PRUEBA DE HABILIDADES PRÁCTICAS

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24

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DIPLOMADO DE PROFUNDIZACIÓN CISCO

CALI

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TABLA DE CONTENIDO

LISTA DE TABLAS

INTRODUCCIÓN

En el siguiente informe se presenta el paso a paso del desarrollo de la prueba de habilidades prácticas en sus dos escenarios propuestos del DIPLOMADO DE PROFUNDIZACIÓN CISCO, donde se ejecutan los conceptos y practicas estudiadas y desarrollas a lo largo del curso.

Los escenarios propuestos se deben de configurar y ejecutar usando un software para su implementación simulando un escenario real y para esta actividad se usará el Packet Tracer 6, donde aplicaremos los conceptos para implementar NAT, servidor de DHCP, RIPV2 y el routing entre VLAN, configuración de direcciones IP y verificar su correcta implementación usando ping únicamente.

Con el desarrollo de esta práctica se pretende también cumplir la programación propuesta a lo largo de la carrera para obtener el título de Ingeniero de Sistemas.

ESCENARIO 1
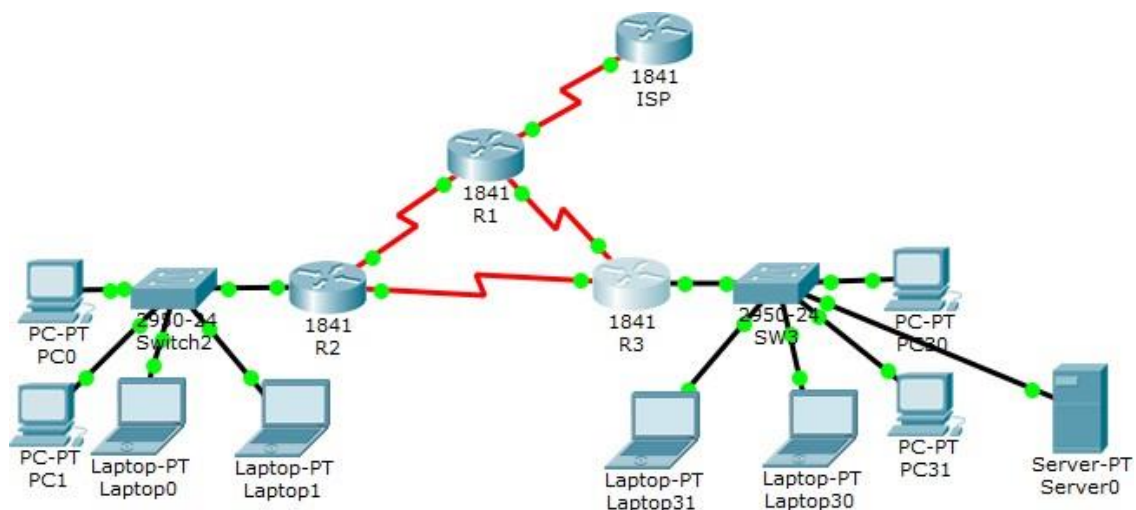
Tabla 1. Direccionamiento

El administrador	Interfaces	Dirección IP	Máscara de subred	Gateway predeterminado
ISP	S0/0/0	200.123.211.1	255.255.255.0	N/D
R1	Se0/0/0	200.123.211.2	255.255.255.0	N/D
	Se0/1/0	10.0.0.1	255.255.255.252	N/D
	Se0/1/1	10.0.0.5	255.255.255.252	N/D
R2	Fa0/0,100	192.168.20.1	255.255.255.0	N/D
	Fa0/0,200	192.168.21.1	255.255.255.0	N/D
	Se0/0/0	10.0.0.2	255.255.255.252	N/D
	Se0/0/1	10.0.0.9	255.255.255.252	N/D
R3	Fa0/0	192.168.30.1	255.255.255.0	N/D
		2001:db8:130::9C0:80F:301	/64	N/D
	Se0/0/0	10.0.0.6	255.255.255.252	N/D
	Se0/0/1	10.0.0.10	255.255.255.252	N/D
SW2	VLAN 100	N/D	N/D	N/D
	VLAN 200	N/D	N/D	N/D
SW3	VLAN1	N/D	N/D	N/D

PC20	NIC	DHCP	DHCP	DHCP
PC21	NIC	DHCP	DHCP	DHCP
PC30	NIC	DHCP	DHCP	DHCP
PC31	NIC	DHCP	DHCP	DHCP
Laptop20	NIC	DHCP	DHCP	DHCP
Laptop21	NIC	DHCP	DHCP	DHCP
Laptop30	NIC	DHCP	DHCP	DHCP
Laptop31	NIC	DHCP	DHCP	DHCP

Tabla 2. Asignación de VLAN y de puertos

Dispositivo	VLAN	Nombre	Interfaz
SW2	100	LAPTOPS	Fa0/2-3
SW2	200	DESTOPS	Fa0/4-5
SW3	1	-	Todas las interfaces

Tabla 3. Enlaces troncales
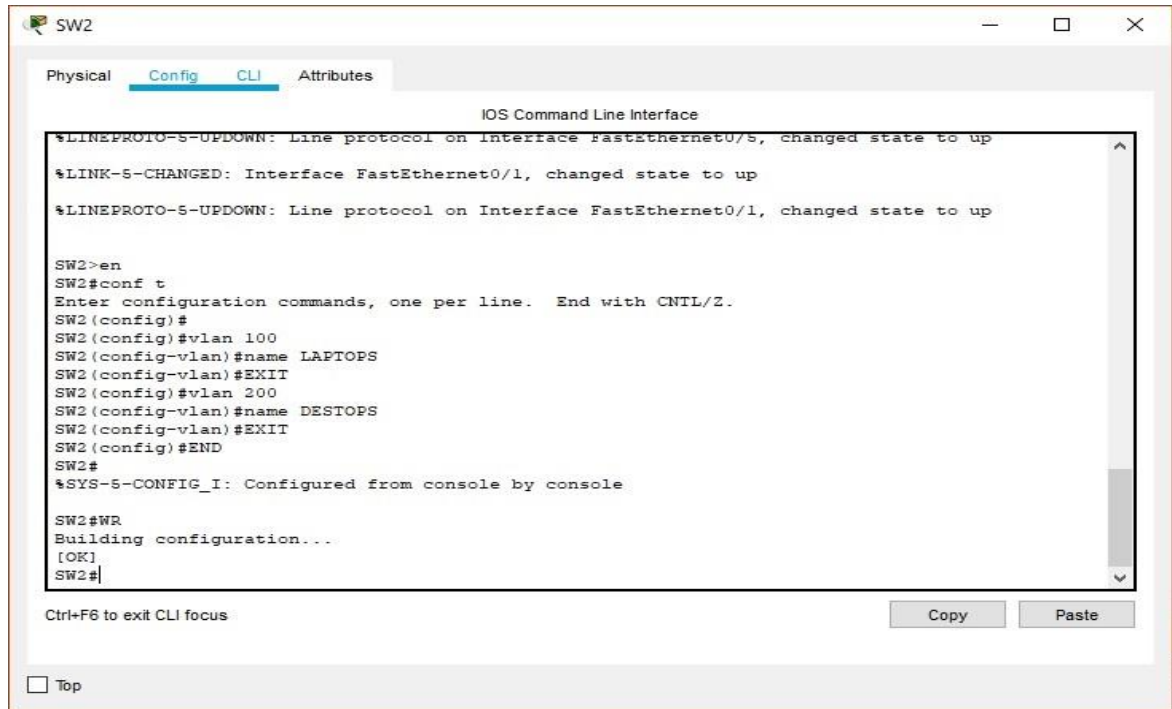
Dispositivo local	Interfaz local	Dispositivo remoto
SW2	Fa0/2-3	100

Situación

En esta actividad, demostrará y reforzará su capacidad para implementar NAT, servidor de DHCP, RIPV2 y el routing entre VLAN, incluida la configuración de direcciones IP, las VLAN, los enlaces troncales y las subinterfaces. Todas las pruebas de alcance deben realizarse a través de ping únicamente.

Descripción de las actividades

- **SW1** VLAN y las asignaciones de puertos de VLAN deben cumplir con la tabla 1.

```
100   LAPTOPS                              active    Fa0/2, Fa0/3
200   DESTOPS                              active    Fa0/4, Fa0/5
1002 fddi-default                          active
1003 token-ring-default                    active
1004 fddinet-default                       active
1005 trnet-default                         active
```

```
SW3                                                              —    □    ×

Physical    Config    CLI    Attributes

                          IOS Command Line Interface

Enter configuration commands, one per line.  End with CNTL/Z.
SW3(config)#vlan 1
SW3(config-vlan)#exit
SW3(config)#int range f0/1-24
SW3(config-if-range)#switchport mode access
SW3(config-if-range)#switchport access vlan 1
SW3(config-if-range)#exit
SW3(config)#end
SW3#
%SYS-5-CONFIG_I: Configured from console by console

SW3#wr
Building configuration...
[OK]
SW3#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23, Fa0/24
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

--More-- |
```

- Los puertos de red que no se utilizan se deben deshabilitar.

