

Laboratorio 4

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Parte 1: Definición de Subredes y Tablas de Rutas

1.1 Definición de Subredes

Para el cálculo de las subredes se hizo uso de la página <https://www.calculadora-redes.com> y X en este caso corresponde a 1

Red San Joaquín

Se tiene la red base 12.0.0.0/8

El número de subredes necesarias $2(X + 1) = 2(1 + 1) = 4$ subredes

Para 4 subredes, se necesitan 2 bits adicionales, ya que $2^2 = 4$

Por lo que la nueva máscara es /10 (255.192.0.0)

Se divide la red en las siguientes 4 subredes

Red	Rango Hosts	Broadcast
12.0.0.0/10	12.0.0.1 -- 12.63.255.254	12.63.255.255
12.64.0.0/10	12.64.0.1 -- 12.127.255.254	12.127.255.255
12.128.0.0/10	12.128.0.1 -- 12.191.255.254	12.191.255.255
12.192.0.0/10	12.192.0.1 -- 12.255.255.254	12.255.255.255

Se obtuvieron haciendo uso de la calculadora mencionada:

Calculadora IP - Subneteo Online - Redes - Hosts - classful / ci...		
calculadora-redes.com/subredes.php?mask=7&o1=12&o2=0&o3...		
LISTADO DE SUBREDES		
IP: 12.0.0.0		
MÁSCARA: 255.0.0.0 (8 bits)		
SUB-MÁSCARA: 255.192.0.0 (10 bits)		
RED	RANGO HOSTS	BROADCAST
12.0.0.0/10	12.0.0.1 -- 12.63.255.254	12.63.255.255
12.64.0.0/10	12.64.0.1 -- 12.127.255.254	12.127.255.255
12.128.0.0/10	12.128.0.1 -- 12.191.255.254	12.191.255.255
12.192.0.0/10	12.192.0.1 -- 12.255.255.254	12.255.255.255

Se elige la red con el nombre más pequeño, por lo que se tiene las siguientes asignaciones

ID Red	12.0.0.0/10
Router SJ	12.0.0.1/10
PC-PT SJ 1	12.0.0.2/10
PC-PT SJ 2	12.0.0.3/10
Broadcast	12.63.255.255

Red Vitacura

Red base 182.13.0.0/16

Número de subredes necesarias es $X = 1$, por lo que no es necesario dividirla

Red	Rango Hosts	Broadcast
182.13.0.0/16	182.13.0.1 - 182.13.255.254	182.13.255.255

Esto se obtuvo de la página de la calculadora mencionada

The screenshot shows an IP calculator interface with the following elements:

- DIRECCIÓN IP**: A header for the IP address input section.
- 182.13.0.0**: The entered IP address, with a green double arrow icon to its right.
- decimal**: A dropdown menu showing the selected base.
- 255.255.0.0**: The default IP address for the decimal base.
- bits**: A dropdown menu showing the selected number of bits.
- 16**: The selected number of bits.
- hexa**: A dropdown menu showing the selected base.
- ff.ff.00.00**: The default IP address for the hexa base.
- 182.13.0.0 / 16**: The resulting network address and prefix length.
- RED**: A section header for the network address.
- 182.13.0.0 / 16**: The network address.
- RANGO HOSTS (65.534 hosts)**: A section header for the host range.
- 182.13.0.1 - 182.13.255.254**: The host range.
- BROADCAST**: A section header for the broadcast address.
- 182.13.255.255**: The broadcast address.

Por lo que se tiene las siguientes asignaciones

ID Red	182.13.0.0/16
Router Vitacura	182.13.0.1/16

PC-PT Vitacura	182.13.0.2/16
Broadcast	182.13.255.255

Red Casa Central

Red base 182.13.0.0/16

Aquí, de las subredes de San Joaquín, se ocupa la red 12.128.0.0/10, esta red no es necesario dividirla ya que necesitamos X = 1 Subred

Red	Rango Hosts	Broadcast
12.128.0.0/10	12.128.0.1 -- 12.191.255.254	12.191.255.255

Obtenido de la siguiente imagen

The image shows a network calculator interface with the following elements:

- DIRECCIÓN IP:** A text input field containing "12.128.0.0" with a green double arrow icon to its right.
- decimal:** A dropdown menu showing "255.192.0.0".
- bits:** A dropdown menu showing "10".
- hexa:** A dropdown menu showing "ff.c0.00.00".
- Result Summary:**
 - 12.128.0.0 / 10** (Network Address)
 - RED:** 12.128.0.0 / 10
 - RANGO HOSTS (4.194.302 hosts):** 12.128.0.1 - 12.191.255.254
 - BROADCAST:** 12.191.255.255

Por lo que se tienen las siguientes asignaciones

ID Red	12.128.0.0/10
Router CC	12.128.0.1/10
Server-PT Siga	12.128.0.2/10
Broadcast	12.191.255.255

Red Concepción

Red base 192.168.0.0/24

Se deben usar $(X + 2) + 1$ bit extras, por lo que se tienen $(1/2) + 1 = 1.5$, lo que aproximamos a 2 bits extras, por lo que hay 4 subredes, por lo que se tiene lo siguiente. La nueva mascara es /26

Por lo que se tienen las siguientes 4 subredes

Red	Rango Hosts	Broadcast
192.168.0.0/26	192.168.0.1 – 192.168.0.62	192.168.0.63
192.168.0.64/26	192.168.0.65 – 192.168.0.126	192.168.0.127
192.168.0.128/26	192.168.0.129 – 192.168.0.190	192.168.0.191
192.168.0.192/26	192.168.0.193 – 192.168.0.254	192.168.0.255

Estas subredes se obtuvieron de la calculadora:

Calculadora IP - Subneteo Online - Redes - Hosts - classful / ci... — □ ×		
calculadora-redes.com/subredes.php?mask=23&o1=192&o2=168...		
LISTADO DE SUBREDES		
IP: 192.168.0.0		
MÁSCARA: 255.255.255.0 (24 bits)		
SUB-MÁSCARA: 255.255.255.192 (26 bits)		
RED	RANGO HOSTS	BROADCAST
192.168.0.0/26	192.168.0.1 -- 192.168.0.62	192.168.0.63
192.168.0.64/26	192.168.0.65 -- 192.168.0.126	192.168.0.127
192.168.0.128/26	192.168.0.129 -- 192.168.0.190	192.168.0.191
192.168.0.192/26	192.168.0.193 -- 192.168.0.254	192.168.0.255

De aquí, se elige la primera red con el nombre más grande, teniendo las siguientes asignaciones

ID Red	192.168.0.192/26
Router Concepción	192.168.0.193/26
PC-PT Conce 1	192.168.0.194/26

PC-PT Conce 2	192.168.0.195/26
Broadcast	192.168.0.255

1.2 Tabla de Rutas

Tabla de Ruta de SJ

Router SJ

Physical
 Config
 CLI
Attributes

IOS Command Line Interface

```

Router>
Router>
Router>
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
  C       1.0.0.0/8 is directly connected, Serial0/1/0
  L       1.0.0.2/32 is directly connected, Serial0/1/0
  O       2.0.0.0/8 [110/128] via 3.0.0.2, 00:03:06, Serial0/1/1
          [110/128] via 1.0.0.1, 00:03:06, Serial0/1/0
    3.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
  C       3.0.0.0/8 is directly connected, Serial0/1/1
  L       3.0.0.1/32 is directly connected, Serial0/1/1
  O E2    4.0.0.0/8 [110/20] via 3.0.0.2, 00:03:06, Serial0/1/1
  O E2    5.0.0.0/8 [110/20] via 3.0.0.2, 00:03:06, Serial0/1/1
  O E2    6.0.0.0/8 [110/20] via 3.0.0.2, 00:03:06, Serial0/1/1
    12.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
  C       12.0.0.0/10 is directly connected, GigabitEthernet0/0
  L       12.0.0.1/32 is directly connected, GigabitEthernet0/0
  O E2    12.128.0.0/10 [110/20] via 3.0.0.2, 00:03:06, Serial0/1/1
  O       182.13.0.0/16 [110/65] via 1.0.0.1, 00:03:16, Serial0/1/0
    192.168.0.0/26 is subnetted, 1 subnets
  O E2    192.168.0.192/26 [110/20] via 3.0.0.2, 00:03:06, Serial0/1/1

Router>
Router>
Router>
Router>

```

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Tabla de Ruta de CC

Router CC

Physical Config CLI Attributes

IOS Command Line Interface

```
%BGP-5-ADJCHANGE: neighbor 4.0.0.2 Up

Router>
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

B    1.0.0.0/8 [20/128] via 4.0.0.2, 00:00:00
B    2.0.0.0/8 [20/20] via 4.0.0.2, 00:00:00
B    3.0.0.0/8 [20/20] via 4.0.0.2, 00:00:00
     4.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    4.0.0.0/8 is directly connected, Serial0/1/0
L    4.0.0.1/32 is directly connected, Serial0/1/0
     5.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    5.0.0.0/8 is directly connected, Serial0/1/1
L    5.0.0.1/32 is directly connected, Serial0/1/1
B    6.0.0.0/8 [20/0] via 5.0.0.2, 00:00:00
     12.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
B    12.0.0.0/10 [20/65] via 4.0.0.2, 00:00:00
C    12.128.0.0/10 is directly connected, GigabitEthernet0/0
L    12.128.0.1/32 is directly connected, GigabitEthernet0/0
B    182.13.0.0/16 [20/65] via 4.0.0.2, 00:00:00
     192.168.0.0/26 is subnetted, 1 subnets
B    192.168.0.192/26 [20/0] via 5.0.0.2, 00:00:00

Router>
Router>
Router>
Router>
```

