

DIPLOMADO DE PROFUNDIZACION CISCO PRUEBA DE HABILIDADES
PRÁCTICAS CCNP

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UNIVERSIDAD NACIONAL ABIERTA Y A DISTANCIA - UNAD
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2022

NOTA DE ACEPTACIÓN

Firma del Presidente del Jurado

Firma del Jurado

Firma del Jurado

BUENAVENTURA, 27 noviembre de 2022

AGRADECIMIENTOS

Quiero iniciar mis agradecimientos a Dios, quien con sus bendiciones nos llena la vida para culminar con éxito todo lo propuesto, a toda mi familia por brindarme el apoyo para culminar esta carrera.

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GLOSARIO

Switch: Es un dispositivo de interconexión utilizado para conectar equipos en red formando lo que se conoce como una red de área local (LAN) y cuyas especificaciones técnicas siguen el estándar conocido como Ethernet (o técnicamente IEEE 802.3).

EtherChannel: Agregación de enlaces IEEE 802.3ad y Teaming son tecnologías de agregación de puertos de red que permiten la agregación de varios adaptadores Ethernet juntos para formar un solo dispositivo pseudo Ethernet.

PAgP: Es un protocolo exclusivo de Cisco que ayuda en la creación automática de enlaces EtherChannel.

LACP: Protocolo de control de agregación de enlaces.

Interfaces de un Switch: Son interfaces que participan del reenvío de paquetes IP a partir de la dirección IP de destino de cada paquete y tomando en cuenta las rutas que se encuentran definidas en la tabla de enrutamiento IP.

RESUMEN

Cisco es una academia que permite a todas las personas interesadas en aprender el funcionamiento y configuración de las redes informáticas que son la revolución de la Industria 4.0, esta plataforma es de gran ayuda por aplicaciones que permiten desarrollar los laboratorios con sus máquinas virtuales las cuales son muy acertadas a la realidad.

El avance tecnológico que se ha tenido en los últimos años, obliga a las empresas a la actualización de sus sistemas de comunicación y herramientas de trabajo, las cuales se pueden integrar y conmutar todos sus servicios y empleados desde diferentes ubicaciones, el enrutamiento de estos servicios permite un acceso seguro a las aplicaciones de la empresa desde cualquier punto autorizado.

ABSTRACT

Cisco is an academy that allows all people interested in learning the operation and configuration of computer networks that are the revolution of Industry 4.0, this platform is of great help for applications that allow the development of laboratories with their virtual machines which are very accurate to reality.

The technological progress that has taken place in recent years forces companies to update their communication systems and work tools, which can integrate and switch all their services and employees from different locations, the routing of these services allows secure access to company applications from any authorized point.

INTRODUCCIÓN

Las plataformas de simulación de red nos brindan la oportunidad de aprender de manera remota el funcionamiento de las redes informáticas, el diplomado CCNP se abordan conceptos claros de enrutamiento, redistribución de rutas, establece niveles de seguridad básicos, diseño de redes escalables mediante el uso del modelo jerárquico de tres niveles.

La configuración de los diferentes dispositivos en el programa GNS3, permite el desarrollo del siguiente laboratorio el cual consiste en un enrutamiento por ipv4, ipv6, vlan, estructurando una red conmutada mediante el uso de protocolo ST y la configuración de Vlans, lo que permite comprender las características de una infraestructura de red jerárquica convergente.

DESARROLLO

1. ESCENARIO 1

Tabla 1. Port Channel Table

Device	Interface	IPv4 Address	IPv6 Address	IPv6 Link-Local
R1	E1/0	209.165.200.225 /27	2001:db8:200::1/64	fe80::1:1
	E1/2	10.XY.10.1/24	2001:db8:100:1010::1/ 64	fe80::1:2
	E1/1	10. XY.13.1/24	2001:db8:100:1013::1/ 64	fe80::1:3
R2	E1/0	209.165.200.226 /27	2001:db8:200::2/64	fe80::2:1
	Loopback0	2.2.2.2/32	2001:db8:2222::1/128	fe80::2:3
R3	E1/0	10. XY.11.1/24	2001:db8:100:1011::1/ 64	fe80::3:2
	E1/1	10. XY.13.3/24	2001:db8:100:1013::3/ 64	fe80::3:3
D1	E1/2	10. XY.10.2/24	2001:db8:100:1010::2/ 64	fe80::d1:1
	VLAN 100	10. XY.100.1/24	2001:db8:100:100::1/6 4	fe80::d1:2
	VLAN 101	10.XY.101.1/24	2001:db8:100:101::1/6 4	fe80::d1:3
	VLAN 102	10.XY.102.1/24	2001:db8:100:102::1/6 4	fe80::d1:4
D2	E1/0	10.XY.11.2/24	2001:db8:100:1011::2/ 64	fe80::d2:1
	VLAN 100	10.XY.100.2/24	2001:db8:100:100::2/6 4	fe80::d2:2
	VLAN 101	10.XY.101.2/24	2001:db8:100:101::2/6 4	fe80::d2:3

Device	Interface	IPv4 Address	IPv6 Address	IPv6 Link-Local
	VLAN 102	10.XY.102.2/24	2001:db8:100:102::2/64	fe80::d2:4
A1	VLAN 100	10.XY.100.3/23	2001:db8:100:100::3/64	fe80::a1:1
PC1	NIC	10.XY.100.5/24	2001:db8:100:100::5/64	EUI-64
PC2	NIC	DHCP	SLAAC	EUI-64
PC3	NIC	DHCP	SLAAC	EUI-64
PC4	NIC	10.0.100.6/24	2001:db8:100:100::6/64	EUI-64

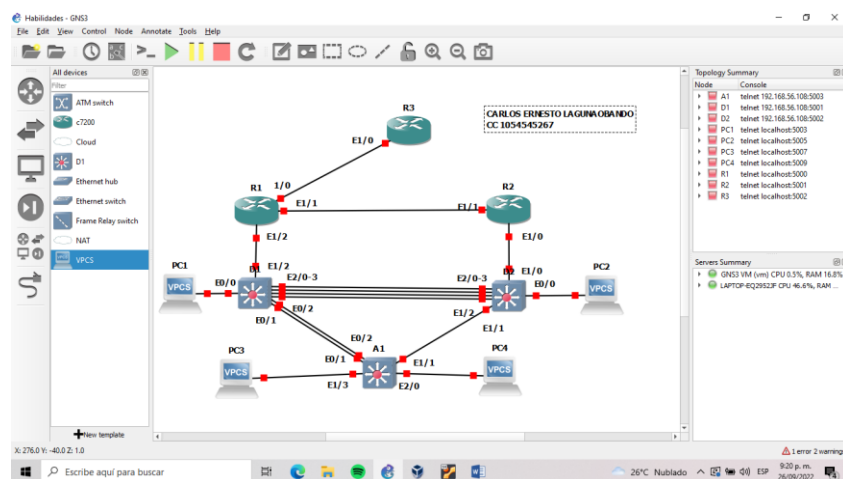
Build the Network and Configure Basic Device Settings and Interface Addressing

In Part 1, you will set up the network topology and configure basic settings and interface addressing.

Cable the network as shown in the topology.

Attach the devices as shown in the topology diagram, and cable as necessary.

Figura N°1 Escenario 1



Fuente: Autoría Propia

Step 1: Configure basic settings for each device.

- a. Console into each device, enter global configuration mode, and apply the basic settings. The startup configurations for each device are provided below.

Router R1

```
enable
config terminal
  hostname R1
  ipv6 unicast-routing
  no ip domain lookup
  banner motd # R1, ENCOR Skills Assessment#
  line con 0
    exec-timeout 0 0
  logging synchronous
  exit

interface e1/0
  ip address 209.165.200.225 255.255.255.224
  ipv6 address fe80::1:1 link-local
  ipv6 address 2001:db8:200::1/64
  no shutdown
  exit

interface e1/2
  ip address 10.67.10.1 255.255.255.0
  ipv6 address fe80::1:2 link-local
  ipv6 address 2001:db8:100:1010::1/64
  no shutdown
  exit

interface e1/1
  ip address 10.67.13.1 255.255.255.0
  ipv6 address fe80::1:3 link-local
  ipv6 address 2001:db8:100:1013::1/64
  no shutdown
exit
```

Router R2

```
enable
config terminal
  hostname R2
  ipv6 unicast-routing
```

```
no ip domain lookup
banner motd # R2, ENCOR Skills Assessment#
line con 0
  exec-timeout 0 0
  logging synchronous
exit
```

```
interface e1/0
ip address 209.165.200.226 255.255.255.224
ipv6 address fe80::2:1 link-local
ipv6 address 2001:db8:200::2/64
no shutdown
exit
```

```
interface Loopback 0
ip address 2.2.2.2 255.255.255.255
ipv6 address fe80::2:3 link-local
ipv6 address 2001:db8:2222::1/128
no shutdown
exit
```

Router R3

```
enable
config terminal
hostname R3
ipv6 unicast-routing
no ip domain lookup
banner motd # R3, ENCOR Skills Assessment#
line con 0
  exec-timeout 0 0
  logging synchronous
exit
```

```
interface e1/0
ip address 10.67.11.1 255.255.255.0
ipv6 address fe80::3:2 link-local
ipv6 address 2001:db8:100:1011::1/64
no shutdown
exit
```

```
interface e1/1
ip address 10.67.13.3 255.255.255.0
ipv6 address fe80::3:3 link-local
```

```
ipv6 address 2001:db8:100:1010::2/64
no shutdown
exit
```

