# DIPLOMADO DE PROFUNDIZACION CISCO
# PRUEBA DE HABILIDADES PRÁCTICAS CCNP

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UNIVERSIDAD NACIONAL ABIERTA Y A DISTANCIA - UNAD ESCUELA DE CIENCIAS BÁSICAS, TECNOLOGÍA E INGENIERÍA - ECBTI
INGENIERÍA TELECOMUNICACIONES
GIRARDOT CUNDINAMARCA
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Diplomado de opción de grado presentado para optar el título de INGENIERO DE TELECOMUNICACIONES

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NOTA DE ACEPTACIÓN

Firma del presidente del Jurado

Firma del Jurado

Firma del Jurado

GIRARDOT CUNDINAMARCA, 17 de noviembre de 2022

# AGRADECIMIENTOS

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## GLOSARIO

Ipv4: IPv4 es el nombre del protocolo de Internet utilizado actualmente para las direcciones IP de los dominios. Estas direcciones IP se asignan automáticamente cuando se registra un dominio.

IPV6: IPv6 (Internet Protocol Versión 6) o IPng (Next Generation Internet Protocol) es la nueva versión del protocolo IP (Internet Protocol). Ha sido diseñado por el IETF (Internet Engineering Task Force) para reemplazar en forma gradual a la versión actual, el IPv4.

OSPF: Open Shortest Path First (OSPF) es un protocolo de direccionamiento de tipo enlace-estado, desarrollado para las redes IP y basado en el algoritmo de primera vía más corta (SPF). OSPF es un protocolo de pasarela interior (IGP).

VLAN: Las VLAN (redes de área local virtuales) pueden considerarse como dominios de difusión lógica. Una VLAN divide los grupos de usuarios de la red de una red física real en segmentos de redes lógicas.

MP-BGP: Multiprotocolo -BGP, permite que BGP lleve información de IPv6 y otros protocolos de red múltiple.

## RESUMEN

El presente trabajo se desarrolla con la finalidad de optar por el título de Ingeniero de Telecomunicaciones y/o Electrónica, de la Universidad nacional Abierta y a Distancia UNAD de Colombia, mediante el desarrollo del Diplomado CISCO, para ellos se debe implementar las habilidades practicas CCNP, mediante el uso de un simulador llamado GNS3 el cual simula Redes reales A partir de Escenarios Propuestos en la guía de actividades, donde primero solicita realizar la configuración de protocolos de conmutación y luego establecer enrutamiento entre la LAN y una IPS, dando así como resultado la posibilidad de comunicarse entre sí, con ello lo que podemos decir es que gracias a este trabajo podemos simular escenarios a los cuales podríamos enfrentarnos como futuros ingenieros.



Palabras Clave: CISCO, CCNP, Conmutación, Enrutamiento, Redes, Electrónica.



## ABSTRACT

The present work is developed with the purpose of opting for the title of Telecommunications and/or Electronics Engineer, of the National Open and Distance University UNAD of Colombia, through the development of the CISCO Diploma, for them the practical skills CCNP must be implemented, through the use of a simulator called GNS3 which simulates real networks From Proposed Scenarios in the activity guide, where it first requests to configure the switching protocols and then establish routing between the LAN and an IPS, thus resulting in the possibility of communicating with each other, with this what we can say is that thanks to this work we can simulate scenarios that we could face as future engineers.



Keywords: CISCO, CCNP, Routing, Swicthing, Networking, Electronics.

# INTRODUCCION

Las Redes de datos y sistemas informáticos han tenido sin duda alguna un auge muy importante en los últimos tiempo, dado es el caso más reciente de la pandemia del covid 19 que sin duda nos afectó de cualquier manera la forma en que veníamos haciendo las cosas y la forma en como nos comunicamos, la forma en que trabajos acrecentó mayormente el uso de las TICS por ello es importante capacitar al futuro ingeniero de Telecomunicaciones, en la configuración de diferentes protocolos que permitan la operabilidad de dichas redes para ello el objetivo del diplomado de CISCO es hacer que podamos desarrollar procesos mediante un simulador que nos permite hacer enrutamientos entre una LAN y una IPS, obteniendo como resultado redes convergentes que simulan la trasmisión de datos.