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Tabla de Ruta de Concepción

Router Concepción

PhysicalConfigCLIAttributes

IOS Command Line Interface

```
%BGP-5-ADJCHANGE: neighbor 6.0.0.2 Up

Router>
Router>
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

B    1.0.0.0/8 [20/128] via 6.0.0.2, 00:00:00
B    2.0.0.0/8 [20/20] via 6.0.0.2, 00:00:00
B    3.0.0.0/8 [20/20] via 6.0.0.2, 00:00:00
B    4.0.0.0/8 [20/0] via 5.0.0.1, 00:00:00
     5.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      5.0.0.0/8 is directly connected, Serial0/1/1
L      5.0.0.2/32 is directly connected, Serial0/1/1
     6.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      6.0.0.0/8 is directly connected, Serial0/1/0
L      6.0.0.1/32 is directly connected, Serial0/1/0
     12.0.0.0/10 is subnetted, 2 subnets
B      12.0.0.0/10 [20/65] via 6.0.0.2, 00:00:00
B      12.128.0.0/10 [20/0] via 5.0.0.1, 00:00:00
B      182.13.0.0/16 [20/65] via 6.0.0.2, 00:00:00
     192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C      192.168.0.192/26 is directly connected, GigabitEthernet0/0
L      192.168.0.193/32 is directly connected, GigabitEthernet0/0

Router>
Router>
Router>
```

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Tabla de Ruta de Vitacura

Router Vitacura

PhysicalConfigCLIAttributes

IOS Command Line Interface

```
Router>
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       1.0.0.0/8 is directly connected, Serial0/1/0
L       1.0.0.1/32 is directly connected, Serial0/1/0
    2.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       2.0.0.0/8 is directly connected, Serial0/1/1
L       2.0.0.1/32 is directly connected, Serial0/1/1
O       3.0.0.0/8 [110/128] via 2.0.0.2, 00:04:35, Serial0/1/1
        [110/128] via 1.0.0.2, 00:04:35, Serial0/1/0
O E2    4.0.0.0/8 [110/20] via 2.0.0.2, 00:04:35, Serial0/1/1
O E2    5.0.0.0/8 [110/20] via 2.0.0.2, 00:04:35, Serial0/1/1
O E2    6.0.0.0/8 [110/20] via 2.0.0.2, 00:04:35, Serial0/1/1
    12.0.0.0/10 is subnetted, 2 subnets
O       12.0.0.0/10 [110/65] via 1.0.0.2, 00:04:35, Serial0/1/0
O E2    12.128.0.0/10 [110/20] via 2.0.0.2, 00:04:35, Serial0/1/1
    182.13.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       182.13.0.0/16 is directly connected, GigabitEthernet0/0
L       182.13.0.1/32 is directly connected, GigabitEthernet0/0
    192.168.0.0/26 is subnetted, 1 subnets
O E2    192.168.0.192/26 [110/20] via 2.0.0.2, 00:04:35, Serial0/1/1

Router>
Router>
Router>
```

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Tabla de Ruta de Sedes

Router Sedes

Physical

Config

CLI

Attributes

IOS Command Line Interface

```
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

O    1.0.0.0/8 [110/128] via 3.0.0.1, 00:02:51, Serial0/1/1
      [110/128] via 2.0.0.1, 00:02:51, Serial0/1/0
      2.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    2.0.0.0/8 is directly connected, Serial0/1/0
L    2.0.0.2/32 is directly connected, Serial0/1/0
      3.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    3.0.0.0/8 is directly connected, Serial0/1/1
L    3.0.0.2/32 is directly connected, Serial0/1/1
      4.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    4.0.0.0/8 is directly connected, Serial0/0/0
L    4.0.0.2/32 is directly connected, Serial0/0/0
B    5.0.0.0/8 [20/0] via 4.0.0.1, 00:00:00
      6.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    6.0.0.0/8 is directly connected, Serial0/0/1
L    6.0.0.2/32 is directly connected, Serial0/0/1
      12.0.0.0/10 is subnetted, 2 subnets
O    12.0.0.0/10 [110/65] via 3.0.0.1, 00:02:51, Serial0/1/1
B    12.128.0.0/10 [20/0] via 4.0.0.1, 00:00:00
O    182.13.0.0/16 [110/65] via 2.0.0.1, 00:02:51, Serial0/1/0
      192.168.0.0/26 is subnetted, 1 subnets
B    192.168.0.192/26 [20/0] via 6.0.0.1, 00:00:00

Router>
Router>
Router>
```

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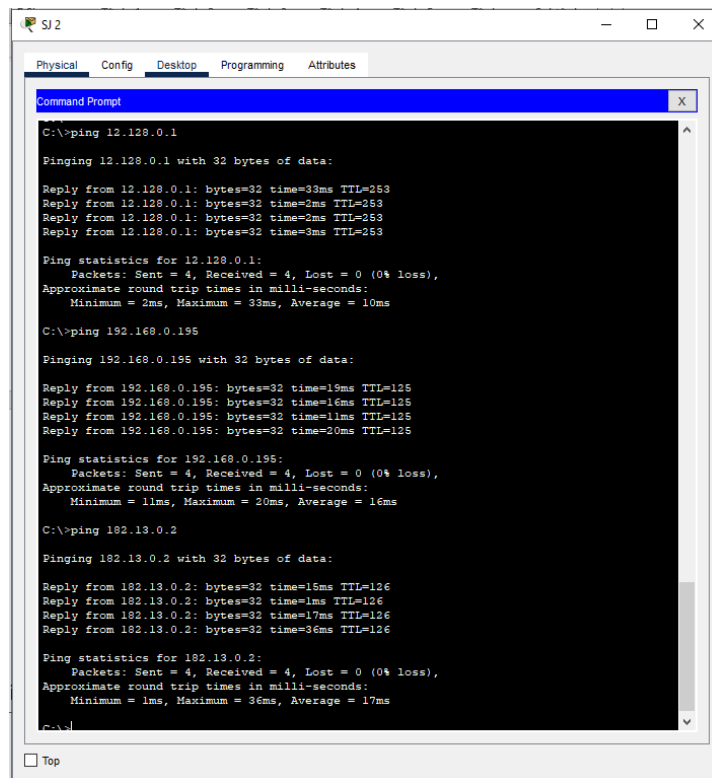
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Parte 2: Preguntas y Análisis

Pregunta 1

A continuación, se mostrará una serie de imágenes por host de servidor, la primera corresponderá a la comunicación de un host perteneciente a un servidor en particular con otro de un servidor distinto a este.

Para el host 2 de SJ usamos el comando ping con un host perteneciente a cada servidor de la red para verificar la conexión, obteniendo lo siguiente:



```
C:\>ping 12.128.0.1

Pinging 12.128.0.1 with 32 bytes of data:

Reply from 12.128.0.1: bytes=32 time=33ms TTL=253
Reply from 12.128.0.1: bytes=32 time=2ms TTL=253
Reply from 12.128.0.1: bytes=32 time=2ms TTL=253
Reply from 12.128.0.1: bytes=32 time=3ms TTL=253

Ping statistics for 12.128.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 33ms, Average = 10ms

C:\>ping 192.168.0.195

Pinging 192.168.0.195 with 32 bytes of data:

Reply from 192.168.0.195: bytes=32 time=19ms TTL=125
Reply from 192.168.0.195: bytes=32 time=16ms TTL=125
Reply from 192.168.0.195: bytes=32 time=11ms TTL=125
Reply from 192.168.0.195: bytes=32 time=20ms TTL=125

Ping statistics for 192.168.0.195:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 11ms, Maximum = 20ms, Average = 16ms

C:\>ping 182.13.0.2

Pinging 182.13.0.2 with 32 bytes of data:

Reply from 182.13.0.2: bytes=32 time=15ms TTL=126
Reply from 182.13.0.2: bytes=32 time=1ms TTL=126
Reply from 182.13.0.2: bytes=32 time=17ms TTL=126
Reply from 182.13.0.2: bytes=32 time=36ms TTL=126

Ping statistics for 182.13.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 36ms, Average = 17ms

C:\>
```

Observamos como la comunicación fue exitosa con cada host al que hicimos el ping. En la siguiente foto se muestra la ruta de un mensaje PDU desde el host 2 de SJ con cada host hecho con el ping anterior.

0.467	Router SJ	0.674	SJ 2	0.001	SJ 2
0.467	SJ 2	0.675	Switch SJ	0.002	Switch SJ
0.468	Switch SJ	0.676	Router SJ	0.003	Router SJ
0.469	Router SJ	0.677	Router Vitacura	0.004	Router Sedes
0.470	Router Sedes	0.678	Switch V	0.005	Router Concepción
0.471	Router CC	0.679	Vitacura	0.006	Switch C
0.472	Siga	0.680	Switch V	0.007	PC Conce 2
0.473	Router CC	0.681	Router Vitacura	0.008	Switch C
0.474	Router Sedes	0.682	Router SJ	0.009	Router Concepción
0.475	Router SJ	0.683	Switch SJ	0.010	Router Sedes
0.476	Switch SJ	1.181	--	0.011	Router SJ
				0.012	Switch SJ
				0.125	--