Switch D1

```
enable
config terminal
hostname D1
ip routing
ipv6 unicast-routing
no ip domain lookup
banner motd # D1, ENCOR Skills Assessment#
line con 0
  exec-timeout 0 0
  logging synchronous
exit
vlan 100
  name Management
exit
vlan 101
  name UserGroupA
exit
vlan 102
  name UserGroupB
exit
vlan 999
  name NATIVE
exit
interface e1/2
  no switchport
  ip address 10.67.10.2 255.255.255.0
  ipv6 address fe80::d1:1 link-local
  ipv6 address 2001:db8:100:1010::2/64
  no shutdown
exit
interface vlan 100
  ip address 10.67.100.1 255.255.255.0
  ipv6 address fe80::d1:2 link-local
  ipv6 address 2001:db8:100:100::1/64
  no shutdown
exit
interface vlan 101
  ip address 10.67.101.1 255.255.255.0
```

```

ipv6 address fe80::d1:3 link-local
ipv6 address 2001:db8:100:101::1/64
no shutdown
exit
interface vlan 102
ip address 10.67.102.1 255.255.255.0
ipv6 address fe80::d1:4 link-local
ipv6 address 2001:db8:100:102::1/64
no shutdown
exit

ip dhcp excluded-address 10.67.101.1 10.67.101.109
ip dhcp excluded-address 10.67.101.141 10.67.101.254
ip dhcp excluded-address 10.67.102.1 10.67.102.109
ip dhcp excluded-address 10.67.102.141 10.67.102.254
ip dhcp pool VLAN-101
network 10.67.101.0 255.255.255.0
default-router 10.67.101.254
exit
ip dhcp pool VLAN-102
network 10.67.102.0 255.255.255.0
default-router 10.67.102.254
exit
interface range e0/0-3,e1/0-1,e1/3,e2/0-3,e3/0-3
shutdown
exit

```

Switch D2

```

enable
config terminal
  hostname D2
  ip routing
  ipv6 unicast-routing
  no ip domain lookup
  banner motd # D2, ENCOR Skills Assessment#
  line con 0
    exec-timeout 0 0
  logging synchronous
  exit
  vlan 100
  name Management
  exit
  vlan 101
  name UserGroupA

```



```
exit
vlan 102
name UserGroupB
exit
vlan 999
name NATIVE
exit
interface e1/0
no switchport
ip address 10.67.11.2 255.255.255.0
ipv6 address fe80::d1:1 link-local
ipv6 address 2001:db8:100:1011::2/64
no shutdown
exit
interface vlan 100
ip address 10.67.100.2 255.255.255.0
ipv6 address fe80::d2:2 link-local
ipv6 address 2001:db8:100:100::2/64
no shutdown
exit
interface vlan 101
ip address 10.67.101.2 255.255.255.0
ipv6 address fe80::d2:3 link-local
ipv6 address 2001:db8:100:101::2/64
no shutdown
exit
interface vlan 102
ip address 10.67.102.2 255.255.255.0
ipv6 address fe80::d2:4 link-local
ipv6 address 2001:db8:100:102::2/64
no shutdown
exit
ip dhcp excluded-address 10.67.101.1 10.67.101.209
ip dhcp excluded-address 10.67.101.241 10.67.101.254
ip dhcp excluded-address 10.67.102.1 10.67.102.209
ip dhcp excluded-address 10.67.102.241 10.67.102.254
ip dhcp pool VLAN-101
network 10.67.101.0 255.255.255.0
default-router 10.67.101.254
exit
ip dhcp pool VLAN-102
network 10.67.102.0 255.255.255.0
default-router 10.67.102.254
exit
```

```
interface range e0/0-3,e1/1-3,e2/0-3,e3/0-3
shutdown
exit
```

Switch A1

```
enable
config terminal
hostname A1
no ip domain lookup
banner motd # A1, ENCOR Skills Assessment#
line con 0
exec-timeout 0 0
logging synchronous
exit
vlan 100
name Management
exit
vlan 101
name UserGroupA
exit
vlan 102
name UserGroupB
exit
vlan 999
name NATIVE
exit
interface vlan 100
ip address 10.67.100.3 255.255.255.0
ipv6 address fe80::a1:1 link-local
ipv6 address 2001:db8:100:100::3/64
no shutdown
exit
interface range e0/0,e0/3,e1/0,e2/1-3,e3/0-3
shutdown
exit
```

Figura 2. Configuración R1

```
R1#
R1#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#
R1(config)#ipv6 unicast-routing
R1(config)#no ip domain lookup
R1(config)#banner motd # R1, ENCOR Skills Assessment#
R1(config)#line con 0
R1(config-line)# exec-timeout 0 0
R1(config-line)# logging synchronous
R1(config-line)# exit
R1(config)#interface e1/0
R1(config-if)# ip address 209.165.200.225 255.255.255.224
R1(config-if)# ipv6 address fe80::1:1 link-local
R1(config-if)# ipv6 address 2001:db8:200::1/64
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)#interface e1/2
R1(config-if)# ip address 10.67.10.1 255.255.255.0
R1(config-if)# ipv6 address fe80::1:2 link-local
R1(config-if)# ipv6 address 2001:db8:100:1010::1/64
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)#interface e1/1
R1(config-if)# ip address 10.67.13.1 255.255.255.0
R1(config-if)# ipv6 address fe80::1:3 link-local
R1(config-if)# ipv6 address 2001:db8:100:1013::1/64
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)#
R1(config)#
R1(config)#
```

Fuente: Autoría Propia

Figura 3. Configuración R2

```
R2#
R2#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#
R2(config)#hostname R2
R2(config)#ipv6 unicast-routing
R2(config)#no ip domain lookup
R2(config)#banner motd # R3, ENCOR Skills Assessment#
R2(config)#line con 0
R2(config-line)# exec-timeout 0 0
R2(config-line)# logging synchronous
R2(config-line)# exit
R2(config)#interface e1/0
R2(config-if)# ip address 10.67.11.1 255.255.255.0
R2(config-if)# ipv6 address fe80::3:2 link-local
R2(config-if)# ipv6 address 2001:db8:100:1011::1/64
R2(config-if)# no shutdown
R2(config-if)# exit
R2(config)#interface e1/1
R2(config-if)# ip address 10.67.13.3 255.255.255.0
R2(config-if)# ipv6 address fe80::3:3 link-local
R2(config-if)# ipv6 address 2001:db8:100:1010::2/64
R2(config-if)# no shutdown
R2(config-if)# exit
R2(config)#
```

Fuente: Autoría Propia

Figura 4. Configuración R3

```
R3#
R3#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#
R3(config)# hostname R3
R3(config)#ipv6 unicast-routing
R3(config)#no ip domain lookup
R3(config)#banner motd # R2, ENCOR Skills Assessment#
R3(config)#line con 0
R3(config-line)# exec-timeout 0 0
R3(config-line)# logging synchronous
R3(config-line)# exit
R3(config)#interface e1/0
R3(config-if)# ip address 209.165.200.226 255.255.255.224
R3(config-if)# ipv6 address fe80::2:1 link-local
R3(config-if)# ipv6 address 2001:db8:200::2/64
R3(config-if)# no shutdown
R3(config-if)# exit
R3(config)#interface Loopback 0
R3(config-if)# ip address 2.2.2.2 255.255.255.255
R3(config-if)# ipv6 address fe80::2:3 link-local
R3(config-if)# ipv6 address 2001:db8:2222::1/128
R3(config-if)# no shutdown
R3(config-if)# exit
R3(config-if)# exit
R3(config)#
```

Fuente: Autoría Propia

Figura 5. Configuración D1

```
D1#
D1#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
D1(config)#
D1(config)#hostname D1
D1(config)#ip routing
D1(config)#ipv6 unicast-routing
D1(config)#no ip domain lookup
D1(config)#banner motd # D1, ENCOR Skills Assessment#
D1(config)#line con 0
D1(config-line)# exec-timeout 0 0
D1(config-line)# logging synchronous
D1(config-line)# exit
D1(config)#vlan 100
D1(config-vlan)# name Management
D1(config-vlan)# exit
D1(config)#vlan 101
D1(config-vlan)# name UserGroupA
D1(config-vlan)# exit
D1(config)#vlan 102
D1(config-vlan)# name UserGroupB
D1(config-vlan)# exit
D1(config)#vlan 999
D1(config-vlan)# name NATIVE
D1(config-vlan)# exit
D1(config)#interface e1/2
D1(config-if)# no switchport
D1(config-if)# ip address 10.67.10.2 255.255.255.0
D1(config-if)# ipv6 address fe80::d1:1 link-local
D1(config-if)# ipv6 address 2001:db8:100:1010::2/64
D1(config-if)# no shutdown
D1(config-if)# exit
D1(config)#interface vlan 100
D1(config-if)# ip address 10.67.100.1 255.255.255.0
D1(config-if)# ipv6 address fe80::d1:2 link-local
D1(config-if)# ipv6 address 2001:db8:100:100::1/64
D1(config-if)# no shutdown
D1(config-if)# exit
D1(config)#interface vlan 101
D1(config-if)# ip address 10.67.101.1 255.255.255.0
D1(config-if)# ipv6 address fe80::d1:3 link-local
D1(config-if)# ipv6 address 2001:db8:100:101::1/64
```