SW3   — □ ✕

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
SW3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW3(config)#
SW3(config)#int range f0/6-23
SW3(config-if-range)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/7, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/8, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/9, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/10, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/11, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/12, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/13, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/14, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/15, changed state to administratively down
```
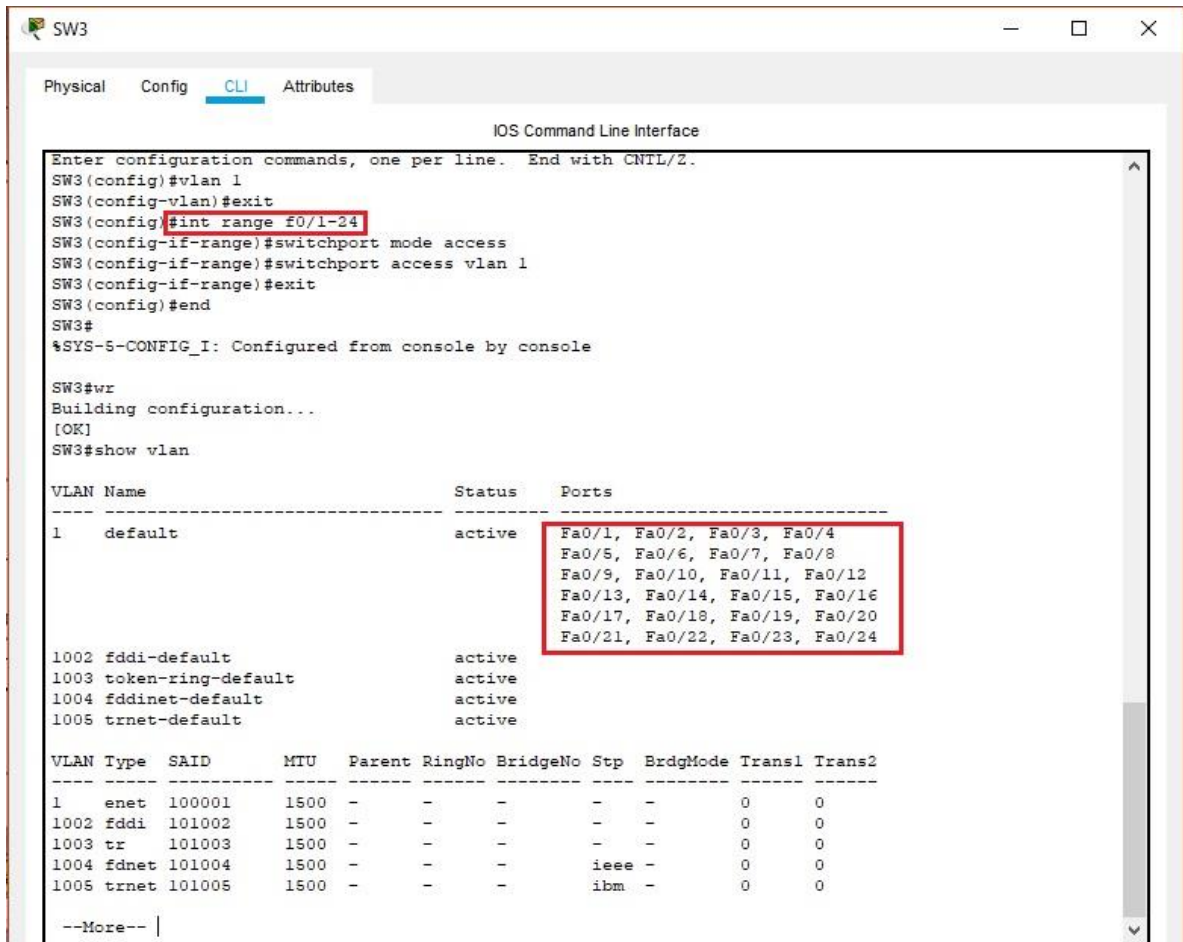
SW2   — □ ✕

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
SW2>en
SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#int range f0/6-24
SW2(config-if-range)#showdown
                       ^
% Invalid input detected at '^' marker.

SW2(config-if-range)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/7, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/8, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/9, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/10, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/11, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/12, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/13, changed state to administratively down
```

```
SW2>en
SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#int f0/1
SW2(config-if)#switchport mode trunk
SW2(config-if)#exit
SW2(config)#
```

```
SW3>en
SW3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW3(config)#int f0/1
SW3(config-if)#switchport mode trunk

SW3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

SW3(config-if)#end
SW3#
%SYS-5-CONFIG_I: Configured from console by console
wr
Building configuration...
[OK]
SW3#
```

- **La información** de dirección **IP R1**, **R2** y R3 debe cumplir con la tabla 1.

```
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int s0/0/0
R1(config-if)#ip address 200.123.211.2 255.255.255.0
R1(config-if)#exit
R1(config)#int s0/1/0
R1(config-if)#ip address 10.0.0.1 255.255.255.252
R1(config-if)#exit
R1(config)#int s0/1/1
R1(config-if)#ip address 10.0.0.5 255.255.255.252
R1(config-if)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
wr
Building configuration...
[OK]
R1#
```

```
R2>en
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int f0/0
R2(config-if)#exit
R2(config)#int f0/0.100
R2(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.100, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.100, changed state
to up
```

```
R2(config-subif)#encapsulation dot1Q 100
R2(config-subif)#ip address 192.168.20.1 255.255.255.0
R2(config-subif)#exit
R2(config)#int f0/0.200
R2(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.200, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.200, changed state
to up
```

```
R2(config-subif)#encapsulation dot1Q 200
R2(config-subif)#ip address 192.168.21.1 255.255.255.0
R2(config-subif)#exit
R2(config)#int s0/0/0
R2(config-if)#ip address 10.0.0.2 255.255.255.253
Bad mask 0xFFFFFFFD for address 10.0.0.2
R2(config-if)#ip address 10.0.0.2 255.255.255.252
R2(config-if)#exi%DHCPD-4-PING_CONFLICT: DHCP address conflict:  server pinged
192.168.21.1.
t
R2(config)#exit
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int s0/0/1
R2(config-if)#ip address 10.0.0.9 255.255.255.252
R2(config-if)#exit
R2(config)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
wr
Building configuration...
[OK]
R2#
```

- **Laptop20, Laptop21, PC20, PC21, Laptop30, Laptop31, PC30 y PC31** deben obtener información IPv4 del servidor DHCP.

- **R1** debe realizar una NAT con sobrecarga sobre una dirección IPv4 pública. Asegúrese de que todos los terminales pueden comunicarse con Internet pública (haga ping a la dirección ISP) y la lista de acceso estándar se **llama INSIDE-DEVS**.

- **R1** debe tener una ruta estática predeterminada al ISP que se configuró y que incluye esa ruta en **el dominio** RIPv2.

```
R1                                                          —   □   ×

Physical    Config    CLI    Attributes

                        IOS Command Line Interface

R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int s0/1/1
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#int s0/1/0
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#int s0/0/0
R1(config-if)#ip nat outside
R1(config-if)#exit
R1(config)#ip nat pool INSIDE-DEVS 200.123.211.2 200.123.211.128 netmask 255.255.255.0
R1(config)#access-list 1 permit 192.168.0.0 0.0.255.255
R1(config)#access-list 1 permit 10.0.0.0 0.255.255.255
R1(config)#ip nat inside source list 1 interface s0/0/0 overload
R1(config)#ip nat inside source static tcp 192.168.30.6 80 200.123.211.1 80
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#network 10.0.0.0
R1(config-router)#exit
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
wr
Building configuration...
[OK]
R1#show ip nat translations
Pro  Inside global     Inside local      Outside local      Outside global
tcp 200.123.211.1:80   192.168.30.6:80     ---                ---

R1#show ip nat statistics
Total translations: 1 (1 static, 0 dynamic, 1 extended)
Outside Interfaces: Serial0/0/0
Inside Interfaces: Serial0/1/0 , Serial0/1/1
Hits: 0  Misses: 0
Expired translations: 0
Dynamic mappings:
R1#
```

- **R2** es un servidor de DHCP para los dispositivos conectados al puerto FastEthernet0/0.
- **R2** debe, además de enrutamiento a otras partes de la red, ruta entre las VLAN 100 y 200.
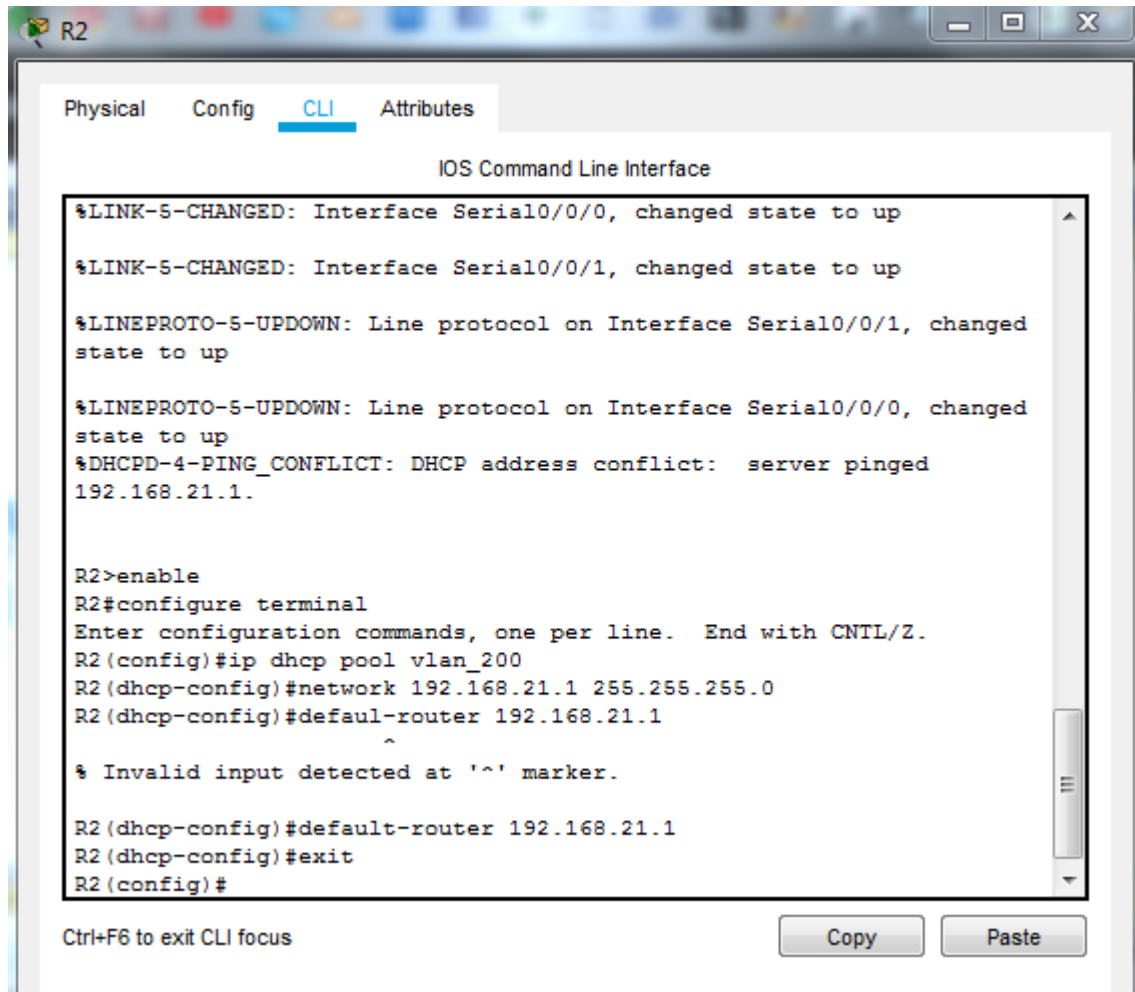

- El Servidor0 es sólo un servidor IPv6 y solo debe ser accesibles para los dispositivos en R3 (ping).