Para el host de Vitacura:

```

C:\>ping 12.128.0.1 with 32 bytes of data:

Reply from 12.128.0.1: bytes=32 time=8ms TTL=253
Reply from 12.128.0.1: bytes=32 time=8ms TTL=253
Reply from 12.128.0.1: bytes=32 time=8ms TTL=253
Reply from 12.128.0.1: bytes=32 time=8ms TTL=253

Ping statistics for 12.128.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 8ms, Maximum = 8ms, Average = 8ms

C:\>ping 12.0.0.3

Pinging 12.0.0.3 with 32 bytes of data:

Reply from 12.0.0.3: bytes=32 time=10ms TTL=126
Reply from 12.0.0.3: bytes=32 time=10ms TTL=126
Reply from 12.0.0.3: bytes=32 time=10ms TTL=126
Reply from 12.0.0.3: bytes=32 time=10ms TTL=126

Ping statistics for 12.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 10ms, Maximum = 10ms, Average = 10ms

C:\>ping 192.168.0.195

Pinging 192.168.0.195 with 32 bytes of data:

Reply from 192.168.0.195: bytes=32 time=12ms TTL=125
Reply from 192.168.0.195: bytes=32 time=12ms TTL=125
Reply from 192.168.0.195: bytes=32 time=12ms TTL=125
Reply from 192.168.0.195: bytes=32 time=12ms TTL=125

Ping statistics for 192.168.0.195:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 12ms, Maximum = 12ms, Average = 12ms

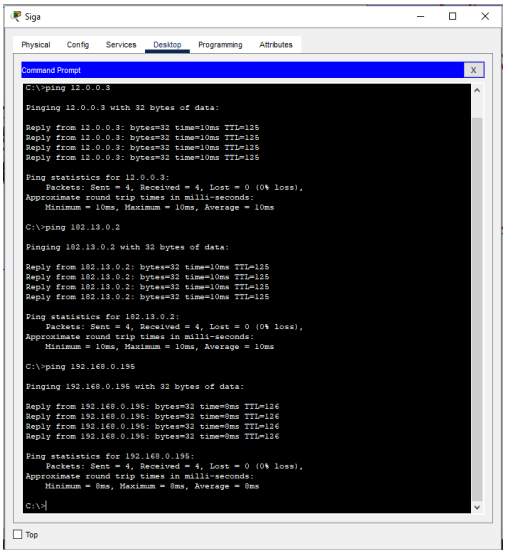
C:\>

```

La ruta que tomo cada mensaje:

0.001	Vitacura	0.000	--	0.000	--
0.002	Switch V	0.001	Vitacura	0.001	Vitacura
0.003	Router Vitacura	0.002	Switch V	0.002	Switch V
0.004	Router SJ	0.003	Router Vitacura	0.003	Router Vitacura
0.005	Switch SJ	0.004	Router Sedes	0.004	Router Sedes
0.006	SJ 2	0.005	Router Concepción	0.005	Router CC
0.007	Switch SJ	0.006	Switch C	0.006	Siga
0.008	Router SJ	0.007	PC Conce 2	0.007	Router CC
0.009	Router Vitacura	0.008	Switch C	0.008	Router Sedes
0.010	Switch V	0.009	Router Concepción	0.009	Router Vitacura
0.011	--	0.010	Router Sedes	0.010	Switch V
0.012	--	0.011	Router Vitacura	0.023	--
0.345	--	0.012	Switch V		
		0.025	--		

Para el host de CC:



La ruta de cada mensaje:

0.001	Siga	0.001	Siga	0.001	Siga
0.002	Router CC	0.002	Router CC	0.002	Router CC
0.003	Router Concepción	0.003	Router Sedes	0.003	Router Sedes
0.004	Switch C	0.004	Router Vitacura	0.004	Router SJ
0.005	PC Conce 2	0.005	Switch V	0.005	Switch SJ
0.006	Switch C	0.006	Vitacura	0.006	SJ 2
0.007	Router Concepción	0.007	Switch V	0.007	Switch SJ
0.008	Router CC	0.008	Router Vitacura	0.008	Router SJ
0.809	--	0.009	Router Sedes	0.009	Router Sedes
		0.010	Router CC	0.010	Router CC

Para el host 2 de Concepción:

```

C:\>ping 12.0.0.2

Pinging 12.0.0.2 with 32 bytes of data:

Reply from 12.0.0.2: bytes=32 time=12ms TTL=126
Reply from 12.0.0.2: bytes=32 time=12ms TTL=126
Reply from 12.0.0.2: bytes=32 time=12ms TTL=126
Reply from 12.0.0.2: bytes=32 time=12ms TTL=126

Ping statistics for 12.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 12ms, Maximum = 12ms, Average = 12ms

C:\>ping 192.13.0.2

Pinging 192.13.0.2 with 32 bytes of data:

Reply from 192.13.0.2: bytes=32 time=12ms TTL=126
Reply from 192.13.0.2: bytes=32 time=12ms TTL=126
Reply from 192.13.0.2: bytes=32 time=12ms TTL=126
Reply from 192.13.0.2: bytes=32 time=12ms TTL=126

Ping statistics for 192.13.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 12ms, Maximum = 12ms, Average = 12ms

C:\>ping 12.128.0.2

Pinging 12.128.0.2 with 32 bytes of data:

Reply from 12.128.0.2: bytes=32 time=12ms TTL=126
Reply from 12.128.0.2: bytes=32 time=12ms TTL=126
Reply from 12.128.0.2: bytes=32 time=12ms TTL=126
Reply from 12.128.0.2: bytes=32 time=12ms TTL=126

Ping statistics for 12.128.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 12ms, Maximum = 12ms, Average = 12ms
  
```

La ruta de cada mensaje:

0.000	--	0.000	--	0.000	--
0.001	PC Conce 2	0.001	PC Conce 2	0.001	PC Conce 2
0.002	Switch SJ	0.002	Switch C	0.002	Switch C
0.002	Switch C	0.002	Switch C	0.003	Router Concepción
0.003	Router Concepción	0.003	Router Concepción	0.004	Router Sedes
0.004	Router Sedes	0.003	Router Concepción	0.005	Router SJ
0.005	Router Vitacura	0.004	Router CC	0.006	Switch SJ
0.006	Switch V	0.005	Siga	0.007	SJ 2
0.007	Vitacura	0.006	Router CC	0.008	Switch SJ
0.008	Switch V	0.007	Router Concepción	0.009	Router SJ
0.008	--	0.008	Switch C	0.010	Router Sedes
0.009	Router Vitacura			0.011	Router Concepción
0.009	--			0.012	Switch C
0.010	Router Vitacura				
0.011	Router Sedes				
0.012	Router Concepción				
0.013	Switch C				

Pregunta 2

Para el primer mensaje se envió este mensaje del host 1 de SJ a Vitacura:

0.000	--
0.001	SJ 1
0.002	Switch SJ
0.003	Router SJ
0.004	Router Vitacura
0.005	Switch V
0.006	Vitacura
0.007	Switch V
0.008	Router Vitacura
0.009	Router SJ
0.010	Switch SJ
0.025	--
0.026	Router SJ

Lo anterior se puede explicar con lo aprendido del curso dado que en una red con el protocolo OSPF, la elección de la ruta por parte de los routers se basa en la métrica del camino más corto. La métrica se utiliza para determinar el costo o el valor asociado a cada ruta posible en la red y se utiliza para calcular la ruta optima hacia un destino.

El protocolo OSPF utiliza el algoritmo de Dijkstra para calcular la ruta más corta hacia un destino. Cada router en la red OSPF mantiene una base de datos llamada Link State Database (LSDB) que contiene información sobre el estado de los enlaces y la topología de la red. Con base en esta información, cada router calcula su tabla de enrutamiento.

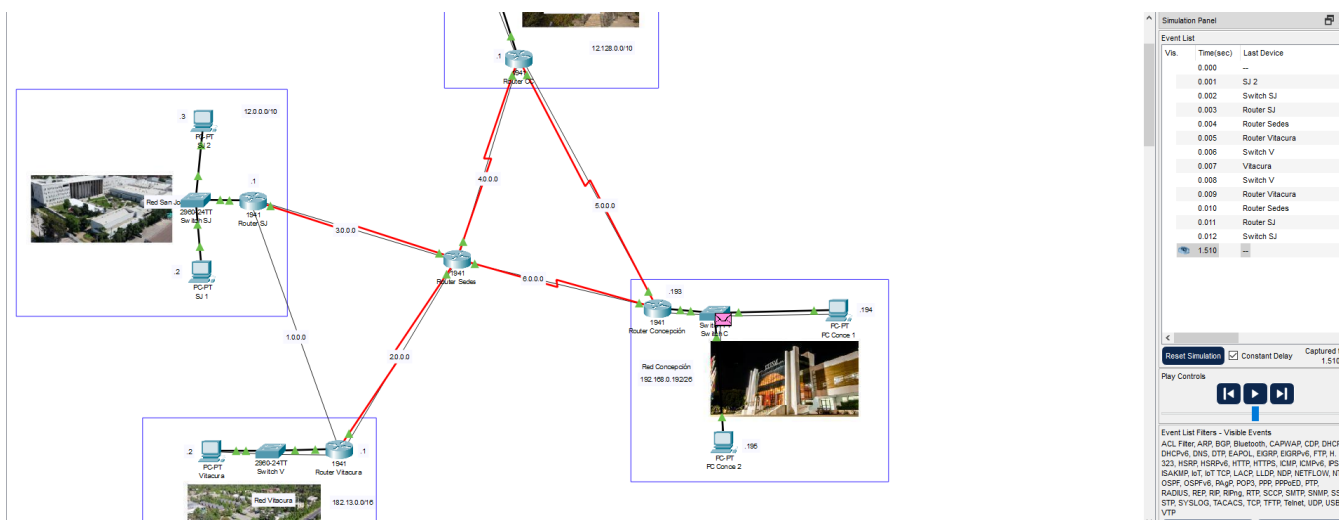
Para el segundo mensaje se ocupó el host 1 de Concepción hacia CC:

0.000	--
0.001	PC Conce 1
0.002	Switch C
0.003	Router Concepción
0.004	Router CC
0.005	Siga
0.006	Router CC
0.007	Router Concepción
0.008	Switch C

Al utilizar el protocolo BGP la ruta y las decisiones de enrutamiento podrían estar influenciadas por factores adicionales típicos de este protocolo. BGP es utilizado comúnmente para realizar enrutamiento entre diferentes sistemas autónomos (AS), permitiendo una política de enrutamiento más flexible y basada en múltiples atributos, es por esto por lo que se toma esta ruta para comunicar.

