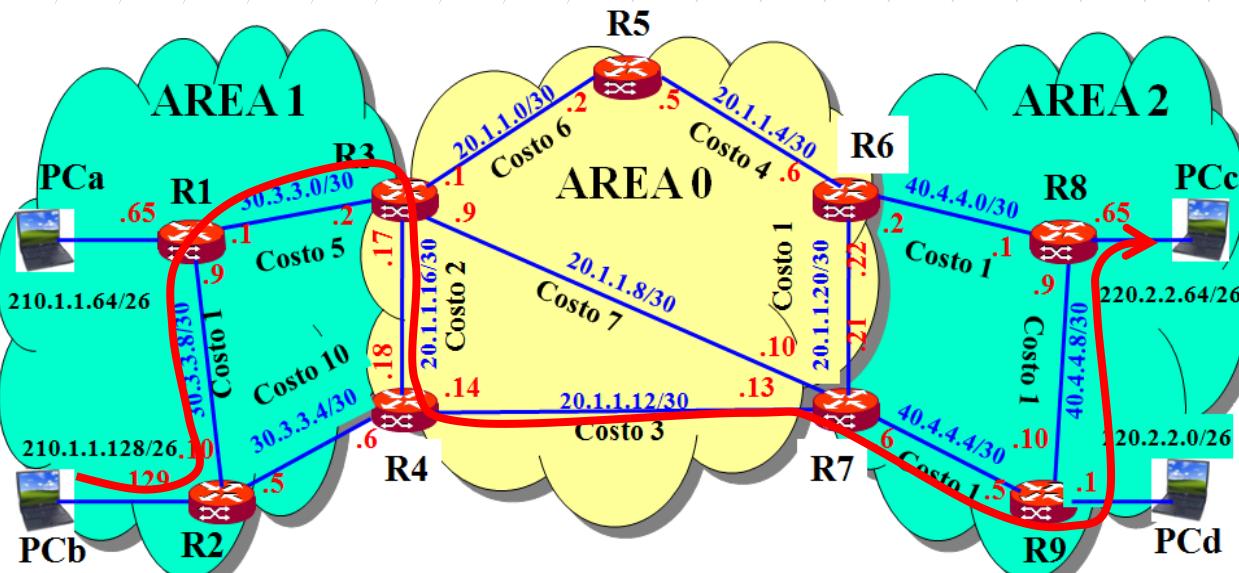
COMANDO debug ip ospf events

```
Dynamips(7): R3, Console port
R3#debug ip ospf events
OSPF events debugging is on
R3#
*Jul 31 19:12:06.531: OSPF: Rcv hello from [REDACTED] area 0 from FastEthernet2/0 2
0.1.1.2 [REDACTED]
*Jul 31 19:12:06.535: OSPF: End of hello processing
R3#
*Jul 31 19:12:08.511: OSPF: Rcv hello from [REDACTED] area 0 from FastEthernet2/1 2
0.1.1.10 [REDACTED]
*Jul 31 19:12:08.515: OSPF: End of hello processing
R3#
*Jul 31 19:12:09.871: OSPF: Rcv hello from 210.1.1.65 area 1 from
30.3.3.1
*Jul 31 19:12:09.875: OSPF: End of hello processing
R3#
*Jul 31 19:12:12.411: OSPF: Send hello to 224.0.0.5 area 1 on FastEthernet1/0 fro
m 30.3.3.2
*Jul 31 19:12:12.455: OSPF: Send hello to 224.0.0.5 area 0 on FastEthernet2/1 fro
m 20.1.1.9
*Jul 31 19:12:12.463: OSPF: Send hello to 224.0.0.5 area 0 on FastEthernet2/0 fro
m 20.1.1.1
*Jul 31 19:12:12.467: OSPF: Send hello to 224.0.0.5 area 0 on FastEthernet1/1 fro
m 20.1.1.17
*Jul 31 19:12:12.711: OSPF: Rcv hello from 30.3.3.6 area 0 from FastEthernet1/1 2
0.1.1.18
*Jul 31 19:12:12.711: OSPF: End of hello processing
R3#
*Jul 31 19:12:16.551: OSPF: Rcv hello from 20.1.1.5 area 0 from FastEthernet2/0 2
0.1.1.2 [REDACTED]
*Jul 31 19:12:16.551: OSPF: End of hello processing
R3#
*Jul 31 19:12:18.511: OSPF: Rcv hello from 40.4.4.6 area 0 from FastEthernet2/1 2
0.1.1.10 [REDACTED]
*Jul 31 19:12:18.515: OSPF: End of hello processing
R3#
*Jul 31 19:12:19.887: OSPF: Rcv hello from 210.1.1.65 area 1 from FastEthernet1/0
30.3.3.1
```

Se desactiva:
R#no debug ip ospf events

Enrutamiento Dinámico: RIP y OSPF

ANALISIS DE PATH PCb a PCc



```
G:\Universidad\Universidad 2011\Todo soporte sobre GNS3\Virtual PC Simulator-VPCS\VPCS-0.21...\
```

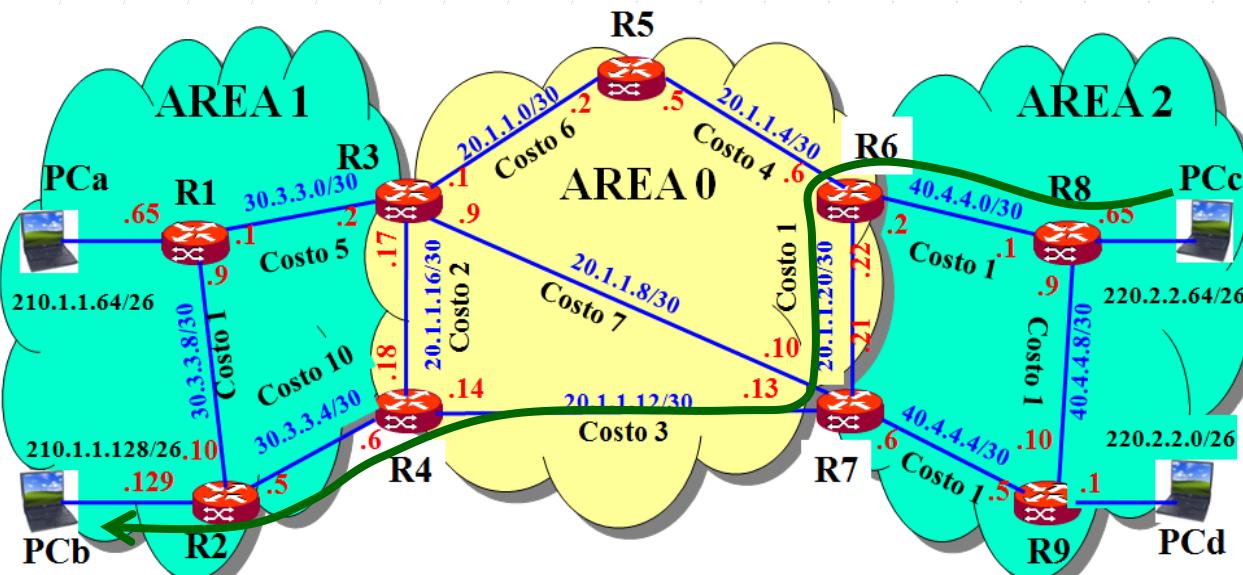
VPCS[2]>
VPCS[2]> ping 220.2.2.66
220.2.2.66 icmp_seq=1 ttl=59 time=52.000 ms
220.2.2.66 icmp_seq=2 ttl=59 time=39.000 ms
220.2.2.66 icmp_seq=3 ttl=59 time=48.000 ms
220.2.2.66 icmp_seq=4 ttl=59 time=74.000 ms
220.2.2.66 icmp_seq=5 ttl=59 time=86.000 ms