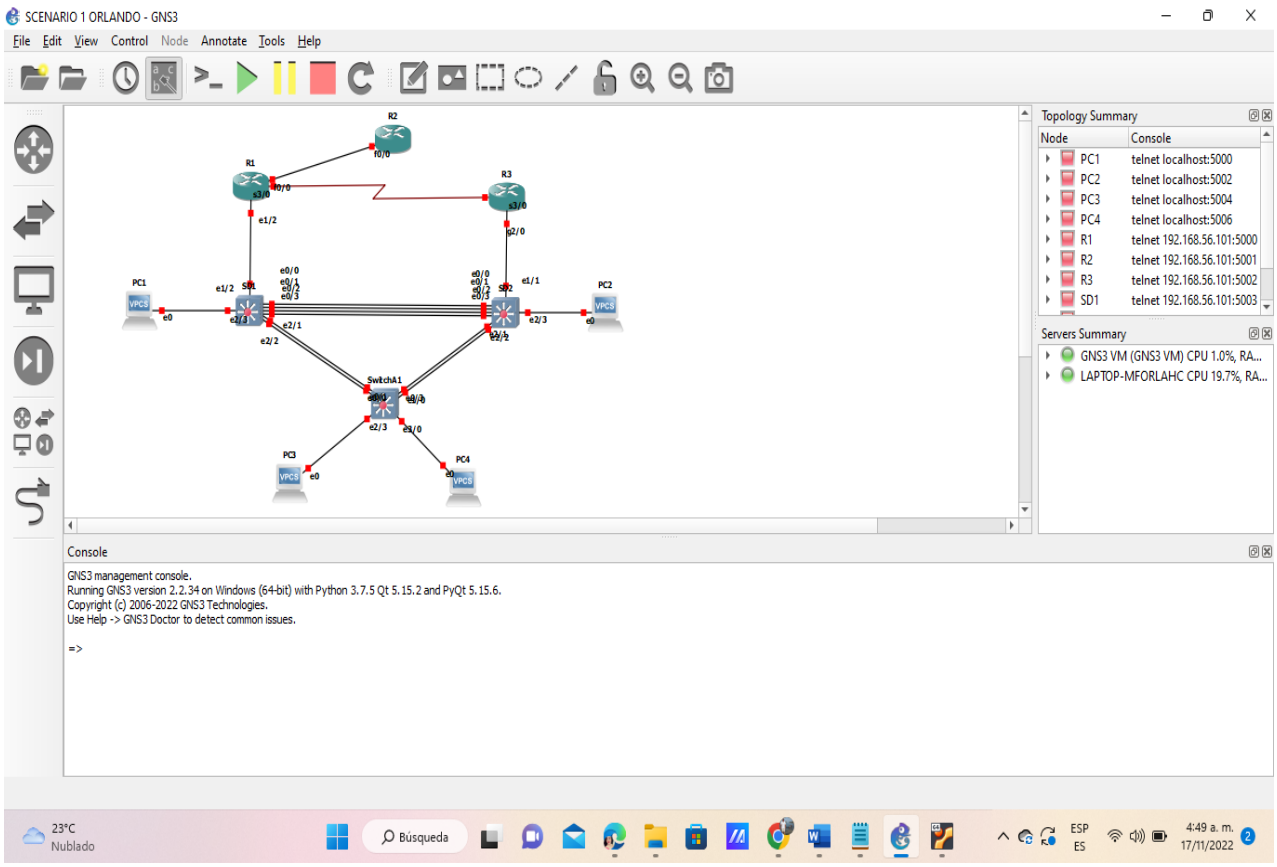
Para ello se divide en dos escenarios el primer escenario, nos solicita construir la Topología de la Red y la configuración de los ajustes básicos del dispositivo y el direccionamiento de la interfaz, para ello se utilizan 3 routers, 3 switches y 4 PCs. Aquí se configuran la red de capa 2 y la configuración de los protocolos de enrutamiento.

Para el segundo escenario se deben configurar los protocolos de enrutamiento Ipv4 e Ipv6, en este paso la red debe estar completamente convergente.