Fuente: Autoría Propia

Figura 6. Configuración D2

```
D2(config)#hostname D2
D2(config)#ip routing
D2(config)#ipv6 unicast-routing
D2(config)#no ip domain lookup
D2(config)#banner motd # D2, ENCOR Skills Assessment#
D2(config)#line con 0
D2(config-line)# exec-timeout 0 0
D2(config-line)# logging synchronous
D2(config-line)# exit
D2(config)#vlan 100
D2(config-vlan)# name Management
D2(config-vlan)# exit
D2(config)#vlan 101
D2(config-vlan)# name UserGroupA
D2(config-vlan)# exit
D2(config)#vlan 102
D2(config-vlan)# name UserGroupB
D2(config-vlan)# exit
D2(config)#vlan 999
D2(config-vlan)# name NATIVE
D2(config-vlan)# exit
D2(config)#interface e1/0
D2(config-if)# no switchport
D2(config-if)# ip address 10.67.11.2 255.255.255.0
D2(config-if)# ipv6 address fe80::d1:1 link-local
D2(config-if)# ipv6 address 2001:db8:100:1011::2/64
D2(config-if)# no shutdown
D2(config-if)# exit
D2(config)#interface vlan 100
D2(config-if)# ip address 10.67.100.2 255.255.255.0
D2(config-if)# ipv6 address fe80::d2:2 link-local
D2(config-if)# ipv6 address 2001:db8:100:100::2/64
D2(config-if)# no shutdown
D2(config-if)# exit
D2(config)#interface vlan 101
D2(config-if)# ip address 10.67.101.2 255.255.255.0
D2(config-if)# ipv6 address fe80::d2:3 link-local
D2(config-if)# ipv6 address 2001:db8:100:101::2/64
D2(config-if)# no shutdown
D2(config-if)# exit
D2(config)#interface vlan 102
```

Fuente: Autoría Propia

Figura 7. Configuración A1

```
A1#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
A1(config)#
A1(config)#
A1(config)#
A1(config)#hostname A1
A1(config)#no ip domain lookup
A1(config)#banner motd # A1, ENCOR Skills Assessment#
A1(config)#line con 0
A1(config-line)# exec-timeout 0 0
A1(config-line)# logging synchronous
A1(config-line)# exit
A1(config)#vlan 100
A1(config-vlan)# name Management
A1(config-vlan)# exit
A1(config)#vlan 101
A1(config-vlan)# name UserGroupA
A1(config-vlan)# exit
A1(config)#vlan 102
A1(config-vlan)# name UserGroupB
A1(config-vlan)# exit
A1(config)#vlan 999
A1(config-vlan)# name NATIVE
A1(config-vlan)# exit
A1(config)#interface vlan 100
A1(config-if)# ip address 10.67.100.3 255.255.255.0
A1(config-if)# ipv6 address fe80::a1:1 link-local
A1(config-if)# ipv6 address 2001:db8:100:100::3/64
A1(config-if)# no shutdown
A1(config-if)# exit
A1(config)#interface range e0/0,e0/3,e1/0,e2/1-3,e3/0-3
A1(config-if-range)# shutdown
A1(config-if-range)# exit
*Dec  2 00:43:04.468: %LINK-3-UPDOWN: Interface Vlan100, changed state to up
*Dec  2 00:43:05.476: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan100, changed state to up
A1(config-if-range)# exit
```

Fuente: Autoría Propia

Configure the Layer 2 Network and Host Support

In this part of the Skills Assessment, you will complete the Layer 2 network configuration and set up basic host support. At the end of this part, all the switches should be able to communicate. PC2 and PC3 should receive addressing from DHCP and SLAAC.

Your configuration tasks are as follows:

Task#	Task	Specification	Points
2.1	On all switches, configure IEEE 802.1Q trunk interfaces on interconnecting switch links	Enable 802.1Q trunk links between: <ul style="list-style-type: none"> • D1 and D2 • D1 and A1 • D2 and A1 	6
2.2	On all switches, change the native VLAN on trunk links.	Use VLAN 999 as the native VLAN.	6
2.3	On all switches, enable the Rapid Spanning-Tree Protocol.	Use Rapid Spanning Tree.	3
2.4	On D1 and D2, configure the appropriate RSTP root bridges based on the information in the topology diagram. D1 and D2 must provide backup in case of root bridge failure.	Configure D1 and D2 as root for the appropriate VLANs with mutually supporting priorities in case of switch failure.	2
2.5	On all switches, create LACP EtherChannels as shown in the topology diagram.	Use the following channel numbers: <ul style="list-style-type: none"> • D1 to D2 – Port channel 12 • D1 to A1 – Port channel 1 • D2 to A1 – Port channel 2 	3
2.6	On all switches, configure host access ports connecting to PC1, PC2, PC3, and PC4.	Configure access ports with appropriate VLAN settings as shown in the topology diagram. Host ports should transition immediately to forwarding state.	4

Task#	Task	Specification	Points
2.7	Verify IPv4 DHCP services.	PC2 and PC3 are DHCP clients and should be receiving valid IPv4 addresses.	1
2.8	Verify local LAN connectivity.	PC1 should successfully ping: <ul style="list-style-type: none"> • D1: 10.XY.100.1 • D2: 10.XY.100.2 • PC4: 10.XY.100.6 PC2 should successfully ping: <ul style="list-style-type: none"> • D1: 10.XY.102.1 • D2: 10.XY.102.2 PC3 should successfully ping: <ul style="list-style-type: none"> • D1: 10.XY.101.1 • D2: 10.XY.101.2 PC4 should successfully ping: <ul style="list-style-type: none"> • D1: 10.XY.100.1 • D2: 10.XY.100.2 • PC1: 10.XY.100.5 	1

2.1	On all switches, configure IEEE 802.1Q trunk interfaces on interconnecting switch links
2.2	On all switches, change the native VLAN on trunk links.

```

SWITCH D1
interface range e2/0-3
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
channel-group 12 mode active
no shutdown

```

exit

```
interface range e0/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
channel-group 1 mode active
no shutdown
exit
```

```
SWITCH D2
spanning mode rapid-pvst
interface range e2/0-3
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
no shutdown
exit
```

```
interface range e1/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
no shutdown
exit
```

```
SWITCH A1
spanning mode rapid-pvst
interface range e0/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
no shutdown
exit
```

```
interface range e1/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
no shutdown
exit
```


2.3	On all switches, enable the Rapid Spanning-Tree Protocol.
2.4	On D1 and D2, configure the appropriate RSTP root bridges based on the information in the topology diagram. D1 and D2 must provide backup in case of root bridge failure.

SWITCH D1

```
spanning-tree mode rapid-pvst
spanning-tree vlan 100,102 root primary
spanning-tree vlan 101 root secondary
```

SWITCH D2

```
spanning-tree mode rapid-pvst
spanning-tree vlan 101root primary
spanning-tree vlan 100,102 root secondary
```

2.5	On all switches, create LACP EtherChannels as shown in the topology diagram.
-----	--

SWITCH D1

```
interface range e2/0-3
channel-group 12 mode active
no shutdown
exit
```

```
interface range e0/1-2
channel-group 1 mode active
no shutdown
exit
```

SWITCH D2

```
interface range e1/1-2
channel-group 2 mode active
```

```
no shutdown
exit
```

```
interface range e2/0-3
channel-group 12 mode active
no shutdown
exit
```

```
SWITCH A1
interface range e0/1-2
channel-group 1 mode active
no shutdown
exit
```

```
interface range e1/1-2
channel-group 2 mode active
no shutdown
exit
```

2.6	On all switches, configure host access ports connecting to PC1, PC2, PC3, and PC4.
-----	--

```
SWITCH D1
interface e0/0
switchport mode access
switchport access vlan 100
spanning-tree portfast
no shutdown
exit
```

```
SWITCH D2
interface e0/0
switchport mode access
switchport access vlan 102
spanning-tree portfast
no shutdown
```

```
SWITCH A1
interface e1/3
switchport mode access
```

```
switchport access vlan 101
spanning-tree portfast
no shutdown
interface e2/0
switchport mode access
switchport access vlan 100
spanning-tree portfast
no shutdown
```

Figura 8. Configuración D1

```
D1(config)#interface range e2/0-3
D1(config-if-range)#switchport trunk encapsulation dot1q
D1(config-if-range)#switchport mode trunk
D1(config-if-range)#switchport trunk native vlan 999
D1(config-if-range)#channel-protocol lacp
D1(config-if-range)#channel-group 12 mode active
D1(config-if-range)#no shutdown
D1(config-if-range)#exit
D1(config)#
D1(config)#interface range e0/1-2
D1(config-if-range)#switchport trunk encapsulation dot1q
D1(config-if-range)#switchport mode trunk
D1(config-if-range)#switchport trunk native vlan 999
D1(config-if-range)#channel-protocol lacp
D1(config-if-range)#channel-group 1 mode active
D1(config-if-range)#no shutdown
D1(config-if-range)#exit
D1(config)#
D1(config)#spanning-tree mode rapid-pvst
D1(config)#spanning-tree vlan 100,102 root primary
D1(config)#spanning-tree vlan 101 root secondary
D1(config)#interface e0/0
D1(config-if)#switchport mode access
D1(config-if)#switchport access vlan 100
D1(config-if)#spanning-tree portfast
D1(config-if)#no shutdown
D1(config-if)#exit
D1(config)#
D1(config)#
D1(config)#
D1(config)#
```

Fuente: Autoría Propia

Figura 9. Configuración D2

```
D2(config)#
D2(config)#interface range e2/0-3
D2(config-if-range)#switchport trunk encapsulation dot1q
D2(config-if-range)#switchport mode trunk
D2(config-if-range)#switchport trunk native vlan 999
D2(config-if-range)#channel-protocol lacp
D2(config-if-range)#channel-group 12 mode active
D2(config-if-range)#no shutdown
D2(config-if-range)#exit
D2(config)#spanning-tree mode rapid-pvst
D2(config)#spanning-tree vlan 101 root primary
D2(config)#spanning-tree vlan 100,102 root secondary
D2(config)#interface range e1/1-2
D2(config-if-range)#switchport trunk encapsulation dot1q
D2(config-if-range)#switchport mode trunk
D2(config-if-range)#switchport trunk native vlan 999
D2(config-if-range)#channel-protocol lacp
D2(config-if-range)#channel-group 2 mode active
D2(config-if-range)#no shutdown
D2(config-if-range)#exit
D2(config)#interface e0/0
D2(config-if)#switchport mode access
D2(config-if)#switchport access vlan 102
D2(config-if)#spanning-tree portfast
D2(config-if)#no shutdown
D2(config-if)#exit
```