VPCS[2]>
VPCS[2]>
VPCS[2]> tracert 220.2.2.66
traceroute to 220.2.2.66, 64 hops max, press Ctrl+C to stop
1 210.1.1.129 28.000 ms 23.000 ms 7.000 ms
2 30.3.3.9 41.000 ms 18.000 ms 10.000 ms
3 30.3.3.2 34.000 ms 32.000 ms 21.000 ms
4 20.1.1.18 59.000 ms 23.000 ms 18.000 ms
5 20.1.1.13 34.000 ms 27.000 ms 29.000 ms
6 40.4.4.5 56.000 ms 27.000 ms 27.000 ms
7 40.4.4.9 34.000 ms 46.000 ms 31.000 ms
8 220.2.2.66 27.000 ms 26.000 ms 31.000 ms

VPCS[2]>
VPCS[2]>
VPCS[2]>

Enrutamiento Dinámico: RIP y OSPF

ANALISIS DE PATH PCc a PCb



G:\Universidad\Universidad 2011\Todo soporte sobre GNS3\Virtual PC Simulator-VPCS\vpcs-0.21\

```
UPCS[3]> ping 210.1.1.130
210.1.1.130 icmp_seq=1 ttl=57 time=41.000 ms
210.1.1.130 icmp_seq=2 ttl=57 time=50.000 ms
210.1.1.130 icmp_seq=3 ttl=57 time=38.000 ms
210.1.1.130 icmp_seq=4 ttl=57 time=46.000 ms
210.1.1.130 icmp_seq=5 ttl=57 time=50.000 ms
```

UPCS [3/1]

UPGS [3/1]

[UPCS[3]]> tracert 210.1.1.130

```
traceroute to 210.1.1.130, 64 hops max, press Ctrl+C to stop
 1  220.2.2.65  19.000 ms  21.000 ms  7.000 ms
 2  40.4.4.2  30.000 ms  9.000 ms  11.000 ms
 3  20.1.1.21  48.000 ms  36.000 ms  13.000 ms
 4  20.1.1.14  42.000 ms  25.000 ms  21.000 ms
 5  30.3.3.5  43.000 ms  31.000 ms  28.000 ms
 6  210.1.1.130  30.000 ms  21.000 ms  20.000 ms
```

HP005212

UPCS [3] >
UPCC [2] >

UPCS [3] >
UPCS [3] >

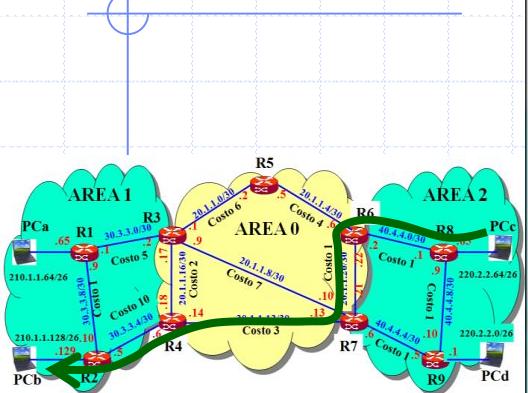
UPCS [31]

UPCS [312]

UPCS [31]

418823

TABLA DE ENRUTAMIENTO DE R2



▶ Costo total
desde R2 hasta
la red
220.2.2.64
es 14.

Dynamips(5): R2, Console port

```
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
Costo total

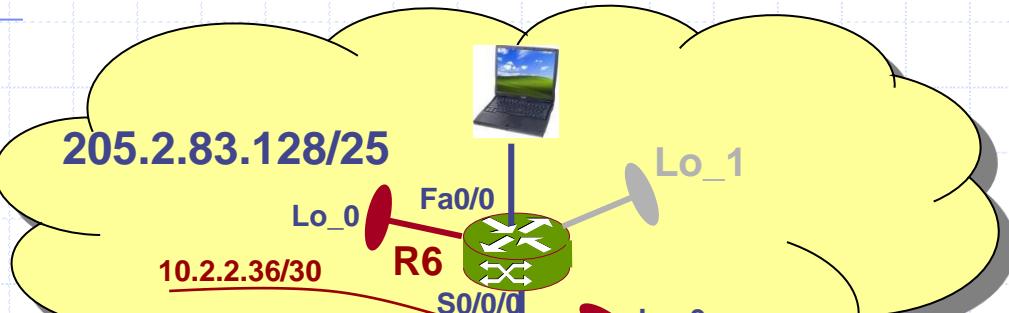
  220.2.2.0/26 is subnetted, 2 subnets
O IA  220.2.2.64 [110/14] via 30.3.3.9, 00:18:22, FastEthernet1/0
O IA  220.2.2.0 [110/13] via 30.3.3.9, 00:18:22, FastEthernet1/0
  20.0.0.0/30 is subnetted, 6 subnets
O IA  20.1.1.20 [110/12] via 30.3.3.9, 00:18:22, FastEthernet1/0
O IA  20.1.1.16 [110/8] via 30.3.3.9, 00:18:22, FastEthernet1/0
O IA  20.1.1.4 [110/16] via 30.3.3.9, 00:18:18, FastEthernet1/0
O IA  20.1.1.0 [110/12] via 30.3.3.9, 00:18:22, FastEthernet1/0
O IA  20.1.1.12 [110/11] via 30.3.3.9, 00:18:18, FastEthernet1/0
O IA  20.1.1.8 [110/13] via 30.3.3.9, 00:18:22, FastEthernet1/0
  40.0.0.0/30 is subnetted, 3 subnets
O IA  40.4.4.8 [110/13] via 30.3.3.9, 00:18:22, FastEthernet1/0
O IA  40.4.4.0 [110/13] via 30.3.3.9, 00:18:22, FastEthernet1/0
O IA  40.4.4.4 [110/12] via 30.3.3.9, 00:18:24, FastEthernet1/0
  210.1.1.0/26 is subnetted, 2 subnets
C  210.1.1.128 is directly connected, FastEthernet2/0
O  210.1.1.64 [110/2] via 30.3.3.9, 00:18:26, FastEthernet1/0
  30.0.0.0/30 is subnetted, 3 subnets
C  30.3.3.8 is directly connected, FastEthernet1/0
C  30.3.3.4 is directly connected, FastEthernet1/1
O  30.3.3.0 [110/6] via 30.3.3.9, 00:18:26, FastEthernet1/0
```