Pregunta 3

A continuación, veremos el sistema sin la conexión entre los routers de SJ y Vitacura, además se puede observar la nueva ruta que toma el paquete:



Como se puede observar en la imagen, al eliminar esta conexión, el mensaje de igual manera se envía, pero utilizando otra ruta, esto ya que al tener otra conexión que pueda permitir la comunicación, si bien, es más larga, OSPF busca la nueva ruta más corta del sistema que permita la conexión entre los hosts. Finalmente, reparamos la conexión eliminada para contestar las siguientes preguntas.

Pregunta 4

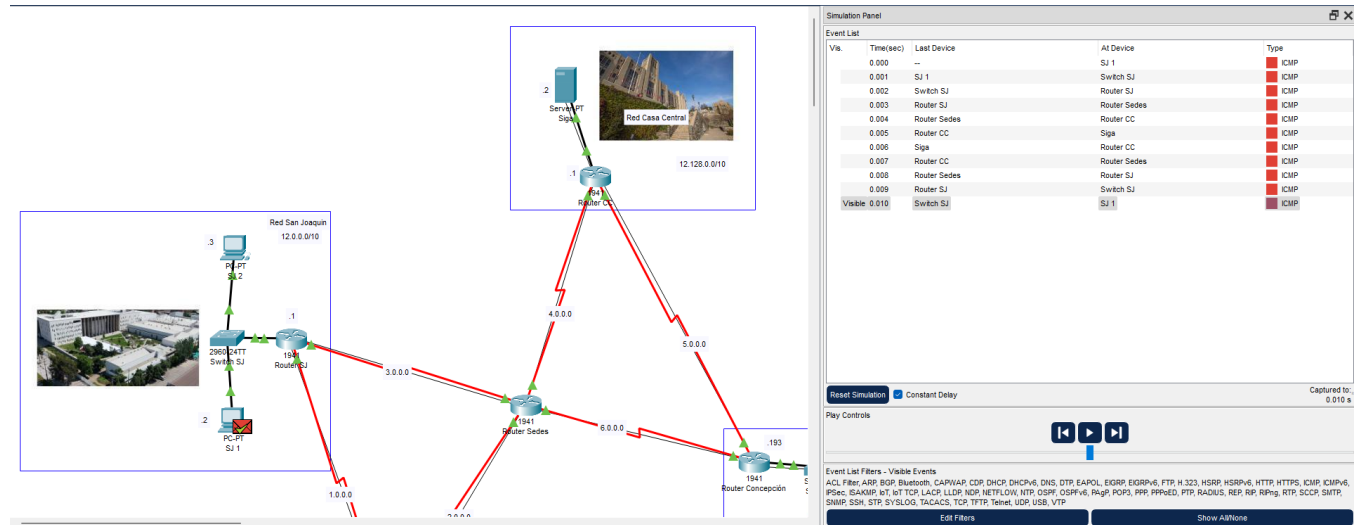
0.467	Router SJ
0.467	SJ 2
0.468	Switch SJ
0.469	Router SJ
0.470	Router Sedes
0.471	Router CC
0.472	Siga
0.473	Router CC
0.474	Router Sedes
0.475	Router SJ
0.476	Switch SJ

Esta fue la ruta que hizo el mensaje para llegar de SJ hasta CC, de acuerdo con lo visto en clases, toma esta ruta debido a que al pasar por el protocolo OSPF se toma la elección de la ruta de acuerdo al camino más corto como ya se explicó anteriormente para este protocolo. Luego al llegar al Router comienza el protocolo BGP donde de acuerdo con políticas de enrutamiento establecidas por los

administradores de red y proveedores de servicios ve la ruta más conveniente. Por lo tanto, se explica la ruta que toma el mensaje.

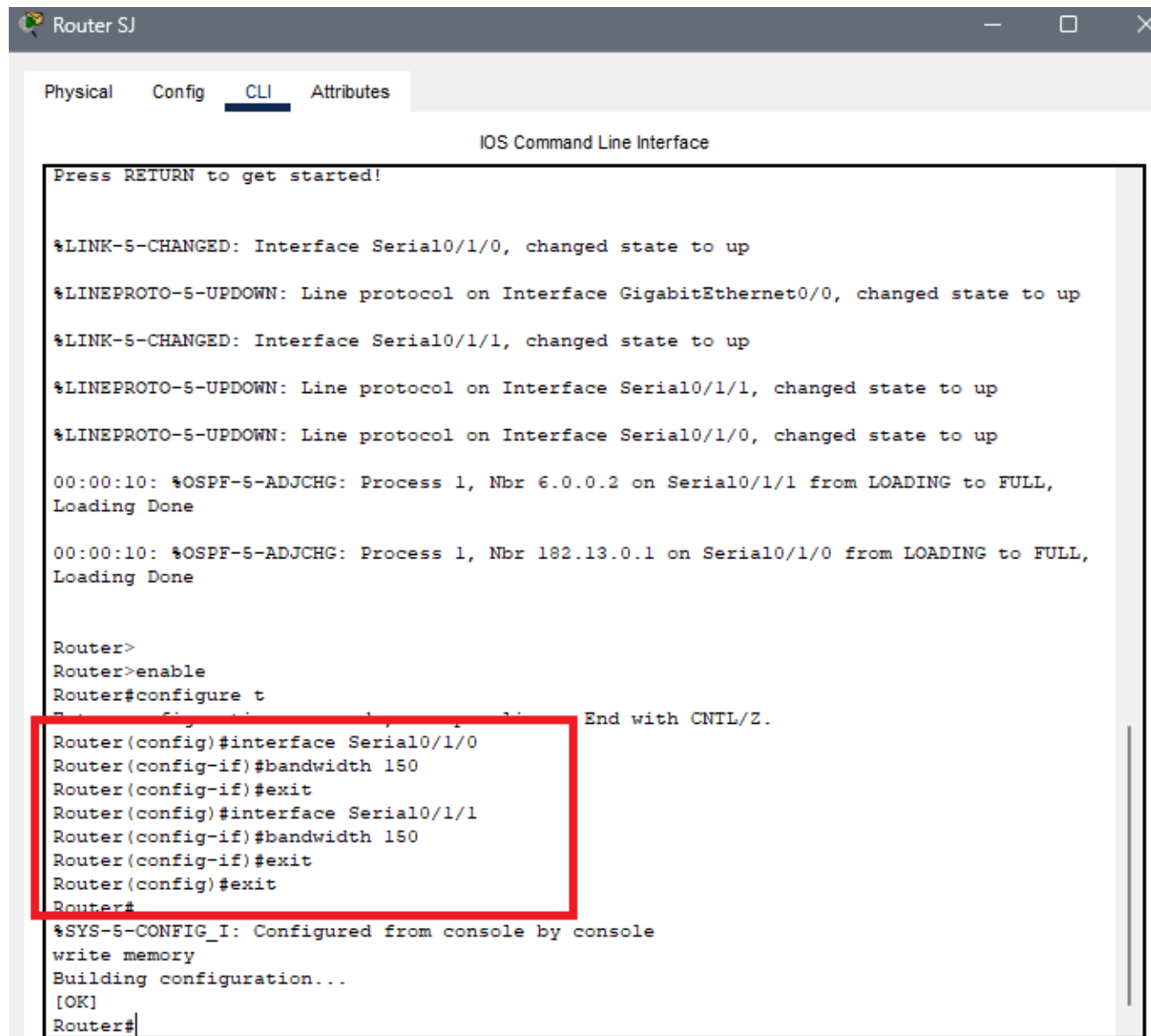
Pregunta 5

La ruta sin ninguna modificación entre SJ y CC era la siguiente



Primero, modificamos el ancho de banda de las conexiones en los Routers SJ y CC, definiendo un ancho de banda de 150kbps.