- La NIC instalado en direcciones IPv4 e IPv6 de Laptop30, de Laptop31, de PC30 y obligación de configurados PC31 simultáneas (dual-stack). Las direcciones se deben configurar mediante DHCP y DHCPv6.
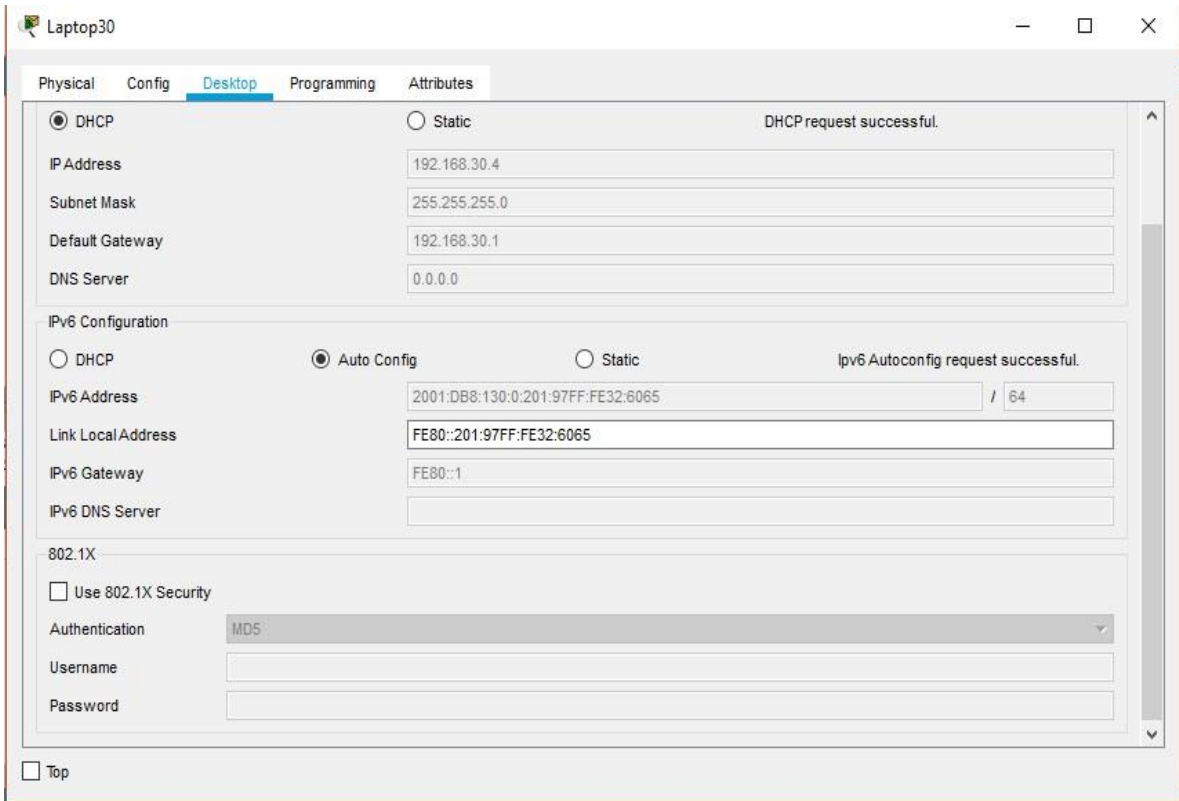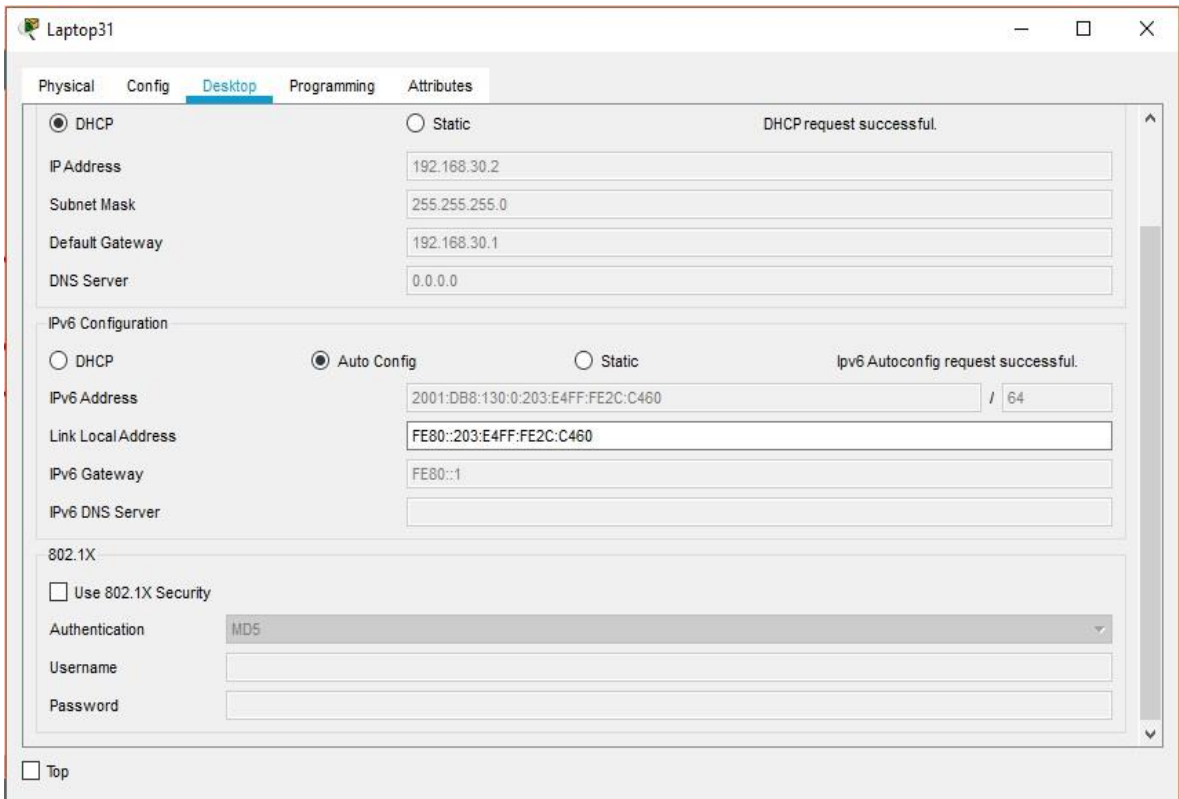
Laptop31

Physical | Config | Desktop | Programming | Attributes

◉ DHCP   ○ Static   DHCP request successful.

IP Address   192.168.30.2
Subnet Mask   255.255.255.0
Default Gateway   192.168.30.1
DNS Server   0.0.0.0

IPv6 Configuration

○ DHCP   ◉ Auto Config   ○ Static   Ipv6 Autoconfig request successful.

IPv6 Address   2001:DB8:130:0:203:E4FF:FE2C:C460   / 64
Link Local Address   FE80::203:E4FF:FE2C:C460
IPv6 Gateway   FE80::1
IPv6 DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5
Username
Password

☐ Top

Laptop30

Physical | Config | Desktop | Programming | Attributes

◉ DHCP   ○ Static   DHCP request successful.

IP Address   192.168.30.4
Subnet Mask   255.255.255.0
Default Gateway   192.168.30.1
DNS Server   0.0.0.0

IPv6 Configuration

○ DHCP   ◉ Auto Config   ○ Static   Ipv6 Autoconfig request successful.

IPv6 Address   2001:DB8:130:0:201:97FF:FE32:6065   / 64
Link Local Address   FE80::201:97FF:FE32:6065
IPv6 Gateway   FE80::1
IPv6 DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5
Username
Password

☐ Top

PC31

Physical Config Desktop Programming Attributes

◉ DHCP   ○ Static

IP Address   192.168.30.3
Subnet Mask   255.255.255.0
Default Gateway   192.168.30.1
DNS Server   0.0.0.0

IPv6 Configuration

◉ DHCP   ○ Auto Config   ○ Static

IPv6 Address   2001:DB8:130:0:20C:85FF:FE03:4271   / 64
Link Local Address FE80::20C:85FF:FE03:4271
IPv6 Gateway   FE80::1
IPv6 DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5
Username
Password

☐ Top

PC30

Physical Config Desktop Programming Attributes

◉ DHCP   ○ Static

IP Address   192.168.30.5
Subnet Mask   255.255.255.0
Default Gateway   192.168.30.1
DNS Server   0.0.0.0

IPv6 Configuration

◉ DHCP   ○ Auto Config   ○ Static

IPv6 Address   2001:DB8:130:0:207:ECFF:FE4A:183C   / 64
Link Local Address FE80::207:ECFF:FE4A:183C
IPv6 Gateway   FE80::1
IPv6 DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5
Username
Password

☐ Top

- La interfaz FastEthernet 0/0 del R3 también deben tener direcciones IPv4 e IPv6 configuradas (dual- stack).

```
R3>en
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#ipv6 unicast-routing
R3(config)#int f0/0
R3(config-if)#ipv6 enable
R3(config-if)#ip address 192.168.30.1 255.255.255.0
R3(config-if)#ipv6 address 2001:db8::9C0:80F:301/64
R3(config-if)#NO SHUTDOWN
R3(config-if)#
```