Fuente: Autoría Propia

Figura 10. Configuración A1

```
A1(config)#spanning mode rapid-pvst
A1(config)#interface range e0/1-2
A1(config-if-range)#switchport trunk encapsulation dot1q
A1(config-if-range)#switchport mode trunk
A1(config-if-range)#switchport trunk native vlan 999
A1(config-if-range)#channel-protocol lacp
A1(config-if-range)#channel-group 1 mode active
A1(config-if-range)#no shutdown
A1(config-if-range)#exit
A1(config)#interface range e1/1-2
A1(config-if-range)#switchport trunk encapsulation dot1q
A1(config-if-range)#switchport mode trunk
A1(config-if-range)#switchport trunk native vlan 999
A1(config-if-range)#channel-protocol lacp
A1(config-if-range)#channel-group 2 mode active
A1(config-if-range)#no shutdown
A1(config-if-range)#exit
A1(config)#interface e1/3
A1(config-if)#switchport mode access
A1(config-if)#switchport access vlan 101
A1(config-if)#spanning-tree portfast
A1(config-if)#no shutdown
A1(config-if)#exit
A1(config)#interface e2/0
A1(config-if)#switchport mode access
A1(config-if)#switchport access vlan 100
A1(config-if)#spanning-tree portfast
A1(config-if)#no shutdown
```

Fuente: Autoría Propia

2.7

Verify IPv4 DHCP services.

Figura 11. Verificación ipv4 pc1

```
PC1> show ip
NAME          : PC1[1]
IP/MASK       : 10.67.100.5/24
GATEWAY       : 255.255.255.0
DNS           :
MAC           : 00:50:79:66:68:00
LPORT        : 10022
RHOST:PORT    : 127.0.0.1:10023
MTU           : 1500

PC1> 
```

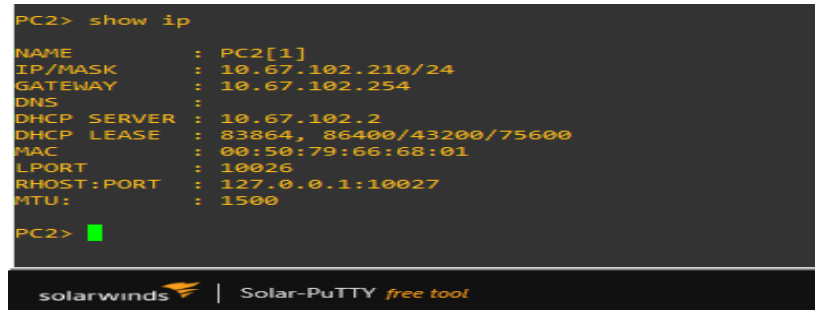
solarwinds | Solar-PuTTY free tool

Fuente: Autoría Propia

Figura 12. Verificación ipv4 pc2

```
PC2> show ip
NAME          : PC2[1]
IP/MASK       : 10.67.102.210/24
GATEWAY       : 10.67.102.254
DNS           :
DHCP SERVER   : 10.67.102.2
DHCP LEASE    : 83864, 86400/43200/75600
MAC           : 00:50:79:66:68:01
LPORT        : 10026
RHOST:PORT    : 127.0.0.1:10027
MTU           : 1500

PC2> █
```

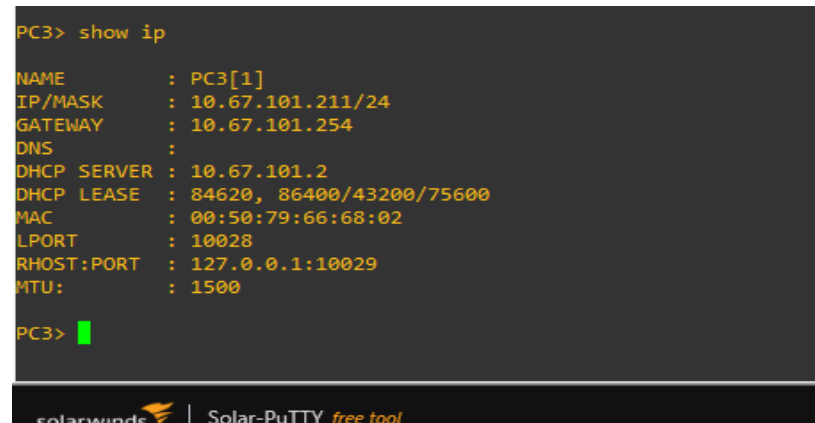


Fuente: Autoría Propia

Figura 13. Verificación ipv4 pc3

```
PC3> show ip
NAME          : PC3[1]
IP/MASK       : 10.67.101.211/24
GATEWAY       : 10.67.101.254
DNS           :
DHCP SERVER   : 10.67.101.2
DHCP LEASE    : 84620, 86400/43200/75600
MAC           : 00:50:79:66:68:02
LPORT        : 10028
RHOST:PORT    : 127.0.0.1:10029
MTU           : 1500

PC3> █
```

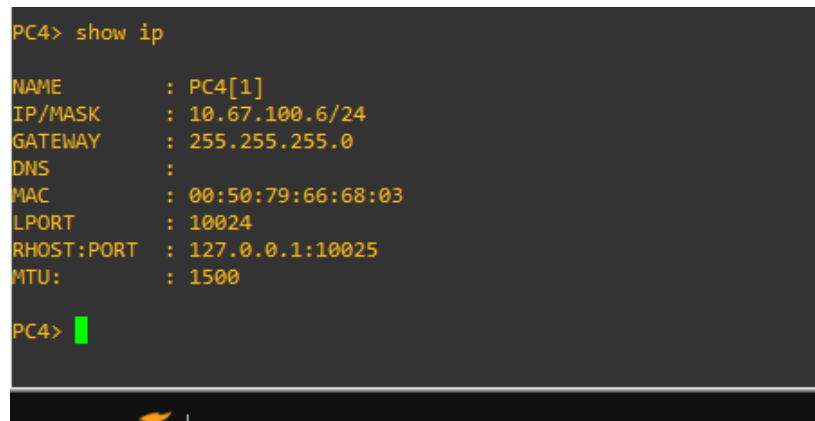


Fuente: Autoría Propia

Figura 14. Verificación ipv4 pc4

```
PC4> show ip
NAME          : PC4[1]
IP/MASK       : 10.67.100.6/24
GATEWAY       : 255.255.255.0
DNS           :
MAC           : 00:50:79:66:68:03
LPORT        : 10024
RHOST:PORT    : 127.0.0.1:10025
MTU           : 1500

PC4> █
```



Fuente: Autoría Propia

Figura 15. Prueba con PC1

```

PC1> ping 10.67.100.1
84 bytes from 10.67.100.1 icmp_seq=1 ttl=255 time=5.133 ms
84 bytes from 10.67.100.1 icmp_seq=2 ttl=255 time=7.780 ms
84 bytes from 10.67.100.1 icmp_seq=3 ttl=255 time=6.384 ms
84 bytes from 10.67.100.1 icmp_seq=4 ttl=255 time=4.445 ms
84 bytes from 10.67.100.1 icmp_seq=5 ttl=255 time=11.712 ms

PC1> ping 10.67.100.2
84 bytes from 10.67.100.2 icmp_seq=1 ttl=255 time=51.761 ms
84 bytes from 10.67.100.2 icmp_seq=2 ttl=255 time=10.582 ms
84 bytes from 10.67.100.2 icmp_seq=3 ttl=255 time=12.577 ms
84 bytes from 10.67.100.2 icmp_seq=4 ttl=255 time=26.485 ms
84 bytes from 10.67.100.2 icmp_seq=5 ttl=255 time=7.462 ms

PC1> ping 10.67.100.6
84 bytes from 10.67.100.6 icmp_seq=1 ttl=64 time=12.368 ms
84 bytes from 10.67.100.6 icmp_seq=2 ttl=64 time=5.017 ms
84 bytes from 10.67.100.6 icmp_seq=3 ttl=64 time=13.156 ms
84 bytes from 10.67.100.6 icmp_seq=4 ttl=64 time=5.797 ms
84 bytes from 10.67.100.6 icmp_seq=5 ttl=64 time=3.862 ms

```

Fuente: Autoría Propia

Figura 16. Prueba con PC2

```

D1 R1 R3 R2 A1 D2 A1 PC1
PC2> ping 10.67.100.1
host (10.67.102.254) not reachable

PC2> ping 10.67.102.1
84 bytes from 10.67.102.1 icmp_seq=1 ttl=255 time=0.799 ms
84 bytes from 10.67.102.1 icmp_seq=2 ttl=255 time=32.441 ms
84 bytes from 10.67.102.1 icmp_seq=3 ttl=255 time=47.026 ms
84 bytes from 10.67.102.1 icmp_seq=4 ttl=255 time=1.073 ms
84 bytes from 10.67.102.1 icmp_seq=5 ttl=255 time=2.180 ms

PC2> ping 10.67.102.2
84 bytes from 10.67.102.2 icmp_seq=1 ttl=255 time=2.361 ms
84 bytes from 10.67.102.2 icmp_seq=2 ttl=255 time=10.993 ms
84 bytes from 10.67.102.2 icmp_seq=3 ttl=255 time=14.724 ms
84 bytes from 10.67.102.2 icmp_seq=4 ttl=255 time=0.795 ms
84 bytes from 10.67.102.2 icmp_seq=5 ttl=255 time=37.288 ms

PC2>