Para el Router SJ



The screenshot shows the 'Router SJ' application window with the 'CLI' tab selected. The title bar includes 'Router SJ' and standard window controls. The main area is titled 'IOS Command Line Interface' and displays a series of system messages and configuration commands. A red rectangular box highlights the configuration commands for interfaces Serial0/1/0 and Serial0/1/1. The messages indicate that the interfaces are up and the OSPF process is loading. The configuration commands set the bandwidth to 150 for both interfaces.

```
Router SJ
Physical Config CLI Attributes
IOS Command Line Interface

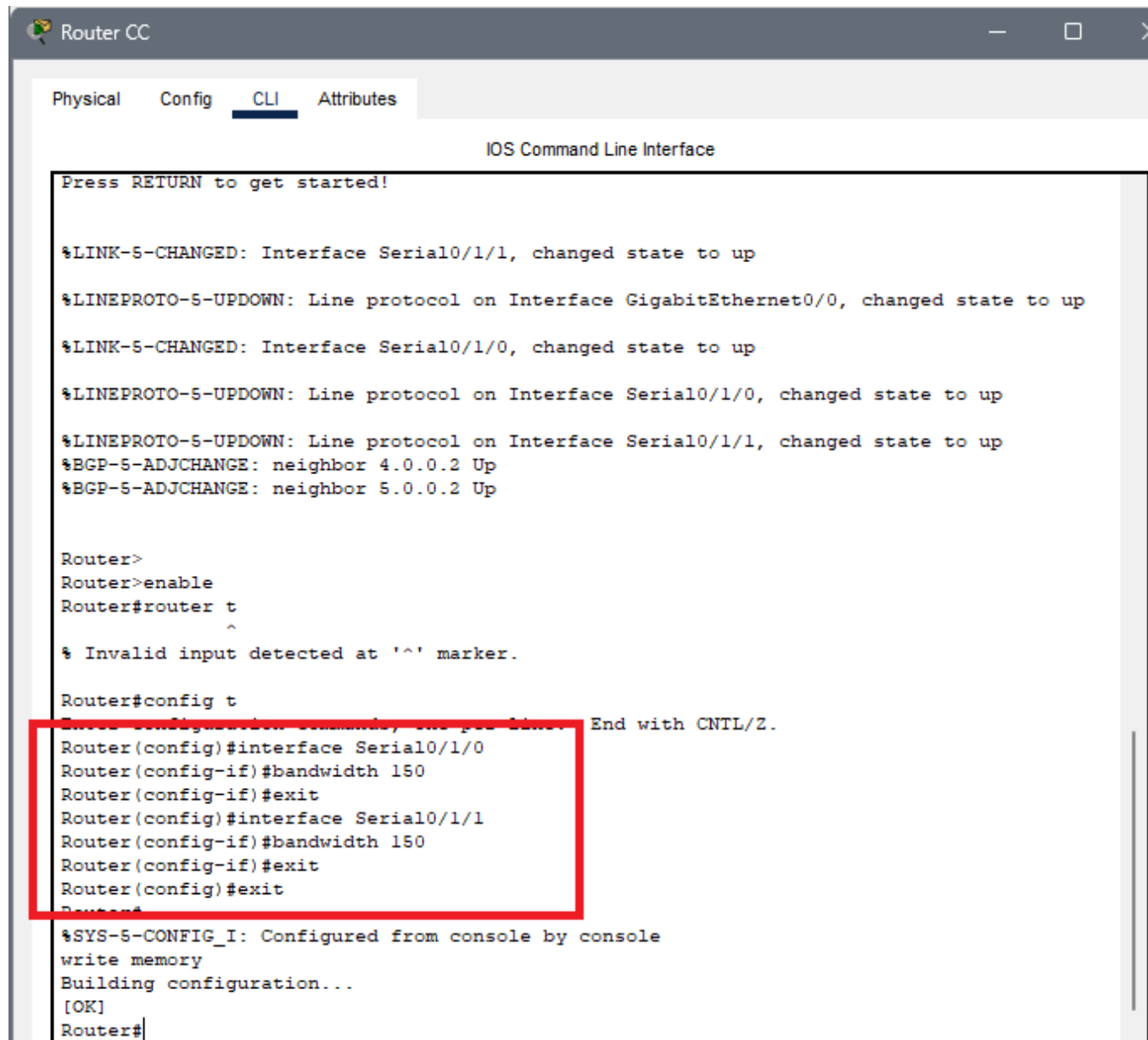
Press RETURN to get started!

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 6.0.0.2 on Serial0/1/1 from LOADING to FULL, Loading Done
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 182.13.0.1 on Serial0/1/0 from LOADING to FULL, Loading Done

Router>
Router>enable
Router#configure t
End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

Se realiza lo mismo para la conexión Serial en el Router Vitacura y Router Sedes

Para el Router CC



The screenshot shows the CLI of a router named 'Router CC'. The 'CLI' tab is selected. The interface displays the following text:

```
Press RETURN to get started!

%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up
%BGP-5-ADJCHANGE: neighbor 4.0.0.2 Up
%BGP-5-ADJCHANGE: neighbor 5.0.0.2 Up

Router>
Router>enable
Router#router t
      ^
% Invalid input detected at '^' marker.

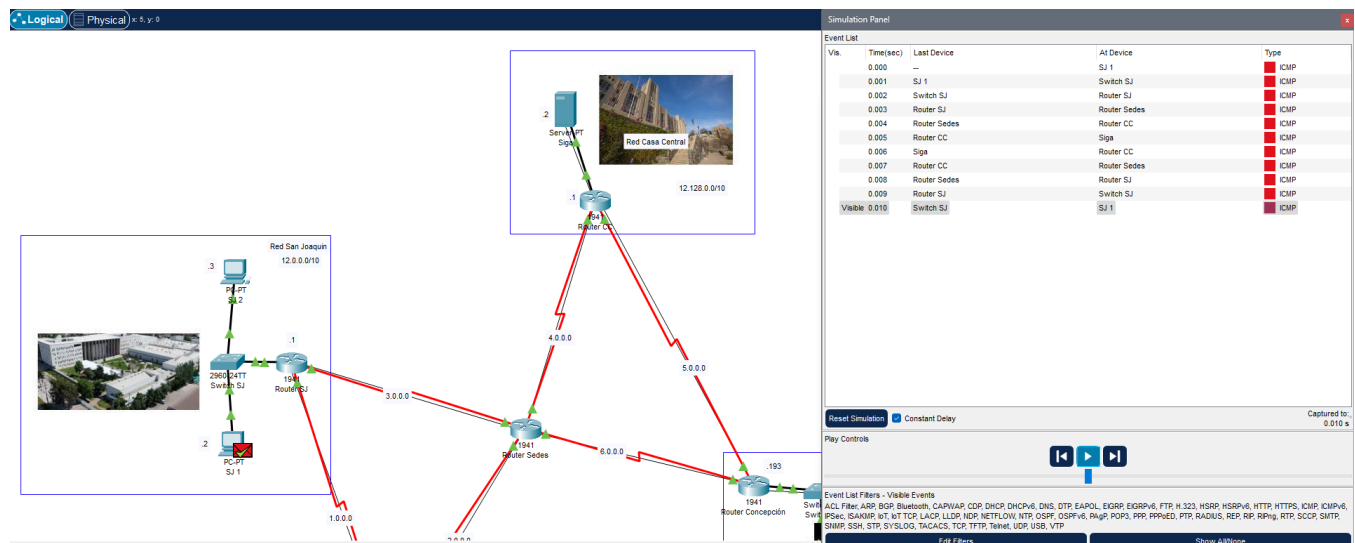
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

A red rectangular box highlights the configuration commands for the Serial interfaces:

```
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
```

Se realiza lo mismo para la conexión Serial en el Router Sedes y Router Concepción

Con el bandwidth de 150, se tiene la siguiente ruta



La cual podemos observar que es la misma, ya que no tiene otra opción que pasar por aquellos enlaces que fueron bajados su ancho de banda al no haber rutas alternativas

Se muestra igualmente el Tracing Route

```
Tracing route to 12.128.0.2 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    12.0.0.1
  2  6 ms    0 ms    0 ms    3.0.0.2
  3  1 ms    9 ms    7 ms    4.0.0.1
  4  0 ms    5 ms    1 ms    12.128.0.2

Trace complete.
```

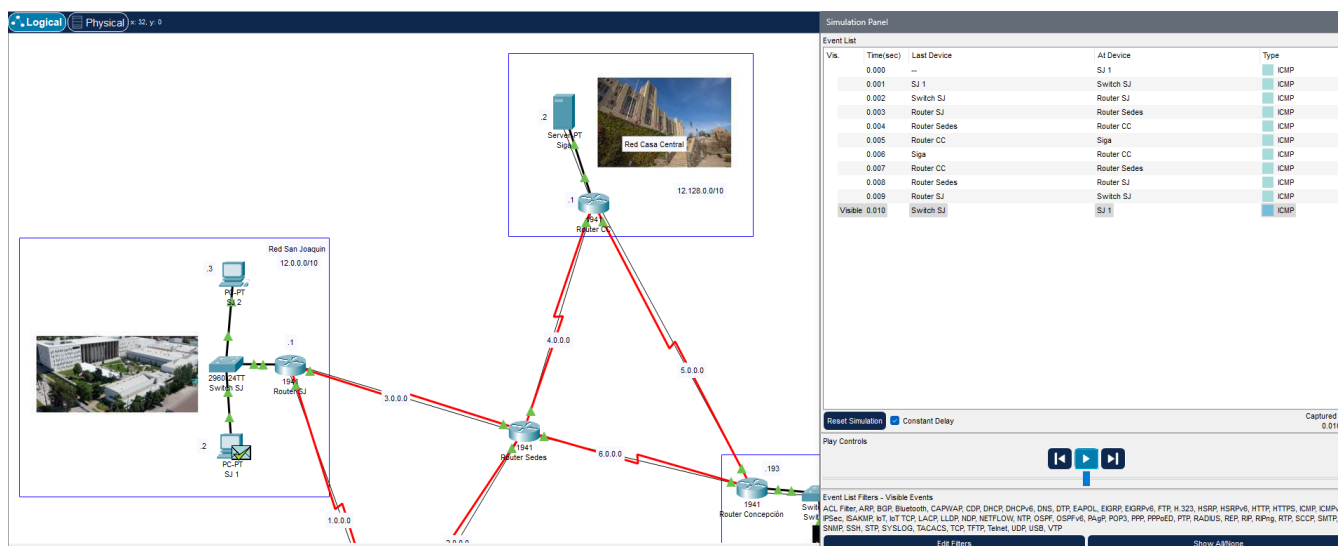
Luego, aumentamos el ancho de banda de San Joaquín a 3500kbps (Al igual que en la conexión con Router Vitacura y Router Sedes)

```
Router SJ
Router(config)#router ip
Router(config-router)#
Router(config-router)#end
Router#vlan database
% Warning: It is recommended to configure VLAN from config mode,
as VLAN database mode is being deprecated. Please consult user
documentation for configuring VTP/VLAN in config mode.

Router(vlan)#
%SYS-5-CONFIG_I: Configured from console by console

Router(vlan)#exit
APPLY completed.
Exiting....
Router#
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 3500
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 3500
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
-----
```

Con este ancho de banda, se tiene la siguiente ruta



De aquí se puede apreciar que, aunque se incrementa el ancho de banda a 3500kbps, la ruta no cambia ya que, aunque la ruta se haya vuelto más “barata” en términos de costo OSPF, ya era la ruta preferida antes del cambio