- R1, R2 y R3 intercambian información de routing mediante RIP versión 2.

```
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#do show ip route connected
C    10.0.0.0/30  is directly connected, Serial0/1/0
C    10.0.0.4/30  is directly connected, Serial0/1/1
C    200.123.211.0/24  is directly connected, Serial0/0/0

R1(config-router)#net
% Incomplete command.
R1(config-router)#network 10.0.0.0
R1(config-router)#network 10.0.0.4
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#wr
Building configuration...
[OK]
R1#
```

```
R2>en
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#router rip
R2(config-router)#version 2
R2(config-router)#network 10.0.0.0
R2(config-router)#network 10.0.0.8
R2(config-router)#do show ip route connected
C    10.0.0.0/30  is directly connected, Serial0/0/0
C    10.0.0.8/30  is directly connected, Serial0/0/1
C    192.168.20.0/24  is directly connected, FastEthernet0/0.100
C    192.168.21.0/24  is directly connected, FastEthernet0/0.200

R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#wr
Building configuration...
[OK]
R2#
```

```
R3>en
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#router rip
R3(config-router)#version 2
R3(config-router)#network 10.0.0.0
R3(config-router)#network 10.0.0.8
R3(config-router)#show ip route connected
                        ^
% Invalid input detected at '^' marker.

R3(config-router)#end
R3#
%SYS-5-CONFIG_I: Configured from console by console

R3#show ip route connected
C    10.0.0.4/30  is directly connected, Serial0/0/0
C    10.0.0.8/30  is directly connected, Serial0/0/1
C    192.168.30.0/24  is directly connected, FastEthernet0/0

R3#wr
Building configuration...
[OK]
R3#
```
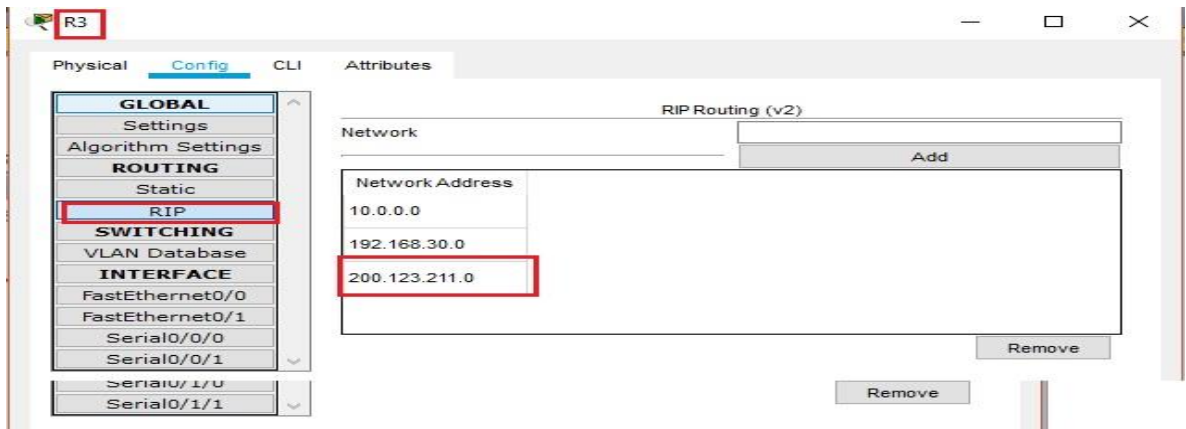
- R1, R2 y R3 deben saber sobre las rutas de cada uno y la ruta predeterminada desde R1.
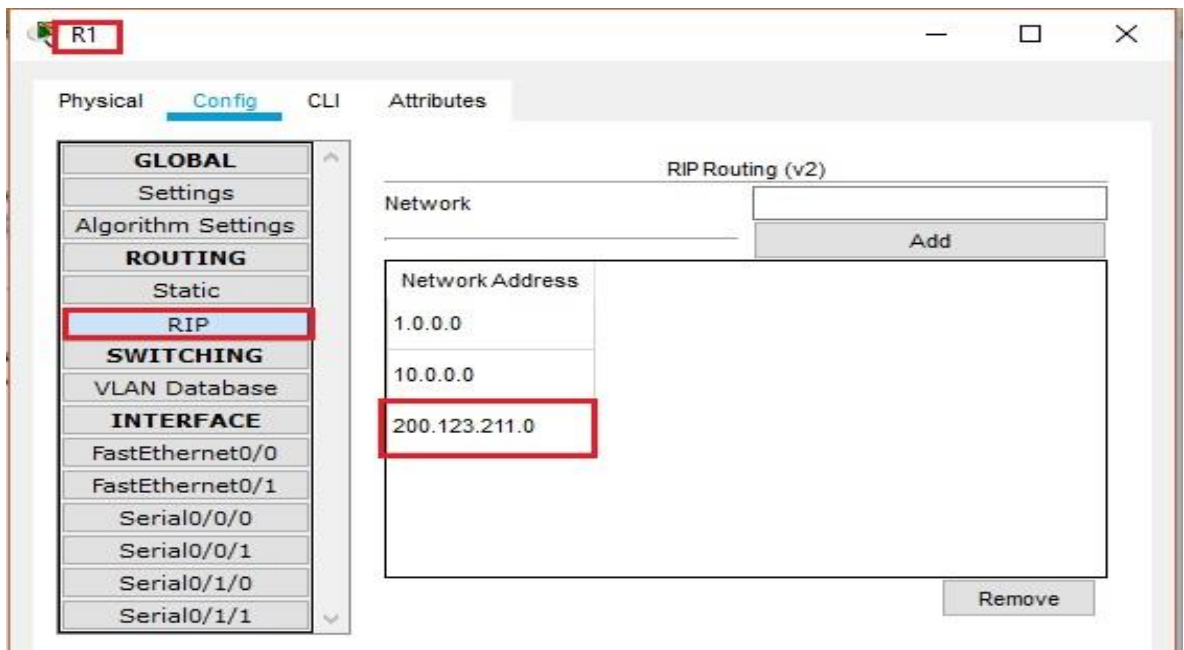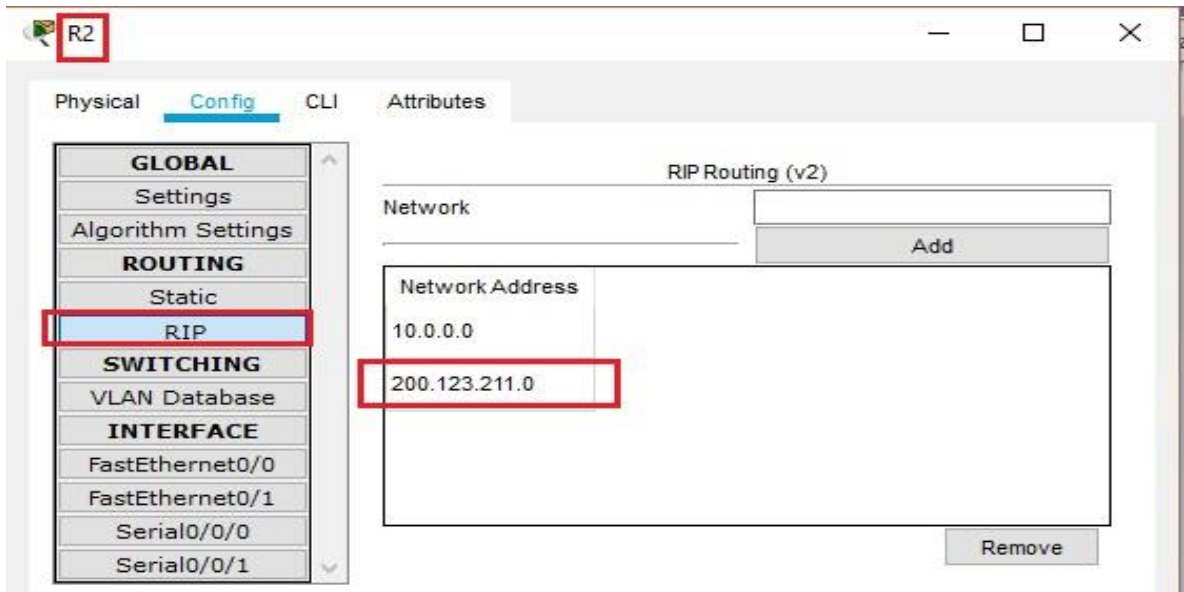
- Verifique la conectividad. Todos los terminales deben poder hacer ping entre sí y a la dirección IP del ISP. Los terminales bajo **el R3** deberían poder hacer IPv6-ping entre ellos y el servidor.

Successful	R1	ISP	ICMP	🟨	0.000	N	24
Failed	ISP	Laptop31	ICMP	🟦	0.000	N	25
Failed	ISP	Laptop30	ICMP	🟫	0.000	N	26
Failed	ISP	PC31	ICMP	🟦	0.000	N	27
Failed	ISP	PC30	ICMP	🟦	0.000	N	28
Failed	ISP	Laptop21	ICMP	▫	0.000	N	29
Failed	ISP	Laptop20	ICMP	🟥	0.000	N	30
Failed	ISP	PC21	ICMP	🟩	0.000	N	31
Failed	ISP	PC20	ICMP	🟪	0.000	N	32
Failed	SW2	ISP	ICMP	🟩	0.000	N	33
Failed	SW2	PC21	ICMP	🟩	0.000	N	34
Successful	Lapto...	Laptop21	ICMP	🟦	0.000	N	35

Ping

```
C:\>ping FE80::2E0:F9FF:FE2E:A20E

Pinging FE80::2E0:F9FF:FE2E:A20E with 32 bytes of data:

Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128

Ping statistics for FE80::2E0:F9FF:FE2E:A20E:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Ping del PC30 al Server0

```
C:\>ping FE80::2E0:F9FF:FE2E:A20E

Pinging FE80::2E0:F9FF:FE2E:A20E with 32 bytes of data:

Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time=1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128

Ping statistics for FE80::2E0:F9FF:FE2E:A20E:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Ping Laptop30 al Server0

```
C:\>ping FE80::2E0:F9FF:FE2E:A20E

Pinging FE80::2E0:F9FF:FE2E:A20E with 32 bytes of data:

Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time=1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128

Ping statistics for FE80::2E0:F9FF:FE2E:A20E:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Ping Laptop31 al Server0

```
C:\>ping FE80::2E0:F9FF:FE2E:A20E

Pinging FE80::2E0:F9FF:FE2E:A20E with 32 bytes of data:

Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time=1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time=1ms TTL=128
Reply from FE80::2E0:F9FF:FE2E:A20E: bytes=32 time<1ms TTL=128

Ping statistics for FE80::2E0:F9FF:FE2E:A20E:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Ping Laptop31 al PC31

```
C:\>ping FE80::20C:85FF:FE03:4271

Pinging FE80::20C:85FF:FE03:4271 with 32 bytes of data:

Reply from FE80::20C:85FF:FE03:4271: bytes=32 time=1ms TTL=128
Reply from FE80::20C:85FF:FE03:4271: bytes=32 time<1ms TTL=128
Reply from FE80::20C:85FF:FE03:4271: bytes=32 time<1ms TTL=128
Reply from FE80::20C:85FF:FE03:4271: bytes=32 time=1ms TTL=128

Ping statistics for FE80::20C:85FF:FE03:4271:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Ping Laptop31 al Laptop30

```
C:\>ping FE80::201:97FF:FE32:6065

Pinging FE80::201:97FF:FE32:6065 with 32 bytes of data:

Reply from FE80::201:97FF:FE32:6065: bytes=32 time=2ms TTL=128
Reply from FE80::201:97FF:FE32:6065: bytes=32 time<1ms TTL=128
Reply from FE80::201:97FF:FE32:6065: bytes=32 time<1ms TTL=128
Reply from FE80::201:97FF:FE32:6065: bytes=32 time<1ms TTL=128

Ping statistics for FE80::201:97FF:FE32:6065:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>
```

Ping Laptop31 al PC30

```
C:\>ping FE80::207:ECFF:FE4A:183C

Pinging FE80::207:ECFF:FE4A:183C with 32 bytes of data:

Reply from FE80::207:ECFF:FE4A:183C: bytes=32 time=1ms TTL=128
Reply from FE80::207:ECFF:FE4A:183C: bytes=32 time<1ms TTL=128
Reply from FE80::207:ECFF:FE4A:183C: bytes=32 time<1ms TTL=128
Reply from FE80::207:ECFF:FE4A:183C: bytes=32 time<1ms TTL=128

Ping statistics for FE80::207:ECFF:FE4A:183C:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Archivo Packet Tracer (Versión 7.2) – Escenario 1

https://drive.google.com/file/d/14p9lYp4urN8DK9RZDyjPJLCbqqeJBoBB/view?usp=sharing

ESCENARIO 2

Escenario: Una empresa de Tecnología posee tres sucursales distribuidas en las ciudades de Miami, Bogotá y Buenos Aires, en donde el estudiante será el administrador de la red, el cual deberá configurar e interconectar entre sí cada uno de los dispositivos que forman parte del escenario, acorde con los lineamientos establecidos para el direccionamiento IP, protocolos de enrutamiento y demás aspectos que forman parte de la topología de red.
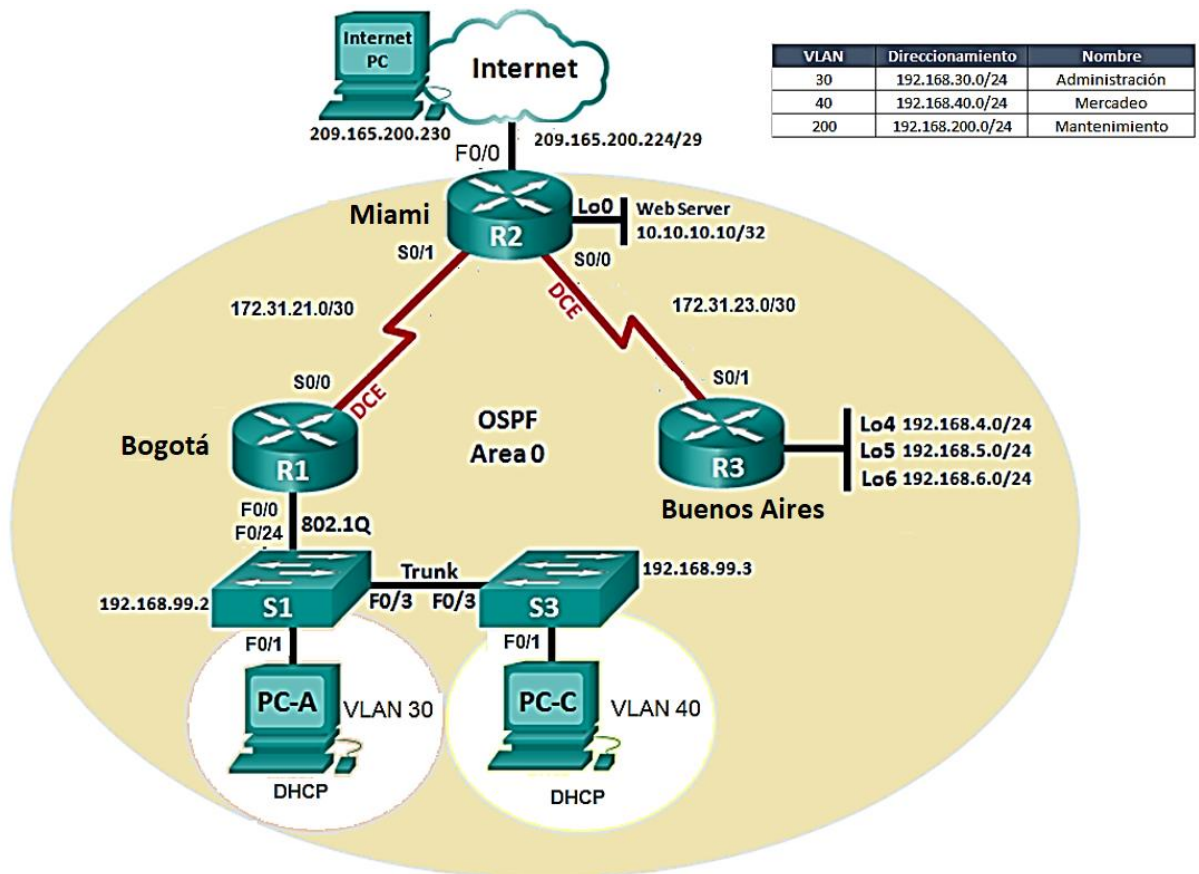
1. Configurar el direccionamiento IP acorde con la topología de red para cada uno de los dispositivos que forman parte del escenario

R1
BOGOTA#enable
BOGOTA#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BOGOTA(config)#int s0/1/0
BOGOTA(config-if)#ip add 172.31.21.1 255.255.255.252
BOGOTA(config-if)#clock rate 64000

BOGOTA(config-if)#no shu

R2
Router(config)#hostname MIAMI
MIAMI(config)#int loop0
MIAMI(config-if)#ip add 10.10.10.10 255.255.255.255
MIAMI(config-if)#ip add 10.10.10.10 255.255.255.255
MIAMI(config-if)#no shut
MIAMI(config-if)#int s0/1/0
MIAMI(config-if)#ip add 172.31.23.1 255.255.255.252
MIAMI(config-if)#clock rate 64000
MIAMI(config-if)#no shut
MIAMI(config-if)#int s0/1/1
MIAMI(config-if)#ip add 172.31.21.2 255.255.255.252
MIAMI(config-if)#no shut
MIAMI(config)#int f0/0
MIAMI(config-if)#ip add 209.165.200.255 255.255.255.248
MIAMI(config-if)#no shut
MIAMI(config)#int f0/1
MIAMI(config-if)#ip add 10.10.10.1 255.255.255.248

R3
Router#configure terminal
BUENOS(config)#hostname BUENOSAIRES
BUENOSAIRES(config)#int loop4

BUENOSAIRES(config-if)#
%LINK-5-CHANGED: Interface Loopback4, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback4, changed state
to up

BUENOSAIRES(config-if)#ip add 192.168.4.1 255.255.255.0
BUENOSAIRES(config-if)#no shut
BUENOSAIRES(config-if)#int loop5

BUENOSAIRES(config-if)#
%LINK-5-CHANGED: Interface Loopback5, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback5, changed state
to up

BUENOSAIRES(config-if)#ip add 192.168.5.1 255.255.255.0
BUENOSAIRES(config-if)#no shut
BUENOSAIRES(config-if)#int loop6

BUENOSAIRES(config-if)#
%LINK-5-CHANGED: Interface Loopback6, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback6, changed state to up

BUENOSAIRES(config-if)#ip add 192.168.6.1 255.255.255.0
BUENOSAIRES(config-if)#no shut
BUENOSAIRES(config-if)#int s0/1/1
BUENOSAIRES(config-if)#ip add 172.31.23.2 255.255.255.252
BUENOSAIRES(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/1/1, changed state to down

2. Configurar el protocolo de enrutamiento OSPFv2 bajo los siguientes criterios:

OSPFv2 area 0

Configuration Item or Task	Specification
Router ID R1	1.1.1.1
Router ID R2	5.5.5.5
Router ID R3	8.8.8.8
Configurar todas las interfaces LAN como pasivas	
Establecer el ancho de banda para enlaces seriales en	256 Kb/s
Ajustar el costo en la métrica de S0/0 a	9500

R1
BOGOTA>enable
BOGOTA#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BOGOTA(config)#router ospf 1
BOGOTA(config-router)#router-id 1.1.1.1
BOGOTA(config-router)#Reload or use "clear ip ospf process" command, for this to take effect

BOGOTA(config-router)#network 192.168.99.0 0.0.0.255 area 0
BOGOTA(config-router)#network 172.31.21.0 0.0.0.3 area 0
BOGOTA(config-router)#passive-interface f0/0
BOGOTA(config-router)#int s0/1/0
BOGOTA(config-if)#bandwidth 128
BOGOTA(config-if)#ip ospf cost 7500
BOGOTA(config-if)#int s0/1/1
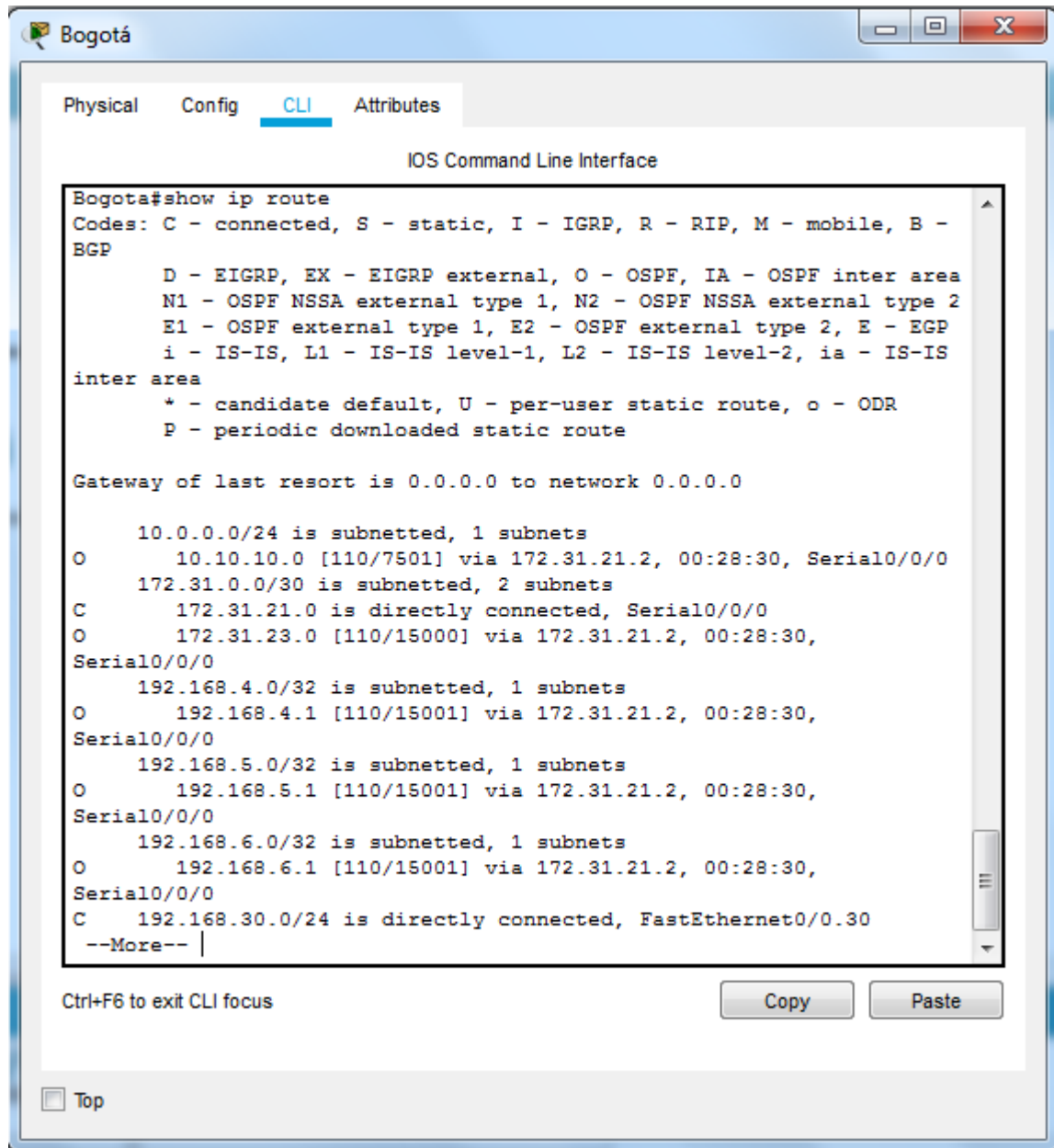
BOGOTA(config-if)#bandwidth 128
BOGOTA(config-if)#