R2#

NUEVO ESCENARIO DE ANÁLISIS

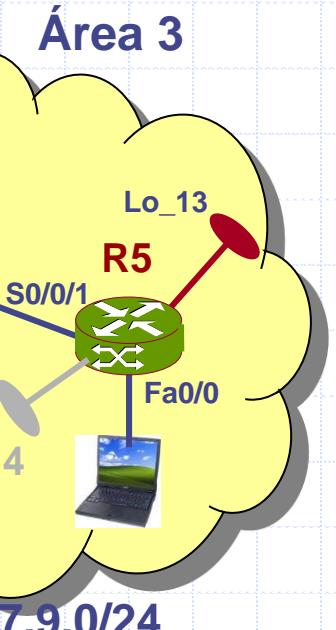
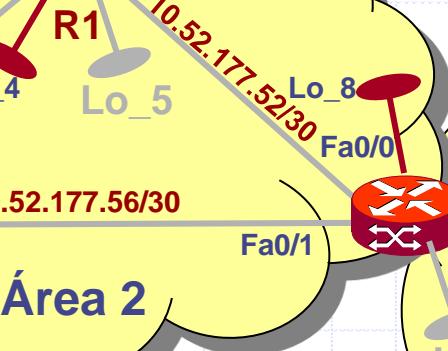
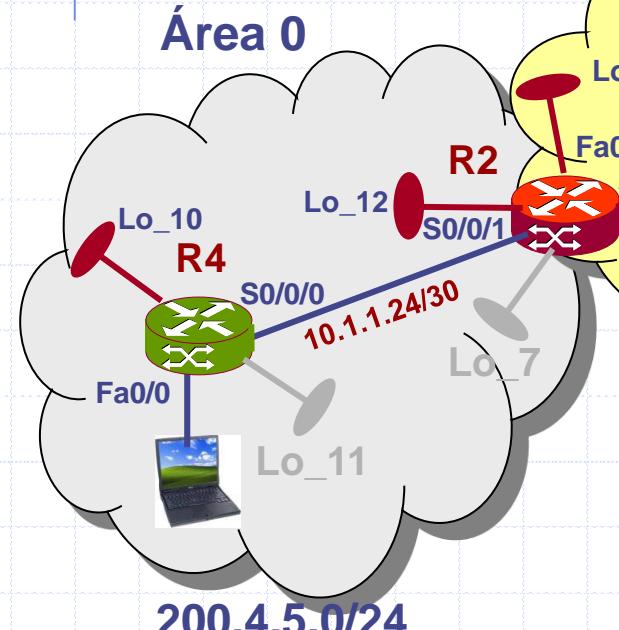
Área 1

Lo_0: 131.4.5.33/28
Lo_1: 131.4.6.163/27



Lo_2: 190.1.7.73/29
Lo_3: 190.1.9.130/25

Lo_10: 10.41.52.3/24
Lo_11: 10.41.68.19/24
Lo_12: 51.5.6.6/24



Propiedad intelectual de Daniel Díaz @ 2011

Lo_4: 210.7.2.31/24
Lo_5: 210.8.8.19/24
Lo_6: 55.0.4.3/17
Lo_7: 55.0.190.90/17
Lo_8: 140.1.160.3/21
Lo_9: 140.1.170.7/21

OBTENCION DE ROUTER-ID

- En el router R1

R1#show ip ospf

Routing Process "ospf 1" with ID 210.8.8.19

- En el router R2

R2#show ip ospf

Routing Process "ospf 3" with ID 55.0.190.90

- En el router R3

R3#show ip ospf

Routing Process "ospf 3" with ID 140.1.170.7



OBTENCION DE ROUTER-ID

- En el router R4

R4#show ip ospf

Routing Process "ospf 1" with ID 10.41.68.19

- En el router R5

R5#show ip ospf

Routing Process "ospf 3" with ID 204.9.80.94

- En el router R6

R6#show ip ospf

Routing Process "ospf 3" with ID 131.4.6.163

USANDO show ip ospf neighbor

- En el router R1

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
131.4.6.163	0	FULL/ -	00:00:33	10.2.2.37	Serial0/0/0
55.0.190.90	1	FULL/BDR	00:00:38	10.52.177.62	FastEthernet0/0/0
140.1.170.7	1	FULL/BDR	00:00:33	10.52.177.53	FastEthernet0/0/1

```
R1#
```

- En el router R3

```
R3#show ip ospf neighbor
```

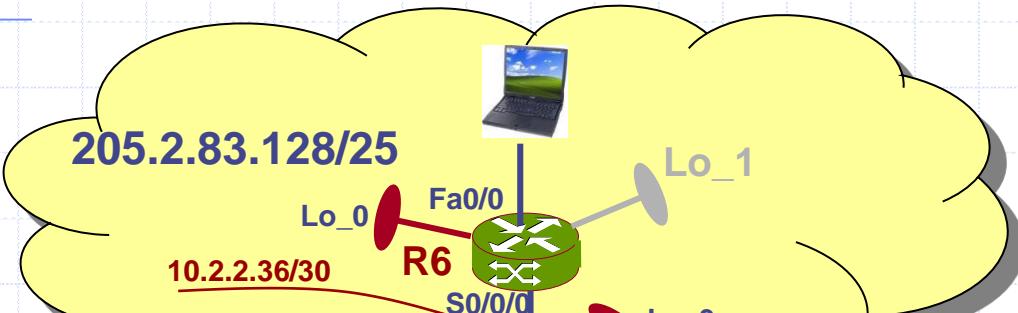
Neighbor ID	Pri	State	Dead Time	Address	Interface
55.0.190.90	1	FULL/BDR	00:00:39	10.52.177.57	GigabitEthernet0/0/0
210.8.8.19	1	FULL/DR	00:00:34	10.52.177.54	GigabitEthernet0/0/1
204.9.80.94	0	FULL/ -	00:00:31	10.1.1.30	Serial0/0/0

```
R3#
```