Con 3500 kbps san Joaquín

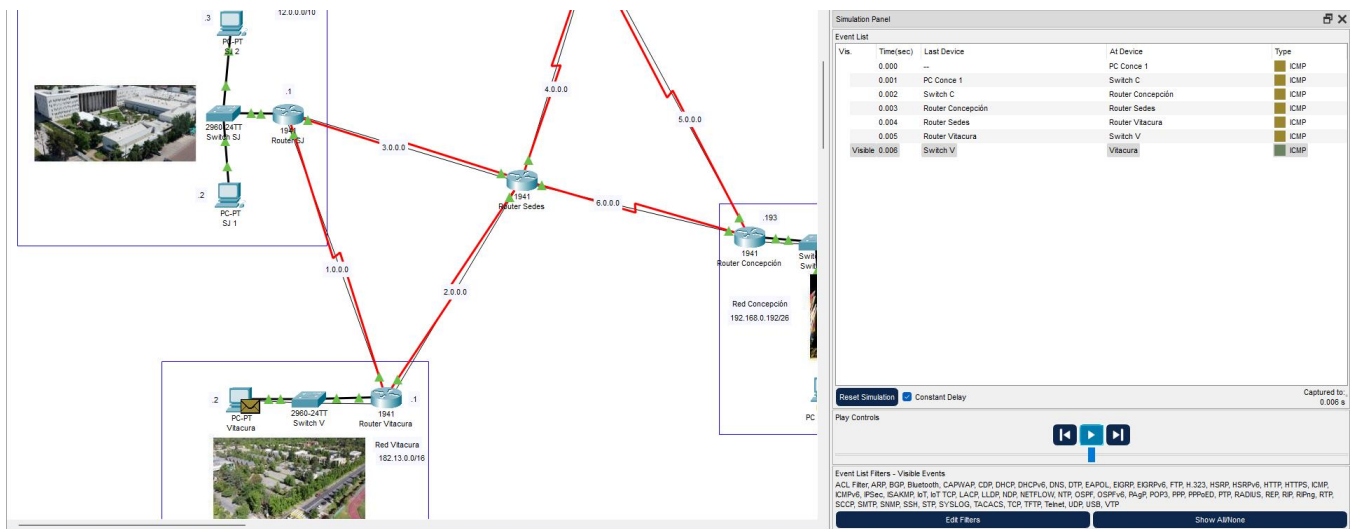
```
Tracing route to 12.128.0.2 over a maximum of 30 hops:

 1  0 ms    0 ms    0 ms    12.0.0.1
 2  1 ms    4 ms    3 ms    3.0.0.2
 3  3 ms    8 ms   21 ms    4.0.0.1
 4  5 ms    5 ms    1 ms   12.128.0.2

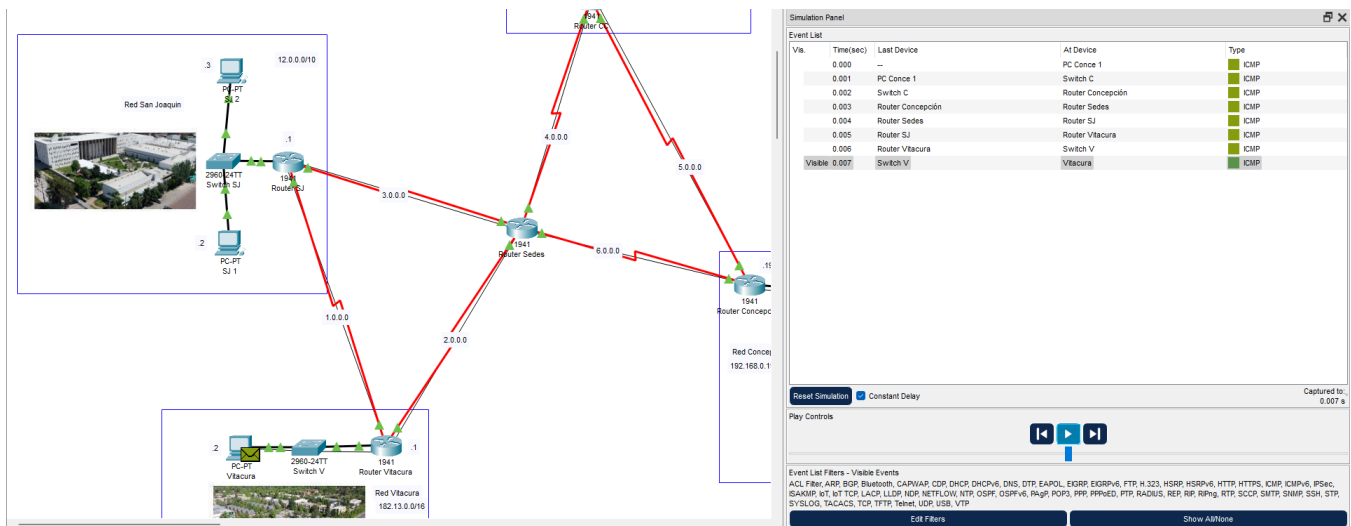
Trace complete.
```

Sin embargo, si se prueba por ejemplo para algún mensaje entre Concepción y Vitacura, si cambia la ruta.

La ruta original es esta



Y la ruta con el bandwidth aumentado es la siguiente



Es decir, prefiere pasar por las conexiones del Router San Joaquín, que las de Vitacura ya que tienen un menor costo de 28, contra el original que es de 64, como se puede apreciar en esta imagen

```

Suppress hello for 0 neighbor(s)
Serial0/1/1 is up, line protocol is up
Internet address is 3.0.0.1/8, Area 1
Process ID 1, Router ID 12.0.0.1, Network Type POINT-TO-POINT Cost: 28
Transmit Delay is 1 sec, State POINT-TO-POINT,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:08
Index 2/2, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 6.0.0.2
Suppress hello for 0 neighbor(s)
Serial0/1/0 is up, line protocol is up
Internet address is 1.0.0.2/8, Area 1
Process ID 1, Router ID 12.0.0.1, Network Type POINT-TO-POINT, Cost: 28
Transmit Delay is 1 sec, State POINT-TO-POINT,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:08
Index 3/3, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 182.13.0.1
Suppress hello for 0 neighbor(s)

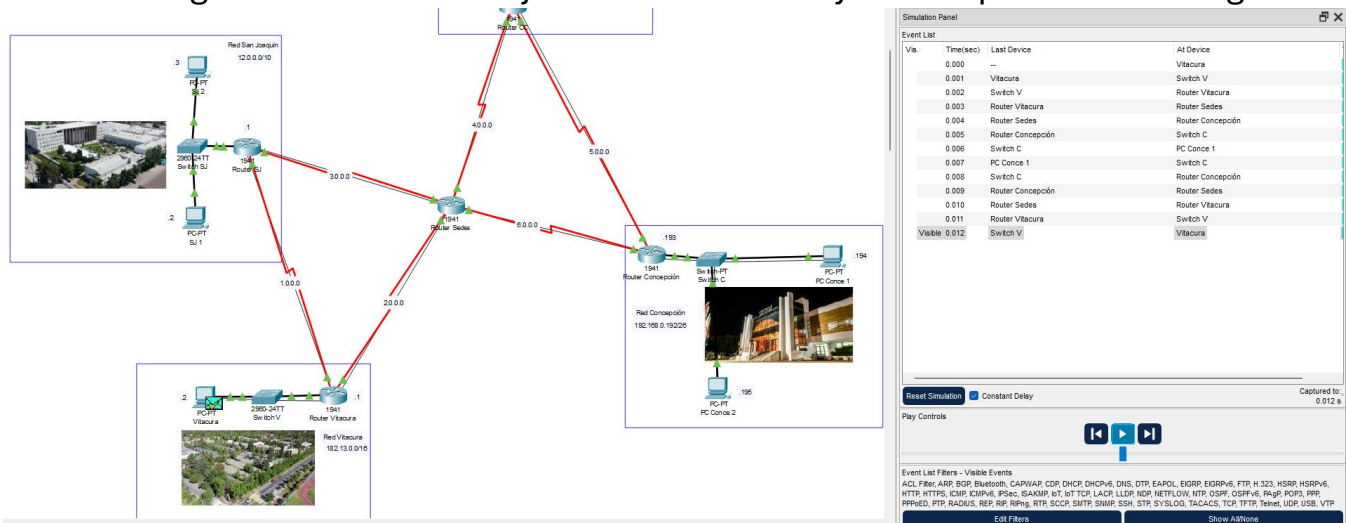
```

Esto es un comportamiento típico de OSPF en donde las rutas con menor costo son las preferidas.

Ya que OSPF calcula la ruta más corta utilizando el algoritmo de Dijkstra, con un incremento en el ancho de banda, el costo OSPF de las rutas a través de estos enlaces se reduce, haciendo que sean más preferibles si comparativamente ofrecen un camino más corto en términos de costos acumulados frente a otras rutas disponibles