R2

MIAMI>enable
MIAMI#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
MIAMI(config)#router ospf 1
MIAMI(config-router)#router-id 2.2.2.2
MIAMI(config-router)#network 209.165.200.224 0.0.0.7 area 0
MIAMI(config-router)#network 172.31.21.0 0.0.0.3 area 0
MIAMI(config-router)#network 10.10.10.10 0.0.0.3 area 0
MIAMI(config-router)#passive-interface f0/0
MIAMI(config-router)#int s0/1/0
MIAMI(config-if)#bandwidth 128
MIAMI(config-if)#ip ospf cost 7500
MIAMI(config-if)#int s0/1/1
MIAMI(config-if)#bandwidth 128
MIAMI(config-if)#

R3

BUENOSAIRES>enable
BUENOSAIRES#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BUENOSAIRES(config)#router ospf 1
BUENOSAIRES(config-router)#router-id 3.3.3.3
BUENOSAIRES(config-router)#network 172.31.23.0 0.0.0.3 area 0
BUENOSAIRES(config-router)#network 192.168.4.0 0.0.0.255 area 0
BUENOSAIRES(config-router)#network 192.168.5.0 0.0.0.255 area 0
BUENOSAIRES(config-router)#network 192.168.6.0 0.0.0.255 area 0
BUENOSAIRES(config-router)#int s0/1/0
BUENOSAIRES(config-if)#bandwidth 128
BUENOSAIRES(config-if)#ip ospf cost 7500
BUENOSAIRES(config-if)#int s0/1/1
BUENOSAIRES(config-if)#bandwidth 128
BUENOSAIRES(config-if)#

Verificar información de OSPF

- Visualizar tablas de enrutamiento y routers conectados por OSPFv2

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
Miami#show ip route
Codes: C - connected, S - static, I - IGRP, 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 0.0.0.0 to network 0.0.0.0

     10.0.0.0/24 is subnetted, 1 subnets
C       10.10.10.0 is directly connected, FastEthernet0/1
     172.31.0.0/30 is subnetted, 2 subnets
C       172.31.21.0 is directly connected, Serial0/0/1
C       172.31.23.0 is directly connected, Serial0/0/0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.1 [110/7501] via 172.31.23.2, 00:27:29, Serial0/0/0
     192.168.5.0/32 is subnetted, 1 subnets
O       192.168.5.1 [110/7501] via 172.31.23.2, 00:27:29, Serial0/0/0
     192.168.6.0/32 is subnetted, 1 subnets
O       192.168.6.1 [110/7501] via 172.31.23.2, 00:27:29, Serial0/0/0
O    192.168.30.0/24 [110/65] via 172.31.21.1, 00:27:29, Serial0/0/1
```

Ctrl+F6 to exit CLI focus   Copy   Paste

☐ Top

- Visualizar lista resumida de interfaces por OSPF en donde se ilustre el costo de cada interface

- Visualizar el OSPF Process ID, Router ID, Address summarizations, Routing Networks, and passive interfaces configuradas en cada router

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
Bogota(config-router)#do sh ip ospf interface

Serial0/0/0 is up, line protocol is up
  Internet address is 172.31.21.1/30, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type POINT-TO-POINT, Cost:
7500
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit
5
    Hello due in 00:00:05
  Index 1/1, 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 2.2.2.2
  Suppress hello for 0 neighbor(s)
FastEthernet0/0.30 is up, line protocol is up
  Internet address is 192.168.30.1/24, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 1.1.1.1, Interface address 192.168.30.1
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit
5
    No Hellos (Passive interface)
  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 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
FastEthernet0/0.40 is up, line protocol is up
```

Ctrl+F6 to exit CLI focus   Copy   Paste

☐ Top

32

Miami

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
Miami(config-router)#do sh ip ospf interface

FastEthernet0/1 is up, line protocol is up
  Internet address is 10.10.10.1/24, Area 0
  Process ID 1, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 2.2.2.2, Interface address 10.10.10.1
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit
5
    No Hellos (Passive interface)
  Index 1/1, 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 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 172.31.23.1/30, Area 0
  Process ID 1, Router ID 2.2.2.2, Network Type POINT-TO-POINT, Cost:
7500
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit
5
    Hello due in 00:00:00
  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 3.3.3.3
```

Ctrl+F6 to exit CLI focus   Copy   Paste

☐ Top
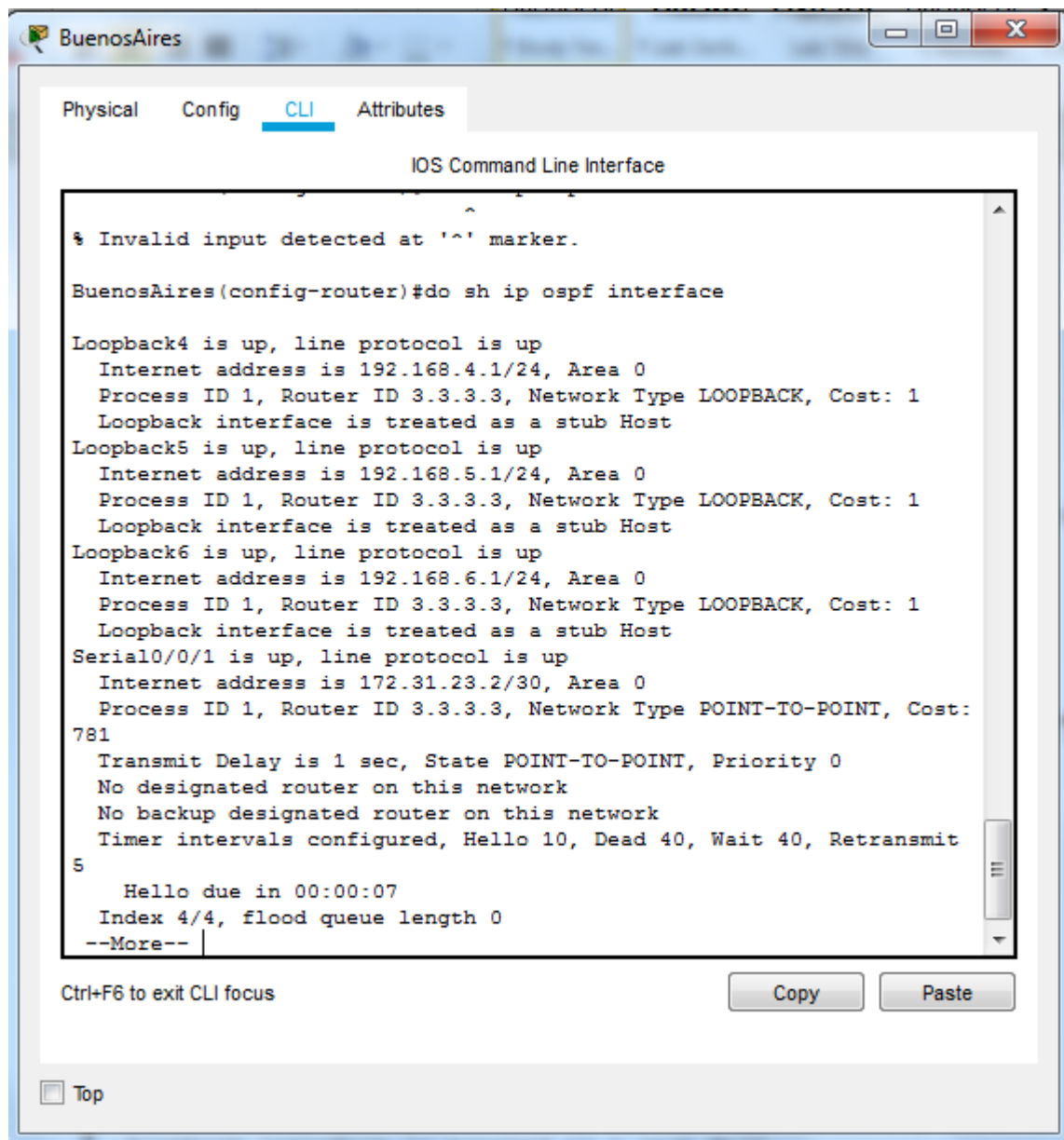
3. Configurar VLANs, Puertos troncales, puertos de acceso, encapsulamiento, Inter-VLAN Routing y Seguridad en los Switches acorde a la topología de red establecida.

S1

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)#name Administracion

Switch(config)#vlan 40
Switch(config-vlan)#name Mercadeo
Switch(config)#vlan 200
Switch(config-vlan)#name Mantenimiento
Switch(config-vlan)#exit

S2
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)#name Administracion
Switch(config)#vlan 40
Switch(config-vlan)#name Mercadeo
Switch(config)#vlan 200
Switch(config-vlan)#name Mantenimiento
Switch(config-vlan)#