```

Fuente: Autoría Propia

Figura 17. Prueba con PC3

```

PC3> ping 10.67.101.1
84 bytes from 10.67.101.1 icmp_seq=1 ttl=255 time=1.161 ms
84 bytes from 10.67.101.1 icmp_seq=2 ttl=255 time=3.914 ms
84 bytes from 10.67.101.1 icmp_seq=3 ttl=255 time=1.316 ms
84 bytes from 10.67.101.1 icmp_seq=4 ttl=255 time=1.369 ms
84 bytes from 10.67.101.1 icmp_seq=5 ttl=255 time=9.047 ms

PC3> ping 10.67.101.2
84 bytes from 10.67.101.2 icmp_seq=1 ttl=255 time=1.002 ms
84 bytes from 10.67.101.2 icmp_seq=2 ttl=255 time=1.112 ms
84 bytes from 10.67.101.2 icmp_seq=3 ttl=255 time=1.113 ms
84 bytes from 10.67.101.2 icmp_seq=4 ttl=255 time=4.307 ms
84 bytes from 10.67.101.2 icmp_seq=5 ttl=255 time=1.409 ms

PC3>

```

Fuente: Autoría Propia

Figura 18. Prueba con PC4

```
PC4> ping 10.67.100.1
84 bytes from 10.67.100.1 icmp_seq=1 ttl=255 time=3.939 ms
84 bytes from 10.67.100.1 icmp_seq=2 ttl=255 time=1.287 ms
84 bytes from 10.67.100.1 icmp_seq=3 ttl=255 time=2.735 ms
84 bytes from 10.67.100.1 icmp_seq=4 ttl=255 time=33.166 ms
84 bytes from 10.67.100.1 icmp_seq=5 ttl=255 time=1.491 ms

PC4> ping 10.67.100.5
84 bytes from 10.67.100.5 icmp_seq=1 ttl=64 time=13.905 ms
84 bytes from 10.67.100.5 icmp_seq=2 ttl=64 time=4.752 ms
84 bytes from 10.67.100.5 icmp_seq=3 ttl=64 time=20.109 ms
84 bytes from 10.67.100.5 icmp_seq=4 ttl=64 time=11.764 ms
84 bytes from 10.67.100.5 icmp_seq=5 ttl=64 time=4.166 ms

PC4> █
```

solarwinds | Solar-PuTTY *free tool*

Fuente: Autoría Propia

2. ESCENARIO 2

Task#	Task	Specification	Points
3.1	On the “Company Network” (i.e., R1, R3, D1, and D2), configure single-area OSPFv2 in area 0.	<p>Use OSPF Process ID 4 and assign the following router-IDs:</p> <ul style="list-style-type: none"> • R1: 0.0.4.1 • R3: 0.0.4.3 • D1: 0.0.4.131 • D2: 0.0.4.132 <p>On R1, R3, D1, and D2, advertise all directly connected networks / VLANs in Area 0.</p> <ul style="list-style-type: none"> • On R1, do not advertise the R1 – R2 network. • On R1, propagate a default route. Note that the default route will be provided by BGP. <p>Disable OSPFv2 advertisements on:</p> <ul style="list-style-type: none"> • D1: All interfaces except E1/2 • D2: All interfaces except E1/0 	8
3.2	On the “Company Network” (i.e., R1, R3, D1, and D2), configure classic single-area OSPFv3 in area 0.	<p>Use OSPF Process ID 6 and assign the following router-IDs:</p> <ul style="list-style-type: none"> • R1: 0.0.6.1 • R3: 0.0.6.3 • D1: 0.0.6.131 • D2: 0.0.6.132 <p>On R1, R3, D1, and D2, advertise all directly connected networks / VLANs in Area 0.</p> <ul style="list-style-type: none"> • On R1, do not advertise the R1 – R2 network. • On R1, propagate a default route. Note that the default route will be provided by BGP. <p>Disable OSPFv3 advertisements on:</p> <ul style="list-style-type: none"> • D1: All interfaces except E1/2 • D2: All interfaces except E1/0 	8

Task#	Task	Specification	Points
3.3	On R2 in the “ISP Network”, configure MP-BGP.	<p>Configure two default static routes via interface Loopback 0:</p> <ul style="list-style-type: none"> • An IPv4 default static route. • An IPv6 default static route. <p>Configure R2 in BGP ASN 500 and use the router-id 2.2.2.2.</p> <p>Configure and enable an IPv4 and IPv6 neighbor relationship with R1 in ASN 300.</p> <p>In IPv4 address family, advertise:</p> <ul style="list-style-type: none"> • The Loopback 0 IPv4 network (/32). • The default route (0.0.0.0/0). <p>In IPv6 address family, advertise:</p> <ul style="list-style-type: none"> • The Loopback 0 IPv4 network (/128). • The default route (::/0). 	4

Task#	Task	Specification	Points
3.4	On R1 in the “ISP Network”, configure MP-BGP.	<p>Configure two static summary routes to interface Null 0:</p> <ul style="list-style-type: none"> • A summary IPv4 route for 10.XY.0.0/8. • A summary IPv6 route for 2001:db8:100::/48. <p>Configure R1 in BGP ASN 300 and use the router-id 1.1.1.1.</p> <p>Configure an IPv4 and IPv6 neighbor relationship with R2 in ASN 500.</p> <p>In IPv4 address family:</p> <ul style="list-style-type: none"> • Disable the IPv6 neighbor relationship. • Enable the IPv4 neighbor relationship. • Advertise the 10.XY.0.0/8 network. <p>In IPv6 address family:</p> <ul style="list-style-type: none"> • Disable the IPv4 neighbor relationship. • Enable the IPv6 neighbor relationship. • Advertise the 2001:db8:100::/48 network. 	4

3.1	On the “Company Network” (i.e., R1, R3, D1, and D2), configure single-area OSPFv2 in area 0.
-----	--

R1

```

router ospf 4
router-id 0.0.4.1
network 10.0.10.0 0.0.0.255 area 0
network 10.0.13.0 0.0.0.255 area 0
default-information originate
exit

```

```
R2
router ospf 4
router-id 0.0.4.3
network 10.0.11.0 0.0.0.255 area 0
network 10.0.13.0 0.0.0.255 area 0
exit
```

```
D1
router ospf 4
router-id 0.0.4.131
network 10.0.100.0 0.0.0.255 area 0
network 10.0.101.0 0.0.0.255 area 0
network 10.0.102.0 0.0.0.255 area 0
network 10.0.10.0 0.0.0.255 area 0
passive-interface default
no passive-interface e3/0
exit
```

```
D2
router ospf 4
router-id 0.0.4.132
network 10.0.100.0 0.0.0.255 area 0
network 10.0.101.0 0.0.0.255 area 0
network 10.0.102.0 0.0.0.255 area 0
network 10.0.11.0 0.0.0.255 area 0
passive-interface default
no passive-interface e3/0
exit
```

3.2

On the “Company Network” (i.e., R1, R3, D1, and D2), configure classic single-area OSPFv3 in area 0.

```
R1
ipv6 router ospf 6
router-id 0.0.6.1
default-information originate
exit
interface e1/2
```

```
ipv6 ospf 6 area 0
exit
interface e1/1
ipv6 ospf 6 area 0
exit
```

```
R2
ipv6 router ospf 6
router-id 0.0.6.3
default-information originate
exit
interface e1/0
ipv6 ospf 6 area 0
exit
interface e1/1
ipv6 ospf 6 area 0
exit
```

```
D1
ipv6 router ospf 6
router-id 0.0.6.131
passive-interface default
no passive-interface e1/2
exit
interface e1/2
ipv6 ospf 6 area 0
exit
interface vlan 100
ipv6 ospf 6 area 0
exit
interface vlan 101
ipv6 ospf 6 area 0
exit
interface vlan 102
ipv6 ospf 6 area 0
exit
```

```
D2
ipv6 router ospf 6
router-id 0.0.6.132
passive-interface default
no passive-interface e1/2
exit
```

```

interface e1/0
ipv6 ospf 6 area 0
exit
interface vlan 100
ipv6 ospf 6 area 0
exit
interface vlan 101
ipv6 ospf 6 area 0
exit
interface vlan 102
ipv6 ospf 6 area 0
exit

```

3.3

On R3 in the “ISP Network”, configure MP-BGP.

```

R3
ip route 0.0.0.0 0.0.0.0 loopback0
ipv6 route ::/0 loopback 0
router bgp 500
  bgp router-id 2.2.2.2
  neighbor 209.165.200.255 remote-as 300
  neighbor 2001:db8:200::1 remote-as 300

  address-family ipv4
    neighbor 209.165.200.255 activate
    no neighbor 2001:db8:200::1 activate
    network 2.2.2.2 mask 255.255.255.255
    network 0.0.0.0
  exit-address-family
  address-family ipv6
    no neighbor 209.165.200.255 activate
    neighbor 2001:db8:200::1 activate
    network 2001:db8:2222::/128
    network ::/0
  exit-address-family

```

3.4

On R1 in the “ISP Network”, configure MP-BGP.

```

ip route 10.0.0.0 255.0.0.0 null0
ipv6 route 2001:db8:100::/48 null0
router bgp 300