ESCENARIO 1

PARTE 1: CONSTRUIR LA RED Y CONFIGURAR LOS PARÁMETROS BÁSICOS DE LOS DISPOSITIVOS Y EL DIRECCIONAMIENTO DE LAS INTERFACES

Figura 1. Escenario 1



Paso 2: Configurar los parámetros básicos para cada dispositivo

Router R1

```
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.XY.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.XY.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

```
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

```
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.XY.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.XY.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

```
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
VLANs 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.XY.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 VLANs 100
```

```
 Ip address 10.XY.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 VLANs 101
 Ip address 10.XY.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 VLANs 102
 Ip address 10.XY.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.XY.101.1 10.XY.101.109
ip dhcp excluded address 10.XY.101.141 10.XY.101.254
ip dhcp excluded address 10.XY.102.1 10.XY.102.109
ip dhcp excluded address 10.XY.102.141 10.XY.102.254
ip dhcp pool VLAN-101
 network 10.XY.101.0 255.255.255.0
 default-router 10.XY.101.254
 exit
ip dhcp pool VLAN-102
 network 10.XY.102.0 255.255.255.0
 default-router 10.XY.102.254
 exit
interface range e0/0-3, e1/0-1, e1/3, e2/0-3, e3/0-3
 shutdown
 exit
```

Switch D2

```
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.XY.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.XY.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.XY.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.XY.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.XY.101.1 10.XY.101.209
ip dhcp excluded address 10.XY.101.241 10.XY.101.254
ip dhcp excluded address 10.XY.102.1 10.XY.102.209
ip dhcp excluded address 10.XY.102.241 10.XY.102.254
ip dhcp pool VLAN-101
 network 10.XY.101.0 255.255.255.0
 default-router XY.0.101.254
 exit
ip dhcp pool VLAN-102
 network 10.XY.102.0 255.255.255.0
 default-router 10.XY.102.254
 exit
interface range e0/0-3, e1/1-3, e2/0-3,e3/0-3
 shutdown
 exit
```

Switch A1