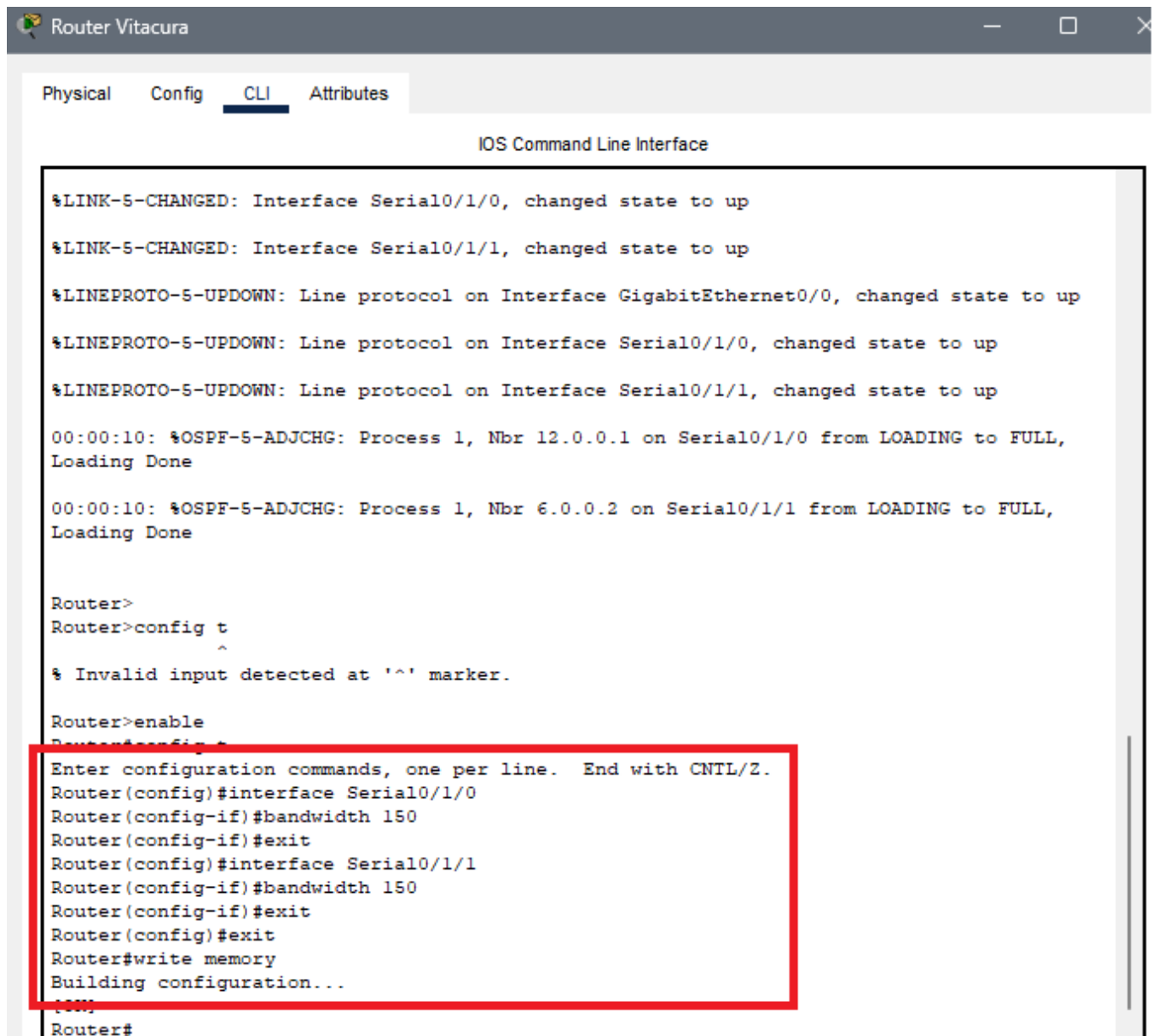
Pregunta 6

La ruta original de un mensaje entre Vitacura y Concepción es la siguiente



Ahora, se baja el ancho de banda de las conexiones de los Routers Vitacura y Concepción a 150kbps

Primero, en el Router de Vitacura



The screenshot shows the 'Router Vitacura' application window with the 'CLI' tab selected. The title bar includes standard window controls. Below the tabs, the text 'IOS Command Line Interface' is displayed. The main area contains a series of system messages and user commands. A red rectangular box highlights the configuration section, which includes setting bandwidth on two serial interfaces and saving the configuration.

```
Router Vitacura
Physical Config CLI Attributes
IOS Command Line Interface

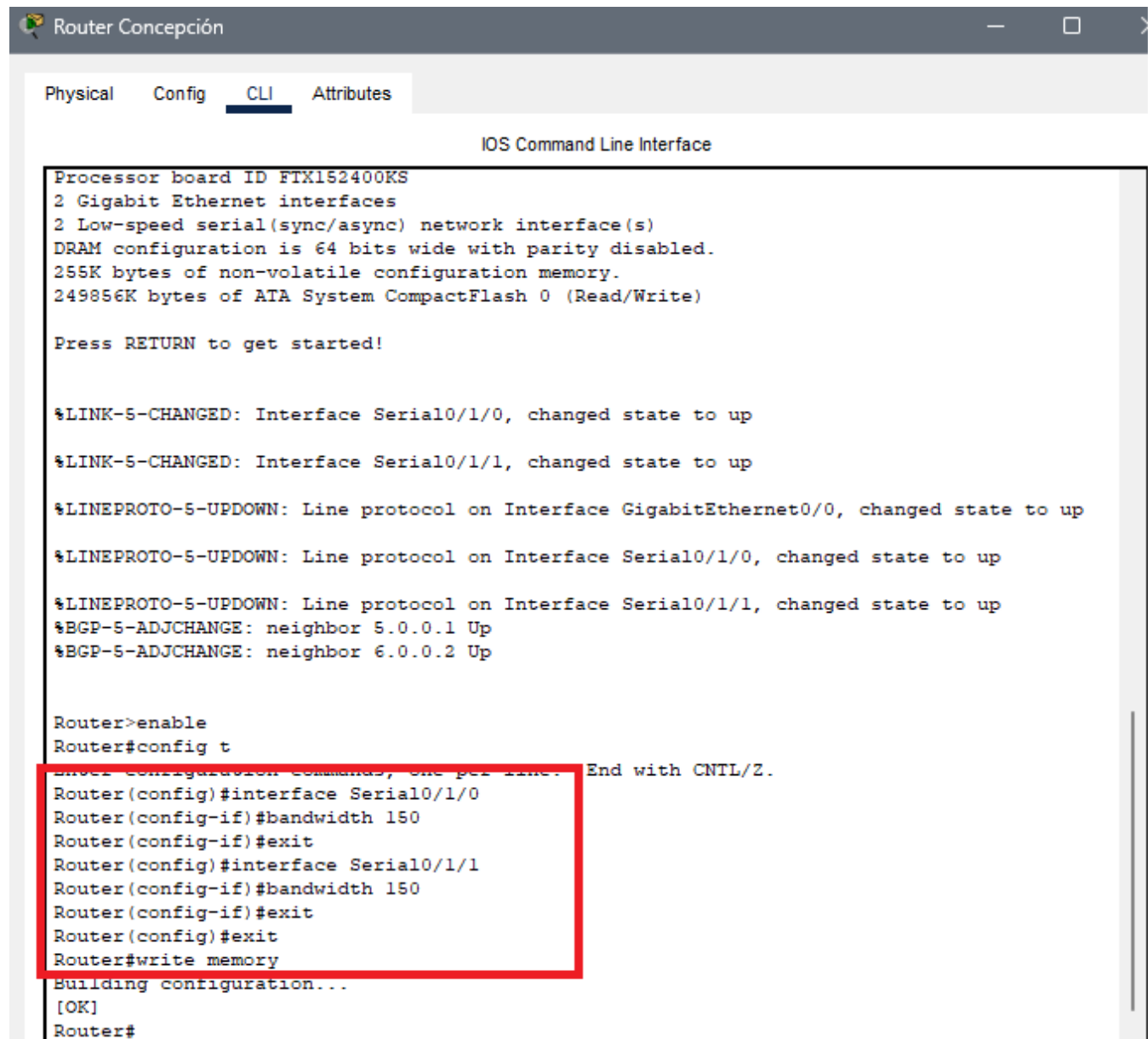
%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 12.0.0.1 on Serial0/1/0 from LOADING to FULL, Loading Done
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 6.0.0.2 on Serial0/1/1 from LOADING to FULL, Loading Done

Router>
Router>config t
^
% Invalid input detected at '^' marker.

Router>enable
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
Router#write memory
Building configuration...
[OK]
Router#
```

Lo mismo se realiza en Router SJ y Router Sedes para las conexiones con Vitacura

Y en el Router de Concepción



The screenshot shows the 'Router Concepción' window with the 'CLI' tab selected. The title bar includes a router icon, the text 'Router Concepción', and standard window controls. The main content area is titled 'IOS Command Line Interface' and displays the following text:

```
Processor board ID FTX152400KS
2 Gigabit Ethernet interfaces
2 Low-speed serial(sync/async) network interface(s)
DRAM configuration is 64 bits wide with parity disabled.
255K bytes of non-volatile configuration memory.
249856K bytes of ATA System CompactFlash 0 (Read/Write)

Press RETURN to get started!

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up
%BGP-5-ADJCHANGE: neighbor 5.0.0.1 Up
%BGP-5-ADJCHANGE: neighbor 6.0.0.2 Up

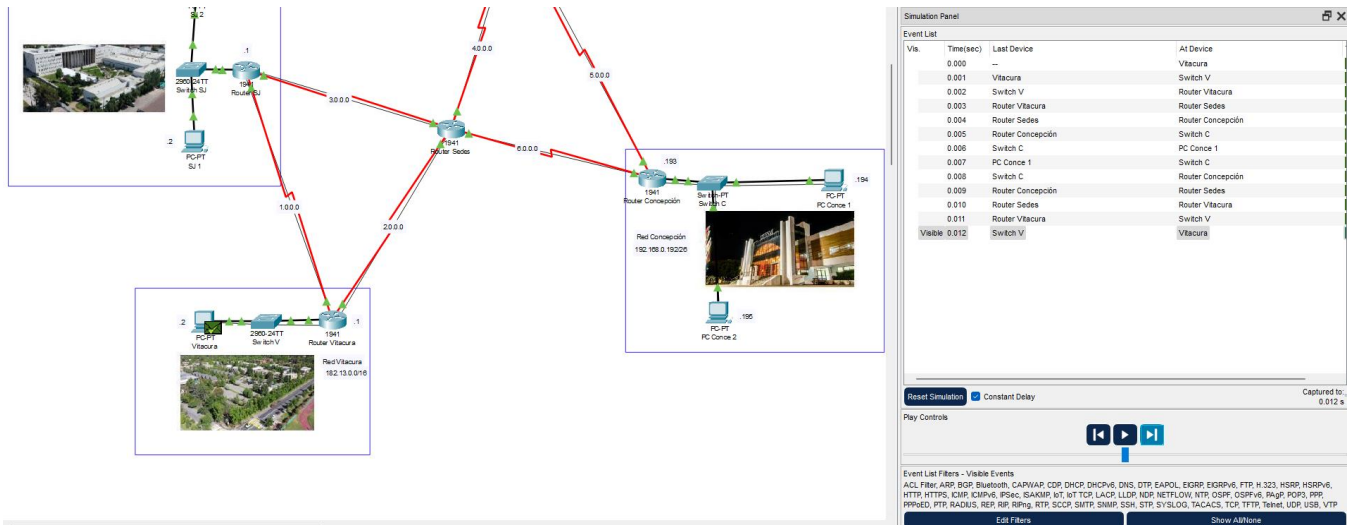
Router>enable
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
Router#write memory
Building configuration...
[OK]
Router#
```