```
Switch#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                Gig0/1, Gig0/2
40   Mercadeo                         active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
Switch#
```

Se configura la seguridad

Switch(config)#line console 0
Switch(config-line)#pass cisco
Switch(config-line)#line vty 04
Switch(config-line)#pass cisco
Switch(config-line)#enable secret cisco
Switch(config)#

Se configura en el switch las interfaces que pertenecen a cada VLAN

Switch(config)#interface range fa0/1
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#exit
Switch(config)#

Se fonfigura la encapsulación en los troncales:

BOGOTA>enable
BOGOTA#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BOGOTA(config)#interface f0/0
BOGOTA(config-if)#no shutdown
BOGOTA(config-if)#exit
BOGOTA(config)#interface f0/0.3
BOGOTA(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.3,
changed state to up

BOGOTA(config-subif)#encapsulation dot1Q 30
BOGOTA(config-subif)#ip address 192.168.30.1 255.255.255.0
BOGOTA(config-subif)#interface f0/0.4
BOGOTA(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.4, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.4,
changed state to up

BOGOTA(config-subif)#encapsulation dot1Q 40
BOGOTA(config-subif)#ip address 192.168.40.1 255.255.255.0
BOGOTA(config-subif)#exit
BOGOTA(config)#

4. En el Switch 3 deshabilitar DNS lookup

no ip domain-lookup

```
Switch(config)#no ip domain-lookup
Switch(config)#
```

5. Asignar direcciones IP a los Switches acorde a los lineamientos.

Switch(config)#no ip domain-lookup
Switch(config)#int vlan 1
Switch(config-if)#ip address 192.168.99.3 255.255.255.0
Switch(config-if)#

6. Desactivar todas las interfaces que no sean utilizadas en el esquema de red.

A través de la interfaz se procede con la desactivación

MIAMI(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

7. Implement DHCP and NAT for IPv4

8. Configurar R1 como servidor DHCP para las VLANs 30 y 40.

BOGOTA(config)#ip dhcp pool vlan30
BOGOTA(dhcp-config)#network 192.168.30.0 255.255.255.0
BOGOTA(dhcp-config)#default-router 192.168.30.1
BOGOTA(dhcp-config)#ip dhcp pool vlan40
BOGOTA(dhcp-config)#network 192.168.40.0 255.255.255.0
BOGOTA(dhcp-config)#default-router 192.168.40.1
BOGOTA(dhcp-config)#ip dhcp pool vlan200
BOGOTA(dhcp-config)#network 192.168.200.0 255.255.255.0
BOGOTA(dhcp-config)#default-router 192.168.200.1
BOGOTA(dhcp-config)#

9. Reservar las primeras 30 direcciones IP de las VLAN 30 y 40 para configuraciones estáticas.

Configurar DHCP pool para VLAN 30	Name: ADMINISTRACION DNS-Server: 10.10.10.11 Domain-Name: ccna-unad.com Establecer default gateway.

	Name: MERCADEO
Configurar DHCP pool para VLAN 40	DNS-Server: 10.10.10.11 Domain-Name: ccna-unad.com Establecer default gateway.

BOGOTA(dhcp-config)#ip dhcp excluded-address 192.168.30.1 192.168.30.30
BOGOTA(config)#ip dhcp excluded-address 192.168.40.1 192.168.40.30

10. Configurar NAT en R2 para permitir que los host puedan salir a internet

MIAMI(config)#
MIAMI(config)#interface FastEthernet0/0
MIAMI(config-if)#ip nat inside
MIAMI(config)#interface Serial0/1/0
MIAMI(config-if)#ip nat outside
MIAMI(config-if)#interface Serial0/1/1
MIAMI(config-if)#ip nat outside
MIAMI(config-if)#exit
MIAMI(config)#

11. Configurar al menos dos listas de acceso de tipo estándar a su criterio en para restringir o permitir tráfico desde R1 o R3 hacia R2.

BUENOSAIRES(config)#access-list 102 deny icmp any 192.168.3.1 0.0.0.255
BUENOSAIRES(config)#access-list 102 deny icmp any 192.168.4.1 0.0.0.255
BUENOSAIRES(config)#do show access
Extended IP access list 102
    10 deny icmp any 192.168.3.0 0.0.0.255
    20 deny icmp any 192.168.4.0 0.0.0.255
BUENOSAIRES(config)#

12. Configurar al menos dos listas de acceso de tipo extendido o nombradas a su criterio en para restringir o permitir tráfico desde R1 o R3 hacia R2.

BOGOTA>enable
BOGOTA#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BOGOTA(config)#access-list 102 deny icmp any 192.168.5.1 0.0.0.255
BOGOTA(config)#access-list 102 deny icmp any 192.168.6.1 0.0.0.255
BOGOTA(config)#do show access
Extended IP access list 102
    10 deny icmp any 192.168.5.0 0.0.0.255
    20 deny icmp any 192.168.6.0 0.0.0.255
BOGOTA(config)#

PC-A

Physical Config **Desktop** Programming Attributes

- ● DHCP   ○ Static

IP Address	192.168.30.31
Subnet Mask	255.255.255.0
Default Gateway	192.168.30.1
DNS Server	10.10.10.11

IPv6 Configuration

- ○ DHCP   ○ Auto Config   ● Static

IPv6 Address	/
Link Local Address	FE80::2E0:A3FF:FEC9:9100
IPv6 Gateway	
IPv6 DNS Server	

802.1X

- ☐ Use 802.1X Security

Authentication	MD5
Username	
Password	

☐ Top

PC-C

Physical Config **Desktop** Programming Attributes

- ● DHCP   ○ Static

IP Address	192.168.40.31
Subnet Mask	255.255.255.0
Default Gateway	192.168.40.1
DNS Server	10.10.10.11

IPv6 Configuration

- ○ DHCP   ○ Auto Config   ● Static

IPv6 Address	/
Link Local Address	FE80::202:16FF:FE32:8084
IPv6 Gateway	
IPv6 DNS Server	

802.1X

- ☐ Use 802.1X Security

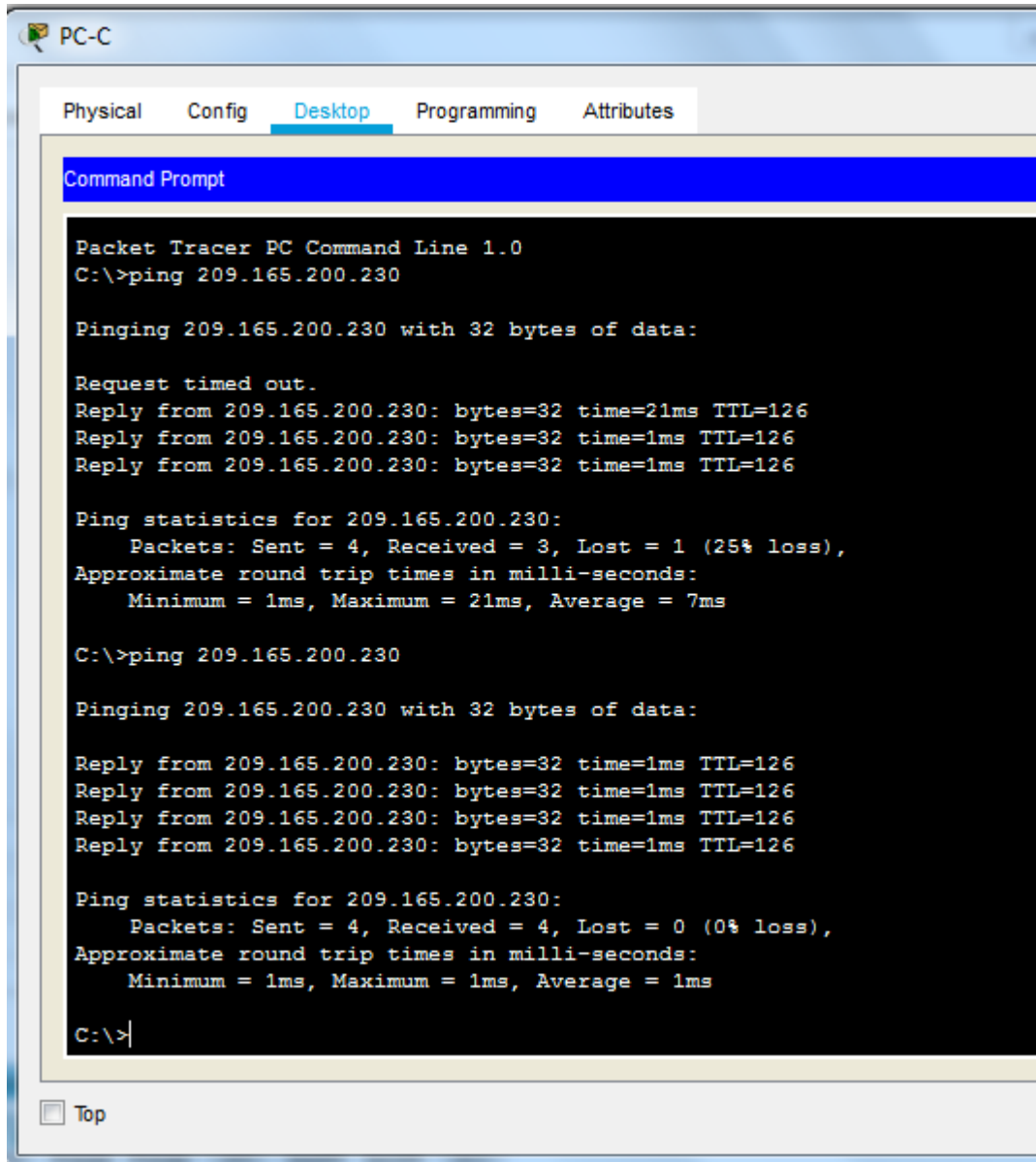|	
Authentication	MD5
Username	
Password	

☐ Top

13. Verificar procesos de comunicación y redireccionamiento de tráfico en los routers mediante el uso de Ping y Traceroute.

PC-C

Physical   Config   Desktop   Programming   Attributes

Command Prompt