```
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.XY.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
```

a. Save the running configuration to startup-config on all devices.

b. Configure PC 1 and PC 4 host addressing as shown in the addressing table. Assign a default gateway address of 10.XY.100.254 which will be the HSRP virtual IP address used in Part 4.

Figura 2. configuración de los PC

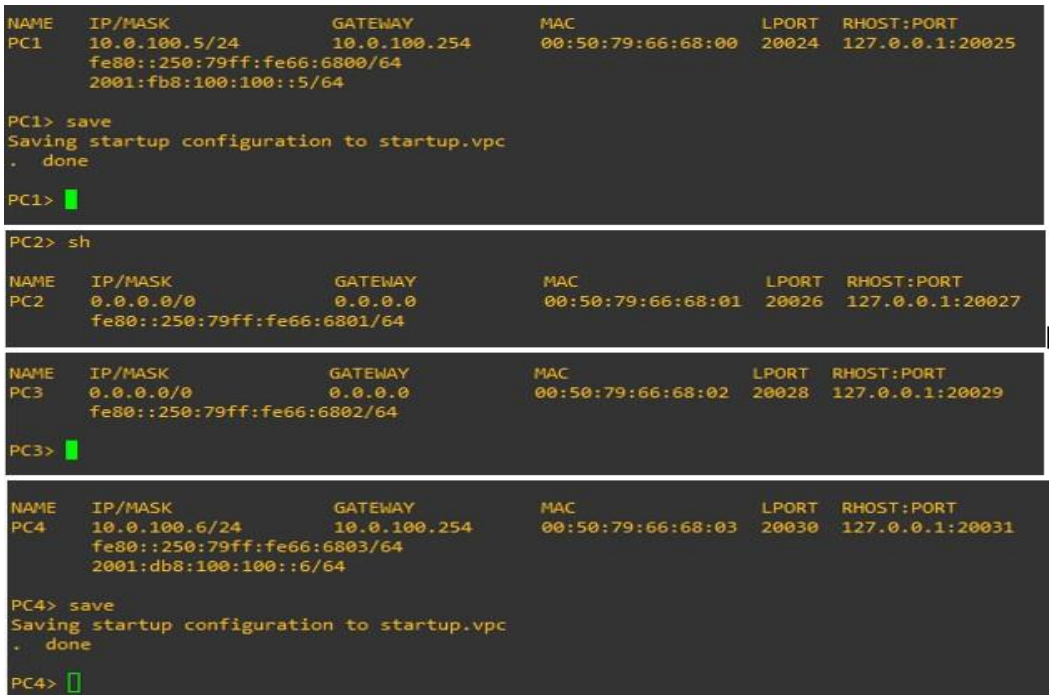


Tabla 1. Especificaciones de configuración

| 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:<br>• D1 and D2<br>• D1 and A1<br>• 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.<br>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 EtherChannel's as shown in the topology diagram. | Use the following channel numbers:<br>• D1 to D2 – Port channel 12<br>• D1 to A1 – Port channel 1<br>• 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.<br>Host ports should transition immediately to forwarding state. | 4 |
| 2.7 | Verify IPv4 DHCP services. | PC2 and PC3 are DHCP clients and should be receiving valid IPv4 addresses. | 1 |

| Task# | Task | Specification | Points |
|---|---|---|---|
| 2.8 | Verify local LAN connectivity. | PC1 should successfully ping:<br>• D1: 10.XY.100.1<br>• D2: 10.XY.100.2<br>• PC4: 10.XY.100.6<br>PC2 should successfully ping:<br>• D1: 10.XY.102.1<br>• D2: 10.XY.102.2<br>PC3 should successfully ping:<br>• D1: 10.XY.101.1<br>• D2: 10.XY.101.2<br>PC4 should successfully ping:<br>• D1: 10.XY.100.1<br>• D2: 10.XY.100.2<br>• PC1: 10.XY.100.5 | 1 |

**Paso 1: Configurar las interfaces troncales**

Switch D1:

D1(config)# interface range e0/0 - 3, e1/0 - 1//configura un grupo de interfaces
D1(config-if-range) # switchport trunk encapsulation dot1q //establece la encapsulación en el estándar IEEE 802.1Q
D1(config-if-range)#switchport mode trunk //configure la interfaz truncal

Switch D2:
D2(config)# interface range e0/0 - 3, e1/0 - 1
D2(config-if-range)#switchport trunk encapsulation dot1q D2(config-if-range)#switchport mode trunk
D2(config-if-range)#exit

Switch A1:
A1(config)#interface range e0/0 – 3
A1(config-if-range)#switchport trunk encapsulation dot1q A1(config-if-range)#switchport mode trunk

Paso 2: Configurar la VLAN 99 como nativa:

Switch D1:

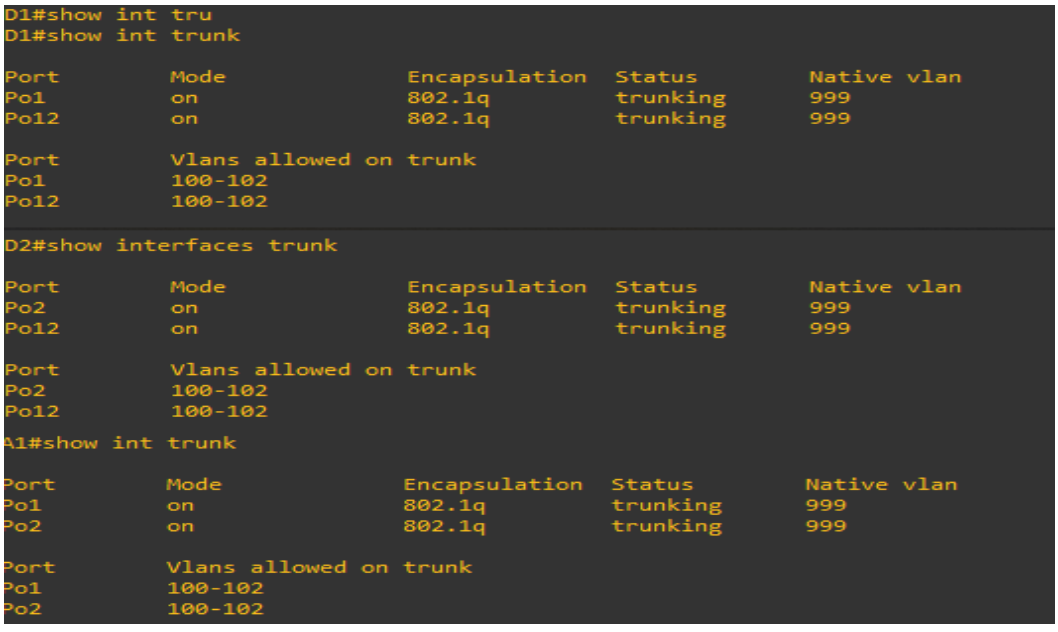
interface range e0/0 - 3, e1/0 - 1
switchport trunk native vlan 999

Switch D2:

interface range e0/0 - 3, e1/0 - 1
switchport trunk native vlan 999

Switch A1:
interface range e0/0 - 3
switchport trunk native vlan 999

Figura 3. Verificación de los enlaces troncales



Paso 3: Habilitar protocolo Rapid Spanning-Tree (RSTP).

Switch D1:
D1(config)#spanning-tree mode rapid-pvst
D1(config)#

Switch D2:
D2(config)#spanning-tree mode rapid-pvst
D2(config)#

Switch A1:
A1(config)#spanning-tree mode rapid-pvst
A1(config)#

Paso 4: Configurar los puentes raíz (root bridges)

Switch D1:

D1(config)#spanning-tree vlan 100 root primary
D1(config)#spanning-tree vlan 102 root primary
D1(config)#spanning-tree vlan 101 root secondary

Switch D2:

D2(config)#spanning-tree vlan 101 root primary
D2(config)#spanning-tree vlan 100 root secondary
D2(config)#spanning-tree vlan 102 root secondary

Figura 4 verificacion Spanning tree