ESTABLECIENDO ENLACE VIRTUAL

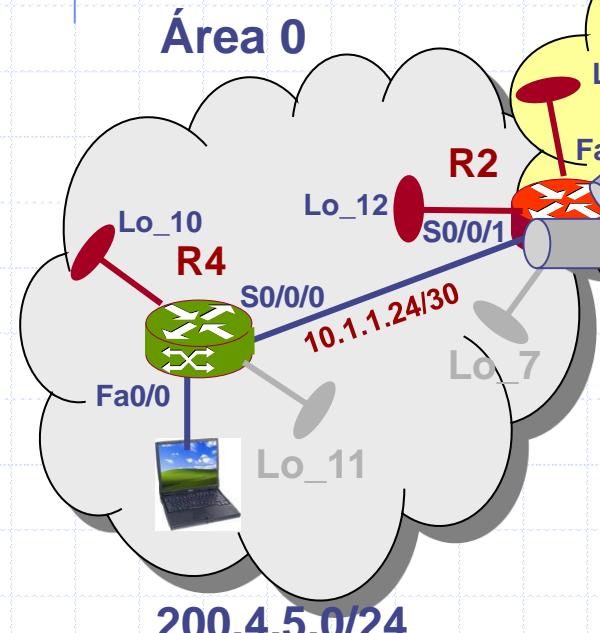
Área 1

Lo_0: 131.4.5.33/28
Lo_1: 131.4.6.163/27

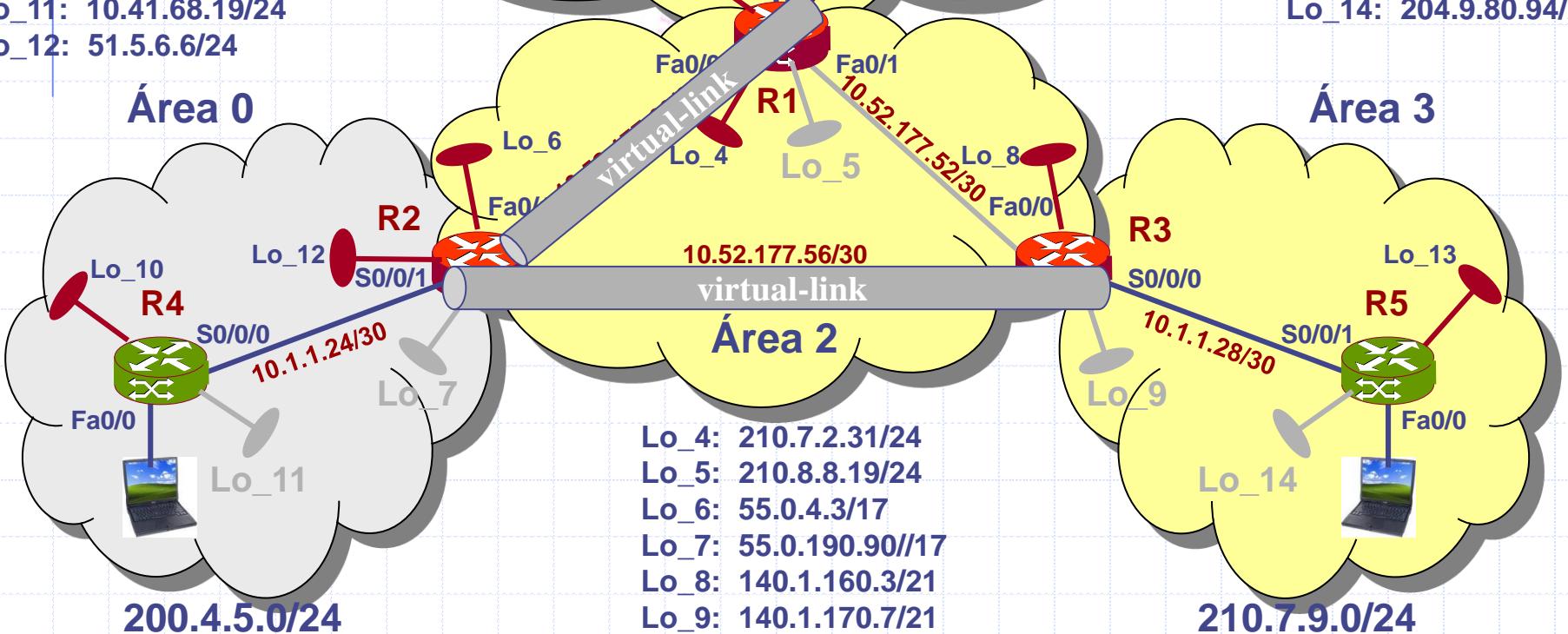


Lo_2: 190.1.7.73/29
Lo_3: 190.1.9.130/25

Lo_10: 10.41.52.3/24
Lo_11: 10.41.68.19/24
Lo_12: 51.5.6.6/24



Lo_13: 204.6.21.36/24
Lo_14: 204.9.80.94/24





OBSERVANDO LA TABLA DE RUTEO EN R5

Router - HyperTerminal

Archivo Edición Ver Llamar Transferir Ayuda

R5#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

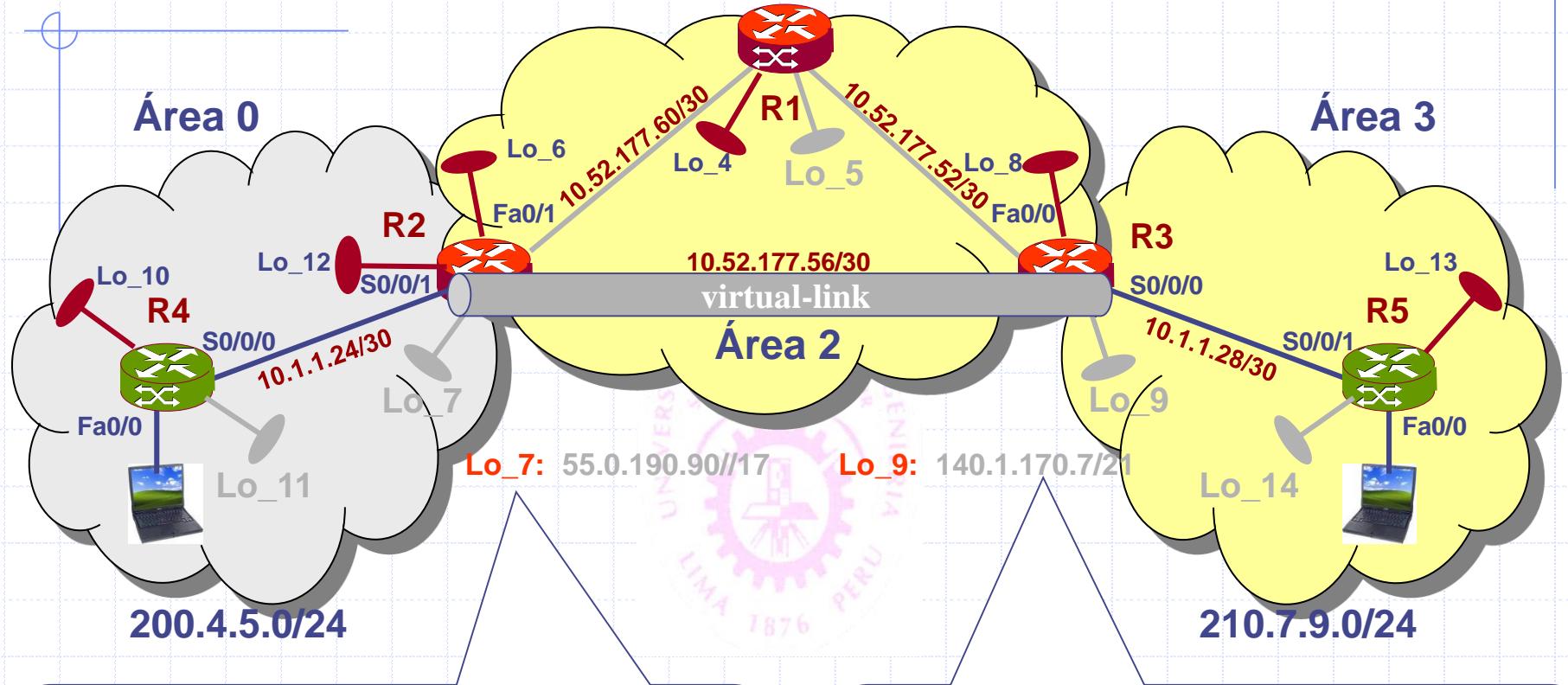
C 204.6.21.0/24 is directly connected, Loopback13
140.1.0.0/32 is subnetted, 1 subnets
O 140.1.170.7 [110/65] via 10.1.1.29, 03:50:29, Serial0/0/1
C 204.9.80.0/24 is directly connected, Loopback14
10.0.0.0/30 is subnetted, 1 subnets
C 10.1.1.28 is directly connected, Serial0/0/1

R5#
R5#
R5#
R5#
R5#
R5#
R5#_

3:52:55 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir >

Observar que un loopback siempre se anuncia con una máscara 255.255.255.255

CONFIGURANDO VIRTUAL-LINK



```
R2>enable
R2#configure terminal.
R2(config)#router ospf 2
R2(config-router)#area 2 virtual-link 140.1.170.7
R2(config-router)#exit
R2(config)#
```

```
R3>enable
R3#configure terminal.
R3(config)#router ospf 3
R3(config-router)#area 2 virtual-link 55.0.190.90
R3(config-router)#exit
R3(config)#
```



OBSERVANDO LA TABLA DE RUTEO EN R5

Router - HyperTerminal