A red rectangular box highlights the configuration commands for the serial interfaces:

```
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
Router#write memory
```

Lo mismo se realiza en Router CC y Router Sedes para las conexiones con Vitacura

Con esta modificación, se sigue la siguiente ruta



Al reducir el ancho de banda en las conexiones entre Vitacura y Concepción a 150kbps, se puede ver que la ruta no cambia, esto ya que BGP no utiliza el ancho de banda como métrica directa para la toma de decisiones de ruta, las decisiones de ruta en BGP están más influidas por políticas administrativas y atributos como AS_PATH, LOCAL_PREF, entre otros

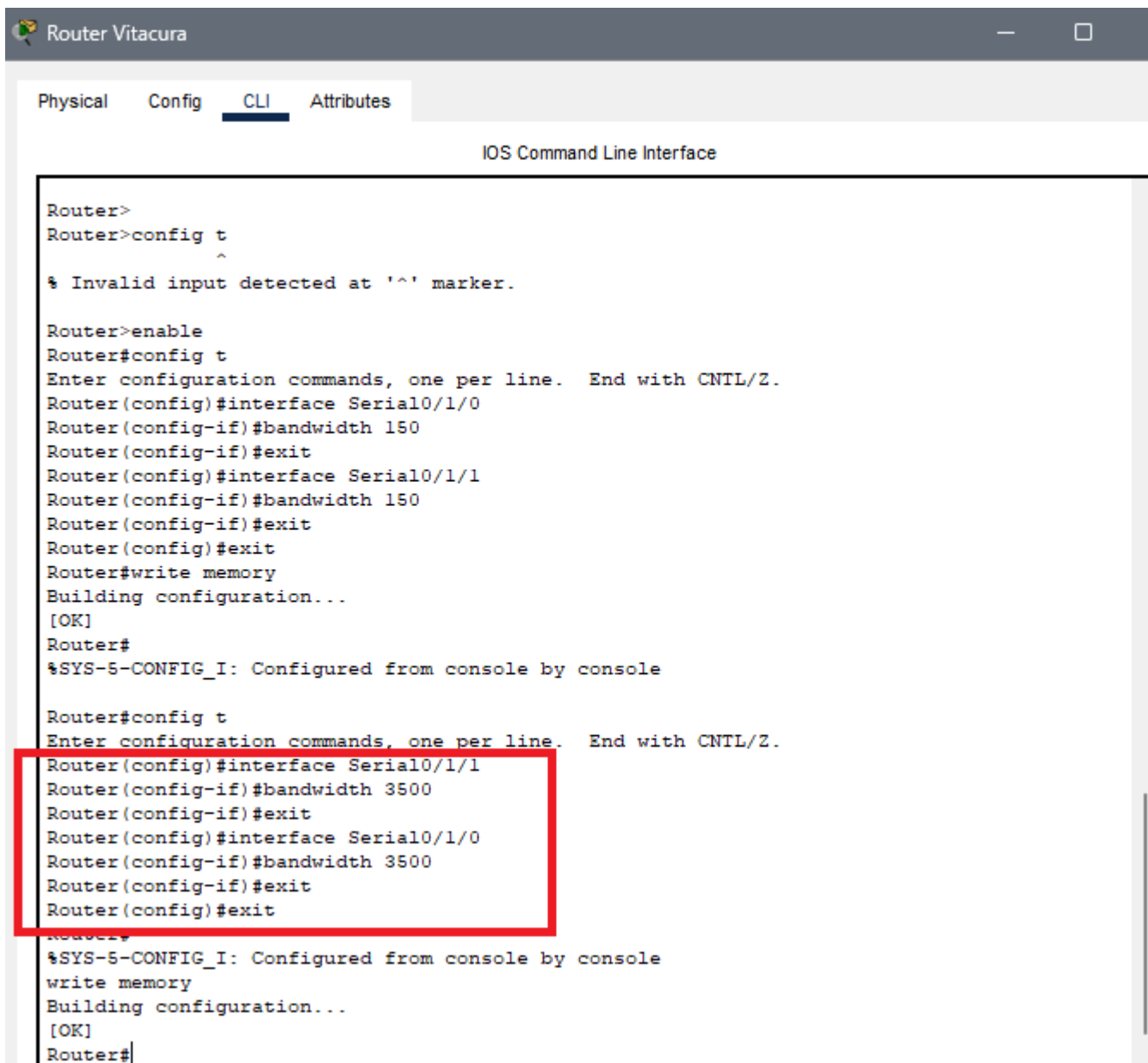
Se presenta el Tracing Route (de Vitacura a Concepción)

```
Tracing route to 192.168.0.194 over a maximum of 30 hops:

 1  0 ms      0 ms      0 ms      182.13.0.1
 2  3 ms      3 ms      3 ms      2.0.0.2
 3  5 ms      5 ms      3 ms      6.0.0.1
 4  0 ms      1 ms      4 ms      192.168.0.194

Trace complete.
```

Ahora, se mejora el ancho de banda de Vitacura y se sube a 3500 kbps



The screenshot shows a web-based interface for a 'Router Vitacura'. At the top, there are tabs for 'Physical', 'Config', 'CLI' (which is selected), and 'Attributes'. Below the tabs, the title 'IOS Command Line Interface' is displayed. The main area contains a text box with a command-line interface simulation. The commands entered are as follows:

```
Router>
Router>config t
      ^
% Invalid input detected at '^' marker.

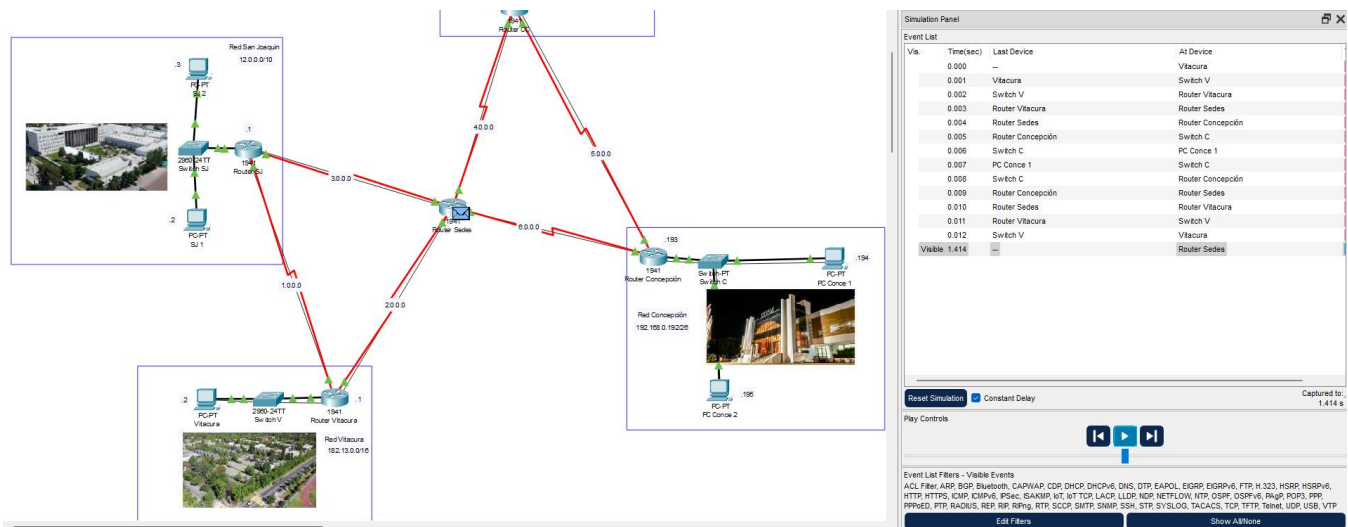
Router>enable
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 150
Router(config-if)#exit
Router(config)#exit
Router#write memory
Building configuration...
[OK]
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/1/1
Router(config-if)#bandwidth 3500
Router(config-if)#exit
Router(config)#interface Serial0/1/0
Router(config-if)#bandwidth 3500
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

A red rectangular box highlights the configuration commands for the Serial0/1/1 and Serial0/1/0 interfaces, specifically the 'interface', 'bandwidth', and 'exit' commands for both.

Lo mismo se realiza en Router SJ y Router Sedes para las conexiones con Vitacura

Teniendo la siguiente ruta



Similarmente a cuando se bajó a 150kbps, al mejorar el ancho de banda a 3500kbps, la ruta sigue siendo la misma, ya que BGP seguirá seleccionando rutas basadas en sus atributos de enrutamiento y políticas, y no directamente en el ancho de banda

Se presenta el Tracing Route (de Vitacura a Concepción)

```
Tracing route to 192.168.0.194 over a maximum of 30 hops:

  1  1 ms      0 ms      0 ms      182.13.0.1
  2  6 ms      0 ms      0 ms      2.0.0.2
  3  6 ms      9 ms      3 ms      6.0.0.1
  4  1 ms      3 ms      0 ms      192.168.0.194

Trace complete.
```

La ruta es la misma, pero se puede apreciar que en las conexiones del Router Vitacura, es decir, en el segundo hop, el RTT es menor con 0 ms en 2 intentos

Sin embargo, cuando si se prueba con mensajes entre San Joaquín y Vitacura, el mensaje toma la ruta Router SJ -> Router Vitacura -> Router Sedes en vez de Router SJ -> Router Sedes, esto ya que las conexiones del Router Vitacura poseen un mayor ancho de banda. Esto se puede apreciar a continuación

ancho de banda no afectarán directamente las decisiones de ruta en BGP a menos que se configuren políticas específicas para considerarlo.