```
Reply from 209.165.200.230: bytes=32 time=1ms TTL=126
Reply from 209.165.200.230: bytes=32 time=1ms TTL=126
Reply from 209.165.200.230: bytes=32 time=1ms TTL=126
Reply from 209.165.200.230: bytes=32 time=1ms TTL=126

Ping statistics for 209.165.200.230:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\>
C:\>ping 209.165.200.225

Pinging 209.165.200.225 with 32 bytes of data:

Reply from 209.165.200.225: bytes=32 time=2ms TTL=254
Reply from 209.165.200.225: bytes=32 time=4ms TTL=254
Reply from 209.165.200.225: bytes=32 time=1ms TTL=254
Reply from 209.165.200.225: bytes=32 time=2ms TTL=254

Ping statistics for 209.165.200.225:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 4ms, Average = 2ms

C:\>
```
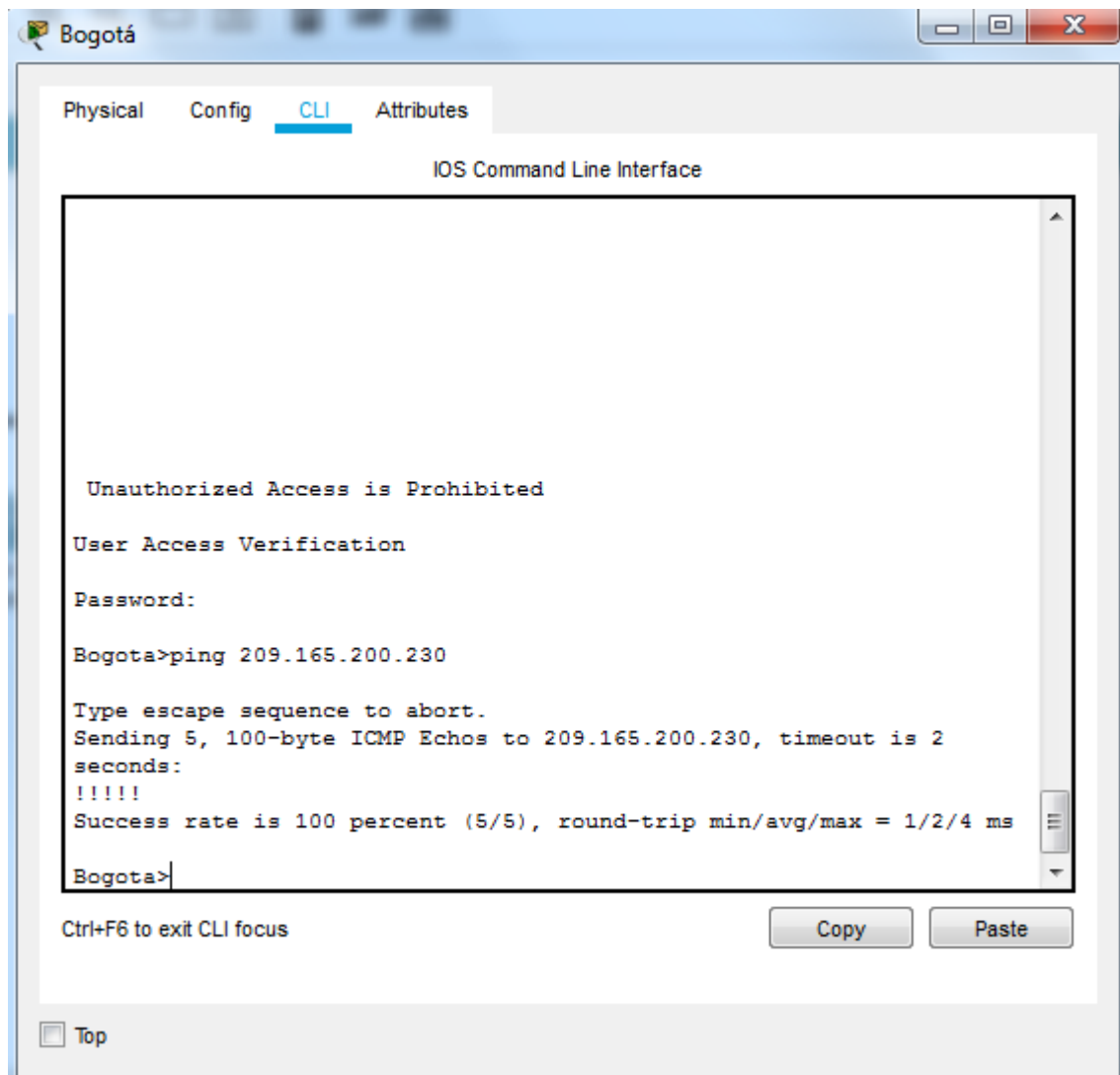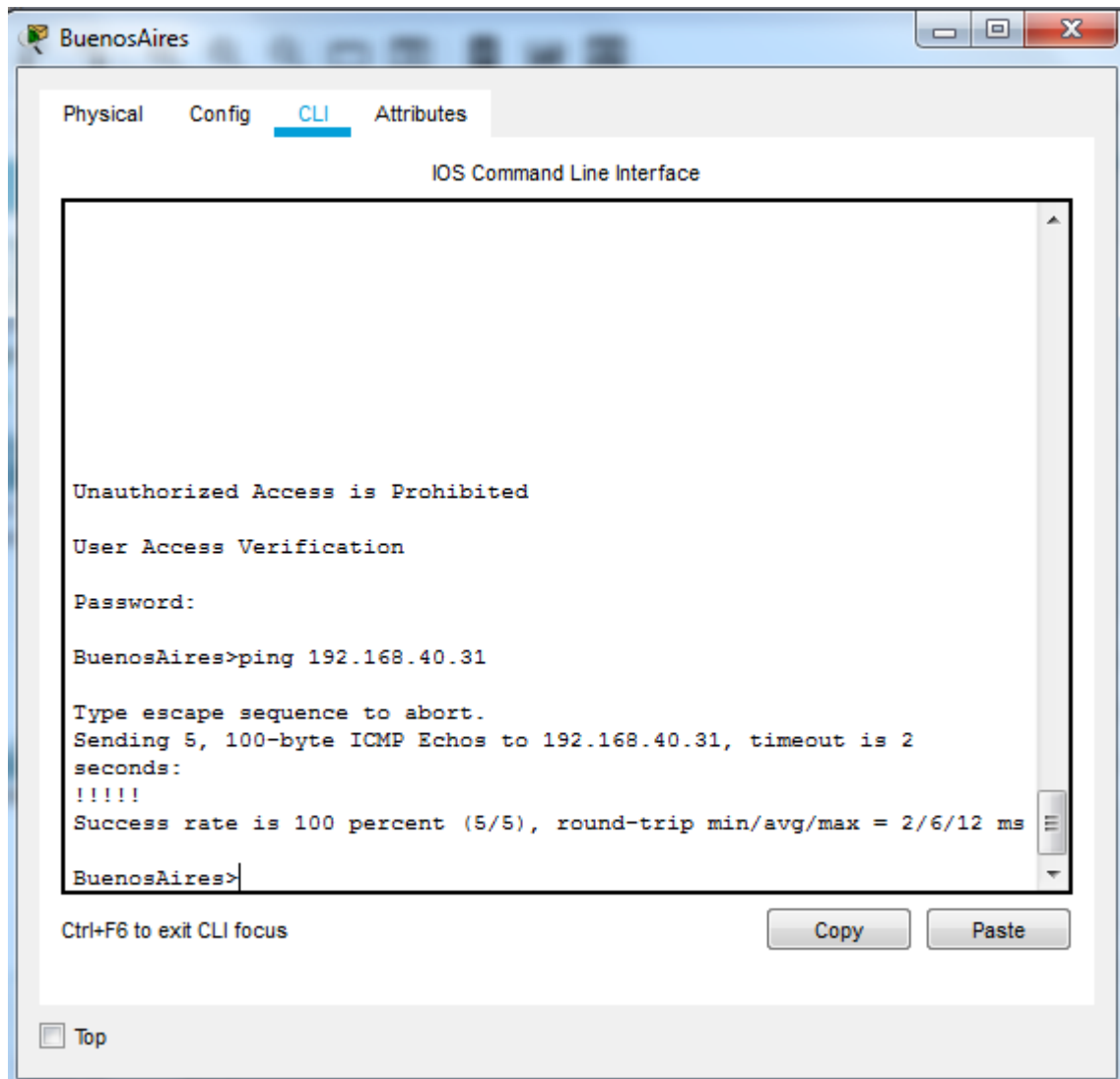
☐ Top

Bogotá ⬜ ⬛ ✖

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
 Unauthorized Access is Prohibited

User Access Verification

Password:

Bogota>ping 209.165.200.230

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.200.230, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Bogota>
```

Ctrl+F6 to exit CLI focus   Copy   Paste

⬜ Top

Archivo Packet Tracer (Versión 7.2) – Escenario 2

https://drive.google.com/file/d/1O2E7VPqT6gVK9ebFv1R-5IxJSlisxtoO/view?usp=sharing

CONCLUSIONES

- Con la ejecución de la práctica de habilidades en sus dos escenarios, se aplicaron los conceptos estudiados a lo largo del curso, lo cual nos da las bases para incentivarnos en la gran rama de las redes de sistemas del diseño e implementación de soluciones integradas lan / wan.

- La practica de habilidades CCNA se ejecuto en su totalidad y se complementa con evidencias de su ejecución de cada uno de sus escenarios implementando NAT, servidor de DHCP, RIPV2 y el routing entre VLAN, configuración de direcciones IP y su posterior verificación de la correcta implementación usando ping.

- Con el uso del protocolo DHCP en los escenarios de las practicas, nos ayuda ahorrar tiempo gestionando las direcciones IP de los equipos en una red grande. De igual forma con el servicio DHCP podemos tener centralizada la administración de las direcciones IP.

- El protocolo OSPF gestiona un sistema autónomo (AS) en áreas, las cuales son grupos de router para direccionadores o sistemas de la misma área que mantienen una base de datos de enlace-estado, también podemos identificar que describe la topología del área OSPF para proporcionarnos un direccionamiento multivía de coste equivalente. Se pueden añadir rutas duplicadas a la pila TCP utilizando saltos siguientes distintos y mantenerlas separadas para disminuir el tráfico de direccionamiento de OSPF y el tamaño de la base de datos de enlace-estado de cada área.

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