Archivo Edición Ver Llamar Transferir Ayuda

Router# show ip route

```
      51.0.0.0/32 is subnetted, 1 subnets
0 IA    51.5.6.6 [110/66] via 10.1.1.29, 00:05:33, Serial0/0/1
      55.0.0.0/32 is subnetted, 2 subnets
0 IA    55.0.4.3 [110/66] via 10.1.1.29, 00:09:12, Serial0/0/1
0 IA    55.0.190.90 [110/66] via 10.1.1.29, 00:05:33, Serial0/0/1
C      204.6.21.0/24 is directly connected, Loopback13
      140.1.0.0/32 is subnetted, 2 subnets
0       140.1.170.7 [110/65] via 10.1.1.29, 00:09:12, Serial0/0/1
0 IA    140.1.160.3 [110/65] via 10.1.1.29, 00:09:12, Serial0/0/1
C      204.9.80.0/24 is directly connected, Loopback14
      210.8.8.0/32 is subnetted, 1 subnets
0 IA    210.8.8.19 [110/66] via 10.1.1.29, 00:09:14, Serial0/0/1
      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
0 IA    10.1.1.24/30 [110/129] via 10.1.1.29, 00:05:37, Serial0/0/1
0 IA    10.41.52.3/32 [110/130] via 10.1.1.29, 00:05:38, Serial0/0/1
C      10.1.1.28/30 is directly connected, Serial0/0/1
0 IA    10.41.68.19/32 [110/130] via 10.1.1.29, 00:05:39, Serial0/0/1
0 IA    10.52.177.60/30 [110/66] via 10.1.1.29, 00:09:19, Serial0/0/1
0 IA    10.52.177.56/30 [110/65] via 10.1.1.29, 00:09:19, Serial0/0/1
0 IA    10.52.177.52/30 [110/65] via 10.1.1.29, 00:09:20, Serial0/0/1
      210.7.2.0/32 is subnetted, 1 subnets
0 IA    210.7.2.31 [110/66] via 10.1.1.29, 00:09:21, Serial0/0/1
R5#_
```