```

```

bgp router-id 1.1.1.1
neighbor 209.165.200.226 remote-as 500
neighbor 2001:db8:200::2 remote-as 500
address-family ipv4 unicast
neighbor 209.165.200.226 activate
neighbor 2001:db8:200::2 activate
network 10.0.0.0 mask 255.0.0.0
exit-address-family
address-family ipv6 unicast
no neighbor 209.165.200.226 activate
neighbor 2001:db8:200::2 activate
network 2001:db8:100::/48
exit-address-family

```

Figura 19. Configuración R1

```

R1(config)#router ospf 4
R1(config-router)#router-id 0.0.4.1
R1(config-router)#network 10.67.10.0 0.0.0.255 area 0
R1(config-router)#network 10.67.13.0 0.0.0.255 area 0
R1(config-router)#default-information originate
R1(config-router)#exit
R1(config)#
R1(config)#ipv6 router ospf 6
R1(config-rtr)#router-id 0.0.6.1
R1(config-rtr)#default-information originate
R1(config-rtr)#exit
R1(config)#interface e1/2
R1(config-if)#ipv6 ospf 6 area 0
R1(config-if)#exit
R1(config)#interface e1/1
R1(config-if)#ipv6 ospf 6 area 0
R1(config-if)#exit
R1(config)#
R1(config)#ip route 10.0.0.0 255.0.0.0 null0
R1(config)#ipv6 route 2001:db8:100::/48 null0
R1(config)#
R1(config)#router bgp 300
R1(config-router)#bgp router-id 1.1.1.1
R1(config-router)#neighbor 209.165.200.226 remote-as 500
R1(config-router)#neighbor 2001:db8:200::2 remote-as 500
R1(config-router)#address-family ipv4 unicast
R1(config-router-af)#neighbor 209.165.200.226 activate
R1(config-router-af)#neighbor 2001:db8:200::2 activate
R1(config-router-af)#network 10.0.0.0 mask 255.0.0.0
R1(config-router-af)#exit-address-family
R1(config-router)#address-family ipv6 unicast
R1(config-router-af)#no neighbor 209.165.200.226 activate
R1(config-router-af)#neighbor 2001:db8:200::2 activate
R1(config-router-af)#network 2001:db8:100::/48
R1(config-router-af)#exit-address-family
R1(config-router)#

```

Fuente: Autoría Propia

Figura 20. Configuration R2

```
R2(config)#router ospf 4
R2(config-router)#router-id 0.0.4.3
R2(config-router)#network 10.67.11.0 0.0.0.255 area 0
R2(config-router)#network 10.67.13.0 0.0.0.255 area 0
R2(config-router)#exit
R2(config)#
R2(config)#
R2(config)#ipv6 router ospf 6
R2(config-rtr)#router-id 0.0.6.3
R2(config-rtr)#default-information originate
R2(config-rtr)#exit
R2(config)#interface e1/0
R2(config-if)#ipv6 ospf 6 area 0
R2(config-if)#exit
R2(config)#interface e1/1
R2(config-if)#ipv6 ospf 6 area 0
R2(config-if)#exit
R2(config)#
*Dec 1 20:02:59.755: %OSPFv3-5-ADJCHG: Process 6, Nbr 0.0.6.1 on Ethernet
R2(config)#
```

Fuente: Autoría Propia

Figura 21. Configuration R3

```
R3(config)#ipv6 unicast-routing
R3(config)#no ip domain lookup
R3(config)#banner motd # R2, ENCOR Skills Assessment#
R3(config)#line con 0
R3(config-line)# exec-timeout 0 0
R3(config-line)# logging synchronous
R3(config-line)# exit
R3(config)#interface e1/0
R3(config-if)# ip address 209.165.200.226 255.255.255.224
R3(config-if)# ipv6 address fe80::2:1 link-local
R3(config-if)# ipv6 address 2001:db8:200::2/64
R3(config-if)# no shutdown
R3(config-if)# exit
R3(config)#interface Loopback 0
R3(config-if)# ip address 2.2.2.2 255.255.255.255
R3(config-if)# ipv6 address fe80::2:3 link-local
R3(config-if)# ipv6 address 2001:db8:2222::1/128
R3(config-if)# no shutdown
R3(config-if)# exit
R3(config)#ip route 0.0.0.0 0.0.0.0 loopback 0
R3(config)#ipv6 route ::/0 loopback 0
R3(config)#router bgp 500
R3(config-router)#bgp router-id 2.2.2.2
R3(config-router)#neighbor 209.165.200.255 remote-as 300
R3(config-router)#neighbor 2001:db8:200::1 remote-as 300
R3(config-router)#
R3(config-router)#address-family ipv4
R3(config-router-af)#neighbor 209.165.200.255 activate
R3(config-router-af)#no neighbor 2001:db8:200::1 activate
R3(config-router-af)#network 2.2.2.2 mask 255.255.255.255
R3(config-router-af)#network 0.0.0.0
R3(config-router-af)#exit-address-family
R3(config-router)#address-family ipv6
R3(config-router-af)#no neighbor 209.165.200.255 activate
R3(config-router-af)#neighbor 2001:db8:200::1 activate
R3(config-router-af)#network 2001:db8:2222::/128
R3(config-router-af)#network ::/0
R3(config-router-af)#exit-address-family
```

Fuente: Autoría Propia

Figura 22. Configuración D1

```
D1(config)#router ospf 4
D1(config-router)#router-id 0.0.4.131
D1(config-router)#network 10.67.100.0 0.0.0.255 area 0
D1(config-router)#network 10.67.101.0 0.0.0.255 area 0
D1(config-router)#network 10.67.102.0 0.0.0.255 area 0
D1(config-router)#network 10.67.10.0 0.0.0.255 area 0
D1(config-router)#passive-interface default
D1(config-router)#no passive-interface e1/2
D1(config-router)#exit
D1(config)#ipv6 router ospf 6
D1(config-rtr)#router-id 0.0.6.131
D1(config-rtr)#passive-interface default
D1(config-rtr)#no passive-interface e1/2
D1(config-rtr)#exit
D1(config)#interface e1/2
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
D1(config)#interface vlan 100
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
D1(config)#interface vlan 101
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
D1(config)#interface vlan 102
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
```

Fuente: Autoría Propia

Figura 23. Configuración D2

```
D2(config)#router ospf 4
D2(config-router)#router-id 0.0.4.132
D2(config-router)#network 10.67.100.0 0.0.0.255 area 0
D2(config-router)#network 10.67.101.0 0.0.0.255 area 0
D2(config-router)#network 10.67.102.0 0.0.0.255 area 0
D2(config-router)#network 10.67.11.0 0.0.0.255 area 0
D2(config-router)#passive-interface default
D2(config-router)#no passive-interface e3/0
D2(config-router)#exit
D2(config)#
D2(config)#
D2(config)#ipv6 router ospf 6
D2(config-rtr)#router-id 0.0.6.132
D2(config-rtr)#passive-interface default
D2(config-rtr)#no passive-interface e1/2
D2(config-rtr)#exit
D2(config)#interface e1/0
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#interface vlan 100
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#interface vlan 101
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#interface vlan 102
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#
```

Fuente: Autoría Propia

Configure First Hop Redundancy

In this part, you will configure HSRP version 2 to provide first-hop redundancy for hosts in the “Company Network”.

Your configuration tasks are as follows:

Task#	Task	Specification	Points
4.1	On D1, create IP SLAs that test the reachability of R1 interface E1/2.	<p>Create two IP SLAs.</p> <ul style="list-style-type: none">• Use SLA number 4 for IPv4.• Use SLA number 6 for IPv6. <p>The IP SLAs will test availability of R1 E1/2 interface every 5 seconds.</p> <p>Schedule the SLA for immediate implementation with no end time.</p> <p>Create an IP SLA object for IP SLA 4 and one for IP SLA 6.</p> <ul style="list-style-type: none">• Use track number 4 for IP SLA 4.• Use track number 6 for IP SLA 6. <p>The tracked objects should notify D1 if the IP SLA state changes from down to up after 10 seconds, or from up to down after 15 seconds.</p>	2

Task#	Task	Specification	Points
4.2	On D2, create IP SLAs that test the reachability of R3 interface E1/0.	<p>Create two IP SLAs.</p> <ul style="list-style-type: none"> • Use SLA number 4 for IPv4. • Use SLA number 6 for IPv6. <p>The IP SLAs will test availability of R3 E1/0 interface every 5 seconds.</p> <p>Schedule the SLA for immediate implementation with no end time.</p> <p>Create an IP SLA object for IP SLA 4 and one for IP SLA 6.</p> <ul style="list-style-type: none"> • Use track number 4 for IP SLA 4. • Use track number 6 for IP SLA 6. <p>The tracked objects should notify D1 if the IP SLA state changes from down to up after 10 seconds, or from up to down after 15 seconds.</p>	2

4.3	On D1, configure HSRPv2.	<p>D1 is the primary router for VLANs 100 and 102; therefore, their priority will also be changed to 150.</p> <p>Configure HSRP version 2.</p> <p>Configure IPv4 HSRP group 104 for VLAN 100:</p> <ul style="list-style-type: none"> • Assign the virtual IP address 10.XY.100.254. • Set the group priority to 150. • Enable preemption. • Track object 4 and decrement by 60. <p>Configure IPv4 HSRP group 114 for VLAN 101:</p> <ul style="list-style-type: none"> • Assign the virtual IP address 10.XY.101.254. • Enable preemption. • Track object 4 to decrement by 60. <p>Configure IPv4 HSRP group 124 for VLAN 102:</p> <ul style="list-style-type: none"> • Assign the virtual IP address 10.XY.102.254. • Set the group priority to 150. • Enable preemption. • Track object 4 to decrement by 60. <p>Configure IPv6 HSRP group 106 for VLAN 100:</p> <ul style="list-style-type: none"> • Assign the virtual IP address using ipv6 autoconfig. • Set the group priority to 150. • Enable preemption. • Track object 6 and decrement by 60. <p>Configure IPv6 HSRP group 116 for VLAN 101:</p> <ul style="list-style-type: none"> • Assign the virtual IP address using ipv6 autoconfig. • Enable preemption. • Track object 6 and decrement by 60. <p>Configure IPv6 HSRP group 126 for VLAN 102:</p>	8
-----	--------------------------	--	---

Task#	Task	Specification	Points
		<ul style="list-style-type: none">• Assign the virtual IP address using ipv6 autoconfig.• Set the group priority to 150.• Enable preemption.• Track object 6 and decrement by 60.	