4:37:51 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir



OBSERVANDO LA TABLA DE RUTEO EN R6

Router - HyperTerminal

Archivo Edición Ver Llamar Transferir Ayuda

R6#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

190.1.0.0/32 is subnetted, 2 subnets

0 190.1.9.130 [110/65] via 10.2.2.38, 04:43:14, Serial0/0/0

0 190.1.7.73 [110/65] via 10.2.2.38, 04:43:14, Serial0/0/0

10.0.0.0/30 is subnetted, 1 subnets

C 10.2.2.36 is directly connected, Serial0/0/0

C 131.4.0.0/16 is variably subnetted, 2 subnets, 2 masks

C 131.4.6.160/27 is directly connected, Loopback1

C 131.4.5.32/28 is directly connected, Loopback0

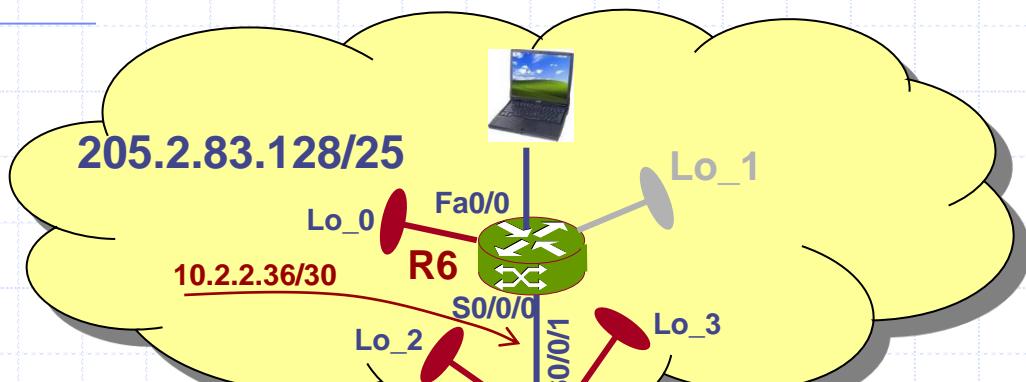
R6#
R6#
R6#
R6#
R6#

4:44:14 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir

Enrutamiento Dinámico: RIP y OSPF

CONFIGURANDO VIRTUAL-LINK

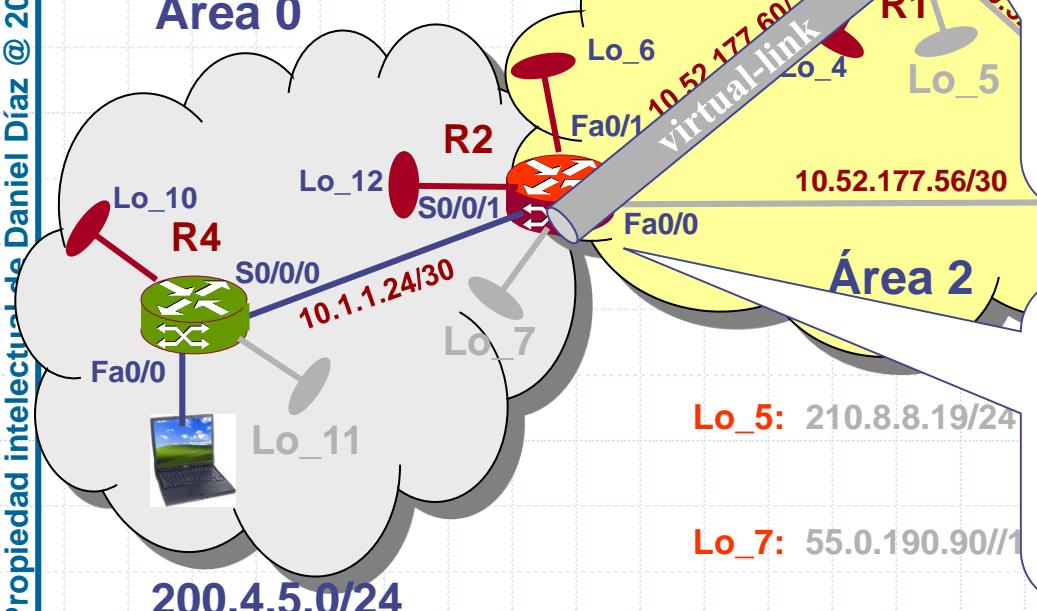
Área 1



```
R1>enable
R1#configure terminal
R1(config)#router ospf 1
R1(config-router)#area 2 virtual-link 55.0.190.90
R1(config-router)#exit
R1(config)#
```

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Área 0



```
R2>enable
R2#configure terminal
R2(config)#router ospf 2
R2(config-router)#area 2 virtual-link 210.8.8.19
R2(config-router)#exit
R2(config)#
```



OBSERVANDO LA TABLA DE RUTEO EN R6

Router - HyperTerminal

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Router# show ip route

```
51.0.0.0/32 is subnetted, 1 subnets
0 IA 51.5.6.6 [110/66] via 10.2.2.38, 00:02:44, Serial0/0/0
  55.0.0.0/32 is subnetted, 2 subnets
0 IA 55.0.4.3 [110/66] via 10.2.2.38, 00:03:04, Serial0/0/0
0 IA 55.0.190.90 [110/66] via 10.2.2.38, 00:02:44, Serial0/0/0
  204.6.21.0/32 is subnetted, 1 subnets
0 IA 204.6.21.36 [110/131] via 10.2.2.38, 00:02:44, Serial0/0/0
    140.1.0.0/32 is subnetted, 2 subnets
0 IA 140.1.170.7 [110/67] via 10.2.2.38, 00:02:44, Serial0/0/0
0 IA 140.1.160.3 [110/66] via 10.2.2.38, 00:03:05, Serial0/0/0
  204.9.80.0/32 is subnetted, 1 subnets
0 IA 204.9.80.94 [110/131] via 10.2.2.38, 00:02:45, Serial0/0/0
    190.1.0.0/32 is subnetted, 2 subnets
0 190.1.9.130 [110/65] via 10.2.2.38, 00:03:06, Serial0/0/0
0 190.1.7.73 [110/65] via 10.2.2.38, 00:03:07, Serial0/0/0
  210.8.8.0/32 is subnetted, 1 subnets
0 IA 210.8.8.19 [110/65] via 10.2.2.38, 00:03:07, Serial0/0/0
  10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
0 IA 10.1.1.24/30 [110/129] via 10.2.2.38, 00:02:48, Serial0/0/0
0 IA 10.41.52.3/32 [110/130] via 10.2.2.38, 00:02:48, Serial0/0/0
0 IA 10.1.1.28/30 [110/130] via 10.2.2.38, 00:02:49, Serial0/0/0
C 10.2.2.36/30 is directly connected, Serial0/0/0
0 IA 10.41.68.19/32 [110/130] via 10.2.2.38, 00:02:51, Serial0/0/0
--More--
```

4:56:30 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir

Router# show ip route

```
C 131.4.5.32/28 is directly connected, Loopback0
  210.7.2.0/32 is subnetted, 1 subnets
0 IA 210.7.2.31 [110/65] via 10.2.2.38, 00:04:23, Serial0/0/0
R6#
```

4:57:43 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir



ANALIZANDO LOS VIRTUAL-LINK

R2#show ip ospf virtual-link

```
Router - HyperTerminal
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Virtual Link OSPF_VL1 to router 210.8.8.19 is up
Run as demand circuit
DoNotAge LSA allowed.
Transit area 2, via interface FastEthernet0/1, Cost of using 1
Transmit Delay is 1 sec, State POINT_TO_POINT,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:06
Adjacency State FULL (Hello suppressed)
Index 3/5, retransmission queue length 0, number of retransmission 1
First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
Last retransmission scan length is 1, maximum is 1
Last retransmission scan time is 0 msec, maximum is 0 msec
Virtual Link OSPF_VL0 to router 140.1.170.7 is up
Run as demand circuit
DoNotAge LSA allowed.
Transit area 2, via interface FastEthernet0/0, Cost of using 1
Transmit Delay is 1 sec, State POINT_TO_POINT,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:03
Adjacency State FULL (Hello suppressed)
Index 2/4, retransmission queue length 0, number of retransmission 1
First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
Last retransmission scan length is 1, maximum is 1
--More--
```



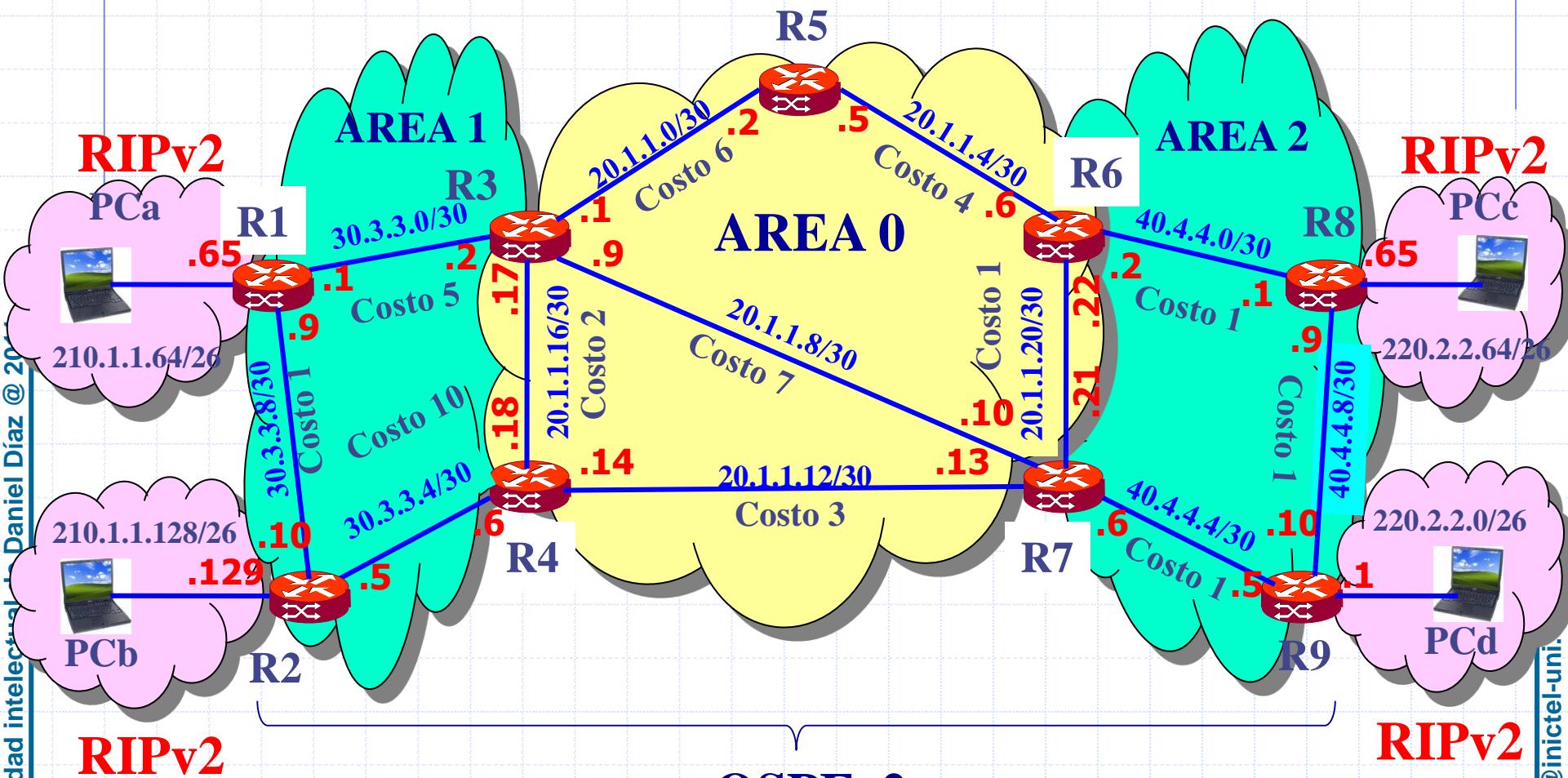
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Enrutamiento Dinámico: RIP y OSPF



CONFIGURACION DE RIPv2-OSPF

ANÁLISIS DE UNA RED OSPF/RIP



Revisión de redistribución RIP y OSPF en:

http://docwiki.cisco.com/wiki/Internetwork_Design_Guide---RIP_and OSPF_Redistribution#RIP_and OSPF_Redistribution