	<p>On D2, configure HSRPv2.</p>	<p>D2 is the primary router for VLAN 101; therefore, the priority will also be changed to 150.</p> <p>Configure HSRP version 2.</p> <p>Configure IPv4 HSRP group 104 for VLAN 100:</p> <ul style="list-style-type: none"> • Assign the virtual IP address 10.XY.100.254. • Enable preemption. • Track object 4 and decrement by 60. <p>Configure IPv4 HSRP group 114 for VLAN 101:</p> <ul style="list-style-type: none"> • Assign the virtual IP address 10.XY.101.254. • Set the group priority to 150. • Enable preemption. • Track object 4 to decrement by 60. <p>Configure IPv4 HSRP group 124 for VLAN 102:</p> <ul style="list-style-type: none"> • Assign the virtual IP address 10.XY.102.254. • Enable preemption. • Track object 4 to decrement by 60. <p>Configure IPv6 HSRP group 106 for VLAN 100:</p> <ul style="list-style-type: none"> • Assign the virtual IP address using ipv6 autoconfig. • Enable preemption. • Track object 6 and decrement by 60. <p>Configure IPv6 HSRP group 116 for VLAN 101:</p> <ul style="list-style-type: none"> • Assign the virtual IP address using ipv6 autoconfig. • Set the group priority to 150. • Enable preemption. • Track object 6 and decrement by 60. <p>Configure IPv6 HSRP group 126 for VLAN 102:</p> <ul style="list-style-type: none"> • Assign the virtual IP address using ipv6 autoconfig. 	
--	---------------------------------	--	--

Task#	Task	Specification	Points
		<ul style="list-style-type: none"> • Enable preemption. • Track object 6 and decrement by 60. 	

4.1	On D1, create IP SLAs that test the reachability of R1 interface E1/2.
-----	--

D1

```

ip sla 4
icmp-echo 10.67.10.1
frequency 5
exit
ip sla 6
icmp-echo 2001:db8:100:1010::1
frequency 5
exit
ip sla schedule 4 life forever start-time now
ip sla schedule 6 life forever start-time now
track 4 ip sla 4
delay down 10 up 15
exit
track 6 ip sla 6
delay down 10 up 15
exit

```

4.2	On D2, create IP SLAs that test the reachability of R3 interface E1/0.
-----	--

D2

```

ip sla 4
icmp-echo 10.67.11.1
frequency 5
exit
ip sla 6
icmp-echo 2001:db8:100:1010::1
frequency 5

```

```

exit
ip sla schedule 4 life forever start-time now
ip sla schedule 6 life forever start-time now
track 4 ip sla 4
delay down 10 up 15
exit
track 6 ip sla 6
delay down 10 up 15
exit

```

4.3	On D1, configure HSRPv2.
-----	--------------------------

```

D1
ip sla 4
icmp-echo 10.67.10.1
frequency 5
exit
ip sla 6
icmp-echo 2001:db8:100:1010::1
frequency 5
exit
ip sla schedule 4 life forever start-time now
ip sla schedule 6 life forever start-time now
track 4 ip sla 4
delay down 10 up 15
exit
track 6 ip sla 6
delay down 10 up 15
exit

```

```

interface vlan 100
standby version 2
standby 104 ip 10.67.100.254
standby 104 priority 150
standby 104 preempt
standby 104 track 4 decrement 60
standby 106 ipv6 autoconfig
standby 106 priority 150
standby 106 preempt
standby 106 track 6 decrement 60
exit

```

```
interface vlan 101
standby version 2
standby 114 ip 10.67.101.254
standby 114 priority 150
standby 114 preempt
standby 114 track 4 decrement 60
standby 116 ipv6 autoconfig
standby 116 priority 150
standby 116 preempt
standby 116 track 6 decrement 60
exit
```

```
interface vlan 102
standby version 2
standby 124 ip 10.67.102.254
standby 124 priority 150
standby 124 preempt
standby 124 track 4 decrement 60
standby 126 ipv6 autoconfig
standby 126 priority 150
standby 126 preempt
standby 126 track 6 decrement 60
exit
```

```
D2
ip sla 4
icmp-echo 10.67.11.1
frequency 5
exit
ip sla 6
icmp-echo 2001:db8:100:1011::1
frequency 5
exit
ip sla schedule 4 life forever start-time now
ip sla schedule 6 life forever start-time now
track 4 ip sla 4
delay down 10 up 15
exit
track 6 ip sla 6
delay down 10 up 15
exit
```

```
interface vlan 100
```



```
standby version 2
standby 104 ip 10.67.100.254
standby 104 preempt
standby 104 track 4 decrement 60
standby 106 ipv6 autoconfig
standby 106 preempt
standby 106 track 6 decrement 60
exit
```

```
interface vlan 101
standby version 2
standby 114 ip 10.67.101.254
standby 114 preempt
standby 114 track 4 decrement 60
standby 116 ipv6 autoconfig
```

```
standby 116 preempt
standby 116 track 6 decrement 60
exit
```

```
interface vlan 102
standby version 2
standby 124 ip 10.67.102.254
standby 124 preempt
standby 124 track 4 decrement 60
standby 126 ipv6 autoconfig
standby 126 preempt
standby 126 track 6 decrement 60
exit
```

Figura 24. Configuración D1

```
D1(config)#router ospf 4
D1(config-router)#router-id 0.0.4.131
D1(config-router)#network 10.67.100.0 0.0.0.255 area 0
D1(config-router)#network 10.67.101.0 0.0.0.255 area 0
D1(config-router)#network 10.67.102.0 0.0.0.255 area 0
D1(config-router)#network 10.67.10.0 0.0.0.255 area 0
D1(config-router)#passive-interface default
D1(config-router)#no passive-interface e1/2
D1(config-router)#exit
D1(config)#ipv6 router ospf 6
D1(config-rtr)#router-id 0.0.6.131
D1(config-rtr)#passive-interface default
D1(config-rtr)#no passive-interface e1/2
D1(config-rtr)#exit
D1(config)#interface e1/2
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
D1(config)#interface vlan 100
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
D1(config)#interface vlan 101
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
D1(config)#interface vlan 102
D1(config-if)#ipv6 ospf 6 area 0
D1(config-if)#exit
*Dec 2 01:06:38.422: %OSPF-5-ADJCHG: Process 4, Nbr 0.0.4.1 on Ethernet1/2 from FULL to
atched
*Dec 2 01:06:38.425: %OSPFv3-5-ADJCHG: Process 6, Nbr 0.0.6.1 on Ethernet1/2 from FULL t
detached
```

Fuente: Autoría Propia

Figura 25. Configuración D2

```
D2(config)#router ospf 4
D2(config-router)#router-id 0.0.4.132
D2(config-router)#network 10.67.100.0 0.0.0.255 area 0
D2(config-router)#network 10.67.101.0 0.0.0.255 area 0
D2(config-router)#network 10.67.102.0 0.0.0.255 area 0
D2(config-router)#network 10.67.11.0 0.0.0.255 area 0
D2(config-router)#passive-interface default
D2(config-router)#no passive-interface e3/0
D2(config-router)#exit
D2(config)#
D2(config)#
D2(config)#ipv6 router ospf 6
D2(config-rtr)#router-id 0.0.6.132
D2(config-rtr)#passive-interface default
D2(config-rtr)#no passive-interface e1/2
D2(config-rtr)#exit
D2(config)#interface e1/0
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#interface vlan 100
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#interface vlan 101
D2(config-if)#ipv6 ospf 6 area 0
D2(config-if)#exit
D2(config)#interface vlan 102
```

Fuente: Autoría Propia

Figura 26. show run | section ip sla D1

```
D1#show run | section ip sla
track 4 ip sla 4
  delay down 10 up 15
track 6 ip sla 6
  delay down 10 up 15
ip sla 4
  icmp-echo 10.67.10.1
  frequency 5
ip sla schedule 4 life forever start-time now
ip sla 6
  icmp-echo 2001:DB8:100:1010::1
  frequency 5
ip sla schedule 6 life forever start-time now
D1#
```

Fuente: Autoría Propia

Figura 27. show standby brief D1

```
D1#show standby brief
          P indicates configured to preempt.
          |
Interface  Grp  Pri P State  Active      Standby      Virtual IP
Vl100     104  150 P Active local       unknown     10.67.100.254
Vl100     106  150 P Active local       FE80::D2:2  FE80::5:73FF:FEA0:6A
Vl101     114  150 P Active local       unknown     10.67.101.254
Vl101     116  150 P Active local       FE80::D2:3  FE80::5:73FF:FEA0:74
Vl102     124  150 P Active local       unknown     10.67.102.254
Vl102     126  150 P Active local       FE80::D2:4  FE80::5:73FF:FEA0:7E
D1#
```