Enrutamiento Dinámico: RIP y OSPF

ANÁLISIS DE UNA RED OSPF/RIP

router ospf 1

redistribute rip subnets

network 30.3.3.0 0.0.0.3 area 1

network 30.3.3.8 0.0.0.3 area 1

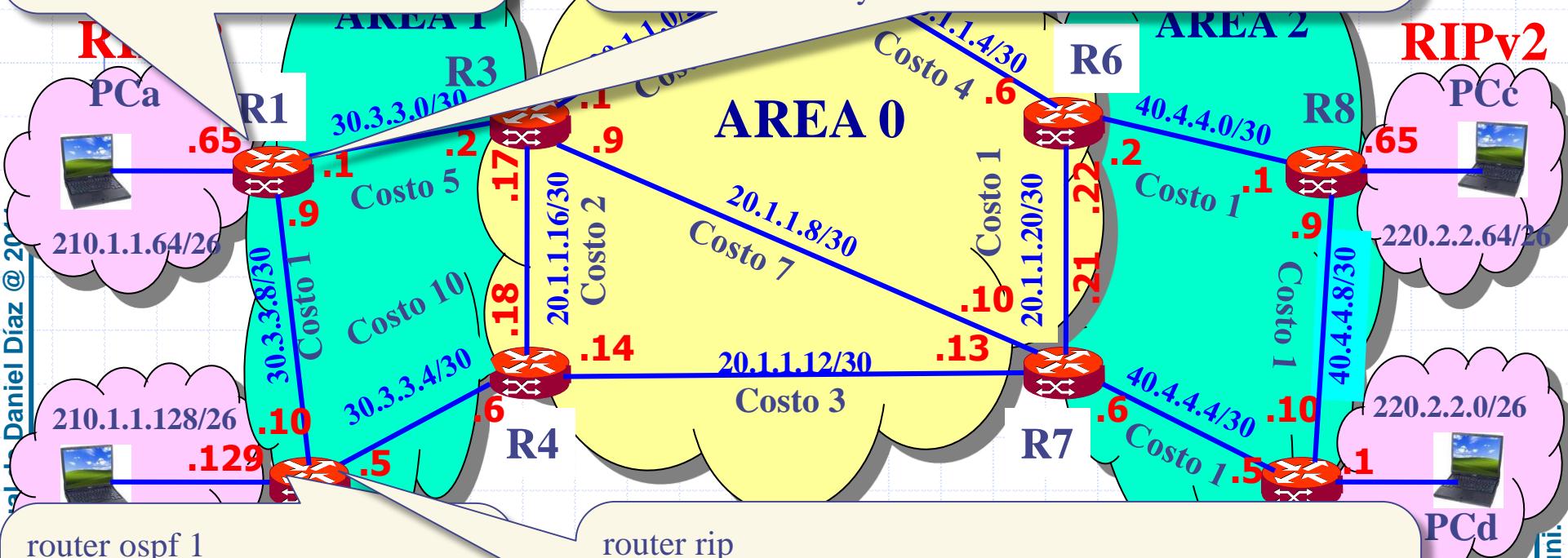
router rip

version 2

redistribute ospf 1 match internal external 1 external 2

network 210.1.1.64

no auto-summary



router ospf 1

redistribute rip subnets

network 30.3.3.4 0.0.0.3 area 1

network 30.3.3.8 0.0.0.3 area 1

router rip

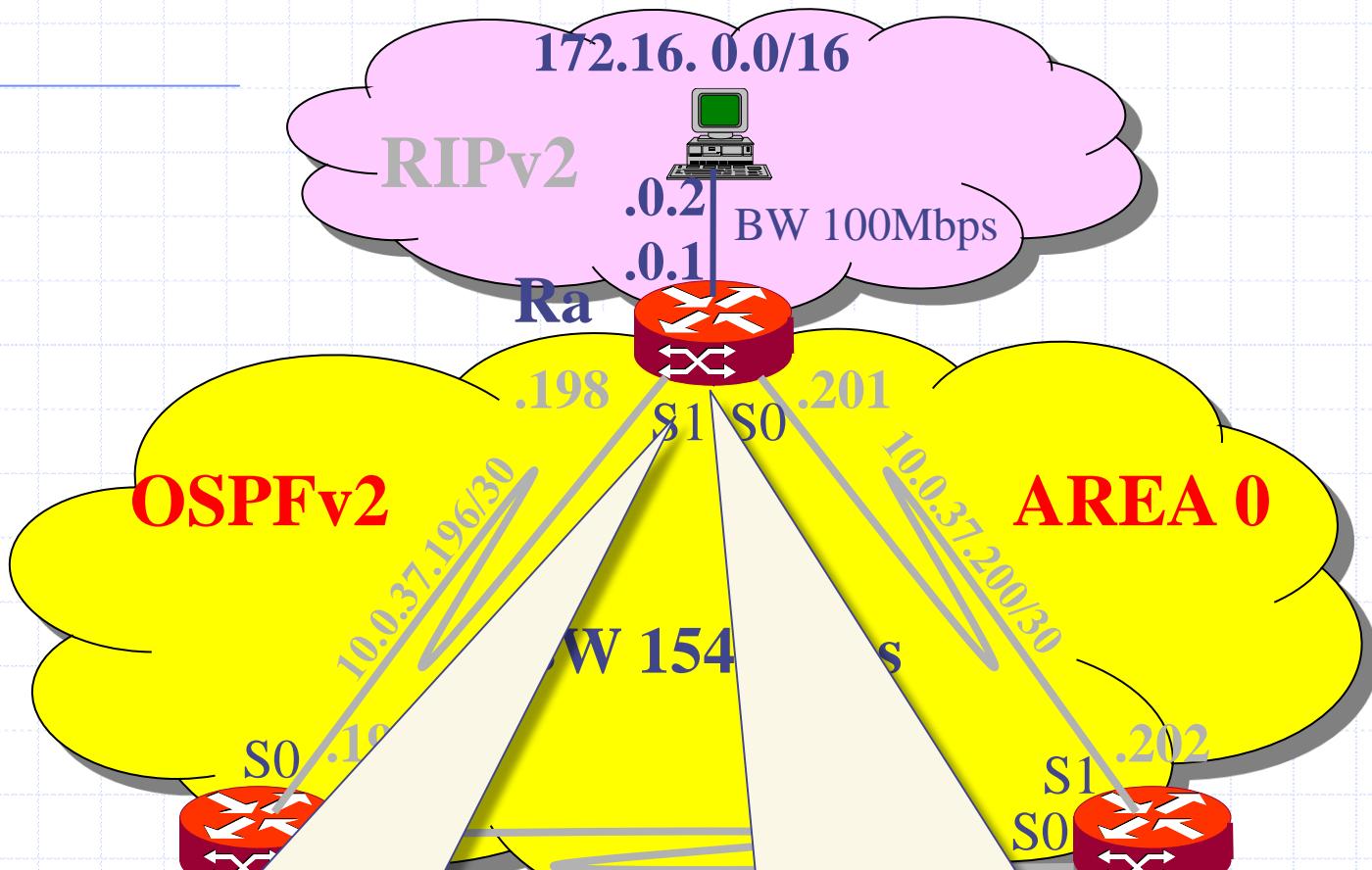
version 2

redistribute ospf 1 match internal external 1 external 2

network 210.1.1.128

no auto-summary

ANÁLISIS DE UNA RED OSPF/RIP



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```
router ospf 1
 redistribute rip subnets
 network 10.0.37.196 0.0.0.3 area 0
 network 10.0.37.200 0.0.0.3 area 0
```

router rip
 version 2
 redistribute ospf 1 match internal external 1 external 2
 network 172.16.0.0
 no auto-summary



TABLA DE ENRUTAMIENTO

routerA - HyperTerminal

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ROUTERA#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

0 E2 200.37.51.0/24 [110/20] via 10.0.37.202, 00:00:54, Serial0/0/0

C 172.16.0.0/16 is directly connected, FastEthernet0/0

10.0.0.0/30 is subnetted, 3 subnets

0 10.0.37.204 [110/128] via 10.0.37.202, 00:00:54, Serial0/0/0
[110/128] via 10.0.37.197, 00:00:54, Serial0/0/1

C 10.0.37.200 is directly connected, Serial0/0/0

C 10.0.37.196 is directly connected, Serial0/0/1

0 E2 200.37.42.0/24 [110/20] via 10.0.37.197, 00:00:54, Serial0/0/1

ROUTERA#

ROUTERA#

ROUTERA#

ROUTERA#

ROUTERA#

6:40:55 conectado Autodetect. 9600 8-N-1 DESPLAZAR MAY NUM Capturar Imprimir



PROPUESTAS DE TEMAS DE EXPOSICION

Network Simulator

The Network Simulator, ns-2

<http://www.isi.edu/nsnam/ns/tutorial>, <http://nile.wpi.edu/NS/>

NS by Example

OPNET IT GURU

http://www.opnet.com/university_program/itguru_academic_ed





BIBLIOGRAFIA

- **RFC 2453 RIP version 2**

Noviembre de 1998.

<http://www.ietf.org/rfc/rfc1058.txt>

- **Routing Information Protocol, Autor CISCO**

http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/rip.p



BIBLIOGRAFIA

- **RFC 1058 Routing Information Protocol
Junio de 1988.**
<http://www.ietf.org/rfc/rfc1058.txt>
- **RFC 1723 RIP version 2, Noviembre de 1994**
<http://www.ietf.org/rfc/rfc1723.txt>
- **RFC 2082 MD5 Authentication**
<http://www.ietf.org/rfc/rfc2082.txt>
- **Routing Information Protocol, Autor CISCO**
http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/rip.html



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MUCHAS GRACIAS