Fuente: Autoría Propia

Figura 28. show run | section ip sla D2

```
D2#show run | section ip sla
track 4 ip sla 4
  delay down 10 up 15
track 6 ip sla 6
  delay down 10 up 15
ip sla 4
  icmp-echo 10.67.11.1
  frequency 5
ip sla schedule 4 life forever start-time now
ip sla 6
  icmp-echo 2001:DB8:100:1011::1
  frequency 5
ip sla schedule 6 life forever start-time now
D2#
```

Fuente: Autoría Propia

Figura 29. Show run | section ^router ospf R1

```
R1#show run | section ^router ospf
*Dec 1 20:20:24.655: %SYS-5-CONFIG_I: Configured from console by console
R1#show run | section ^router ospf
router ospf 4
  router-id 0.0.4.1
  log-adjacency-changes
  network 10.67.10.0 0.0.0.255 area 0
  network 10.67.13.0 0.0.0.255 area 0
  default-information originate
R1#
```

Fuente: Autoría Propia

Figura 30. Show run | section ^router ospf R2

```
R2#show run | section ^router ospf
router ospf 4
  router-id 0.0.4.3
  log-adjacency-changes
  network 10.67.11.0 0.0.0.255 area 0
  network 10.67.13.0 0.0.0.255 area 0
R2#
```

Fuente: Autoría Propia

Figura 31. Show run | section ^router ospf on D1

```
D1#show run | section ^router ospf
router ospf 4
  router-id 0.0.4.131
  passive-interface default
  no passive-interface Ethernet1/2
  network 10.67.10.0 0.0.0.255 area 0
  network 10.67.100.0 0.0.0.255 area 0
  network 10.67.101.0 0.0.0.255 area 0
  network 10.67.102.0 0.0.0.255 area 0
D1#
```

Fuente: Autoría Propia

Figura 32. Show run | section ^router ospf on D2

```
D2#show run | section ^router ospf
router ospf 4
  router-id 0.0.4.132
  passive-interface default
  no passive-interface Ethernet3/0
  network 10.67.11.0 0.0.0.255 area 0
  network 10.67.100.0 0.0.0.255 area 0
  network 10.67.101.0 0.0.0.255 area 0
  network 10.67.102.0 0.0.0.255 area 0
D2#
```

Fuente: Autoría Propia

Figura 33. Show run | section ^ipv6 route R1

```
R1#show run | section ^ipv6 route
ipv6 route 2001:DB8:100::/48 Null0
ipv6 router ospf 6
  router-id 0.0.6.1
  log-adjacency-changes
  default-information originate
R1#
```

Fuente: Autoría Propia

Figura 34. Show ipv6 ospf interface brief R1

```
R1#show ipv6 ospf interface brief
Interface  PID  Area      Intf ID  Cost  State Nbrs F/C
Et1/2     6   0         7        10   DR    1/1
Et1/1     6   0         6        10   DR    1/1
R1#
R1#
```

Fuente: Autoría Propia

Figura 35. Show ipv6 ospf interface brief R2

```
R2#show run | section ^ipv6 route
R2#show ipv6 ospf interface brief
Interface  PID  Area      Intf ID  Cost  State Nbrs F/C
Et1/1     6   0         6        10   BDR   1/1
Et1/0     6   0         5        10   DR    0/0
R2#
```

Fuente: Autoría Propia

Figura 36. Show ipv6 ospf interface brief D1

```
D1#show ipv6 ospf interface brief
Interface PID Area Intf ID Cost State Nbrs F/C
Vl102 6 0 29 1 DR 0/0
Vl101 6 0 28 1 DR 0/0
Vl100 6 0 27 1 DR 0/0
Et1/2 6 0 25 10 BDR 1/1
D1#
```

Fuente: Autoría Propia

Figura 37. Show ipv6 ospf interface brief D2

```
D2#show ipv6 ospf interface brief
Interface PID Area Intf ID Cost State Nbrs F/C
Vl102 6 0 29 1 DR 0/0
Vl101 6 0 28 1 DR 0/0
Vl100 6 0 27 1 DR 0/0
Et1/0 6 0 25 10 DR 0/0
D2#
```

Fuente: Autoría Propia

Figura 38. Show run | section bgp R3

```
R3#show run | section ^ipv6 route
ipv6 route ::/0 Loopback0
R3#show run | section bgp and show run | include route
R3#
R3#
R3#show run | section bgp
router bgp 500
  bgp router-id 2.2.2.2
  bgp log-neighbor-changes
  neighbor 2001:DB8:200::1 remote-as 300
  neighbor 209.165.200.255 remote-as 300
  !
  address-family ipv4
    no neighbor 2001:DB8:200::1 activate
    neighbor 209.165.200.255 activate
    no auto-summary
    no synchronization
    network 0.0.0.0
    network 2.2.2.2 mask 255.255.255.255
  exit-address-family
  !
  address-family ipv6
    neighbor 2001:DB8:200::1 activate
    network ::/0
    network 2001:DB8:2222::/128
  exit-address-family
R3#
```

Fuente: Autoría Propia

Figura 39. Show run | include route R3

```
R3#show run | include route
router bgp 500
  bgp router-id 2.2.2.2
ip route 0.0.0.0 0.0.0.0 Loopback0
ipv6 route ::/0 Loopback0
R3#
```

Fuente: Autoría Propia

Figura 40. Show run | section bgp R1

```
R1#show run | section bgp
router bgp 300
  bgp router-id 1.1.1.1
  bgp log-neighbor-changes
  neighbor 2001:DB8:200::2 remote-as 500
  neighbor 209.165.200.226 remote-as 500
  !
  address-family ipv4
    neighbor 2001:DB8:200::2 activate
    neighbor 209.165.200.226 activate
    no auto-summary
    no synchronization
    network 10.0.0.0
  exit-address-family
  !
  address-family ipv6
    neighbor 2001:DB8:200::2 activate
    network 2001:DB8:100::/48
  exit-address-family
R1#
```

Fuente: Autoría Propia

Figura 41. Show ip route | include O|B R1

```
R1#show ip route | include O|B
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
       o - ODR, P - periodic downloaded static route
O       10.67.101.0/24 [110/11] via 10.67.10.2, 00:26:01, Ethernet1/2
O       10.67.100.0/24 [110/11] via 10.67.10.2, 00:26:01, Ethernet1/2
O       10.67.102.0/24 [110/11] via 10.67.10.2, 00:26:01, Ethernet1/2
O       10.67.11.0/24 [110/20] via 10.67.13.3, 00:26:01, Ethernet1/1
R1#
```

Fuente: Autoría Propia

Figura 42. Show ipv6 route command R1

```
R1#show ipv6 route
IPv6 Routing Table - 14 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
B   ::/0 [20/0]
    via FE80::2:1, Ethernet1/0
S   2001:DB8:100::/48 [1/0]
    via ::, Null0
O   2001:DB8:100:100::/64 [110/11]
    via FE80:D1:1, Ethernet1/2
O   2001:DB8:100:101::/64 [110/11]
    via FE80:D1:1, Ethernet1/2
O   2001:DB8:100:102::/64 [110/11]
    via FE80:D1:1, Ethernet1/2
C   2001:DB8:100:1010::/64 [0/0]
    via ::, Ethernet1/2
L   2001:DB8:100:1010::1/128 [0/0]
    via ::, Ethernet1/2
O   2001:DB8:100:1011::/64 [110/20]
    via FE80:3:3, Ethernet1/1
C   2001:DB8:100:1013::/64 [0/0]
    via ::, Ethernet1/1
L   2001:DB8:100:1013::1/128 [0/0]
    via ::, Ethernet1/1
C   2001:DB8:200::/64 [0/0]
    via ::, Ethernet1/0
L   2001:DB8:200::1/128 [0/0]
    via ::, Ethernet1/0
L   FE80::/10 [0/0]
    via ::, Null0
L   FF00::/8 [0/0]
    via ::, Null0
```

Fuente: Autoría Propia

Figura 43. Show ip route ospf | begin Gateway R2

```
R2#show ip route ospf
 10.0.0.0/24 is subnetted, 6 subnets
O    10.67.101.0 [110/21] via 10.67.13.1, 00:29:11, Ethernet1/1
O    10.67.100.0 [110/21] via 10.67.13.1, 00:29:11, Ethernet1/1
O    10.67.102.0 [110/21] via 10.67.13.1, 00:29:11, Ethernet1/1
O    10.67.10.0 [110/20] via 10.67.13.1, 00:29:11, Ethernet1/1
R2#
R2#
```

Fuente: Autoría Propia

Figura 44. Show ipv6 route ospf R2

```
R2#show ipv6 route ospf
IPv6 Routing Table - 14 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
OE2  ::/0 [110/1], tag 6
     via FE80::1:3, Ethernet1/1
O   2001:DB8:100:100::/64 [110/21]
     via FE80::1:3, Ethernet1/1
O   2001:DB8:100:101::/64 [110/21]
     via FE80::1:3, Ethernet1/1
O   2001:DB8:100:102::/64 [110/21]
     via FE80::1:3, Ethernet1/1
O   2001:DB8:100:1013::/64 [110/10]
     via ::, Ethernet1/1
R2#
R2#
```

Fuente: Autoría Propia

CONCLUSIONES

Con el software GNS3, se realiza la configuración de los router, switch, pc estructurando una red conmutada mediante el uso del protocolo STP y la configuración de Vlans, permitiendo comprender las características de una infraestructura de red jerárquica convergente.

Se logra establecer el enrutamiento requerido por ipv4, ipv6, Vlans, diseñando soluciones de red escalable mediante la configuración básica y avanzada de protocolos de enrutamiento para la implementación de servicios IP con calidad de servicios en ambientes de red empresarial.

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