```
D1# show run | include spanning-tree
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 100,102 priority 8192
spanning-tree vlan 101 priority 28672
D1#
```

```
D2#show run | include spanning-tree
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 100,102 priority 28672
spanning-tree vlan 101 priority 8192
D2#
```

Paso 5: crear los LACP.

Switch D1:
interface range e0/0 – 3
channel-protocol lacp
channel-group 12 mode active
Creating a port-channel interface Port-channel 12
exit
interface port-channel 12
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
switchport trunk allowed vlan 100-102
exit
interface range e1/0 - 1
channel-protocol lacp
channel-group 1 mode active
Creating a port-channel interface Port-channel 1
exit
interface port-channel 1
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
switchport trunk allowed vlan 100-102
exit.

Switch D2:
D2(config)# interface range e0/0 - 3
D2(config-if-range) #channel-protocol lacp
D2(config-if-range) #channel-group 12 mode active
D2(config-if-range) #
Creating a port-channel interface Port-channel 12
D2(config-if-range) #exit
D2(config)#interfac port-channel 12
D2(config-if) #switchport trunk encapsulation dot1q
D2(config-if) #switchport mode trunk
D2(config-if) #switchport trunk native vlan 999
D2(config-if) #switchport trunk allowed vlan 100-102
D2(config-if) #exit
D2(config)# interface range e1/0 - 1
D2(config-if-range) #channel-protocol lacp
D2(config-if-range) #channel-group 2 mode active
D2(config-if-range) #

Creating a port-channel interface Port-channel 2
D2(config-if-range) #exit
D2(config)#interfac port-channel 2
D2(config-if) #switchport trunk encapsulation dot1q
D2(config-if) #switchport mode trunk
D2(config-if) #switchport trunk native vlan 999
D2(config-if) #switchport trunk allowed vlan 100-102
D2(config-if) #exit
D2(config)#

Switch A1:
A1(config)# interface range e0/0 - 1
A1(config-if-range) #channel-protocol lacp
A1(config-if-range) #channel-group 1 mode passive
A1(config-if-range) #
Creating a port-channel interface Port-channel 1
A1(config-if-range) #exit
A1(config)#interfac port-channel 1
A1(config-if) #switchport trunk native vlan 999
A1(config-if) #switchport trunk allowed vlan 100-102
A1(config-if) #switchport mode trunk
A1(config-if) #exit
A1(config)# interface range e0/2 - 3
A1(config-if-range) #channel-protocol lacp
A1(config-if-range) #channel-group 2 mode passive
A1(config-if-range) #
Creating a port-channel interface Port-channel 2
A1(config-if-range) #exit
A1(config)#interfac port-channel 2
A1(config-if) #switchport mode trunk
A1(config-if) #switchport trunk native vlan 999
A1(config-if) #switchport trunk allowed vlan 100-102
A1(config-if) #exit

Paso 6: Configurar los puertos de acceso a los PC.

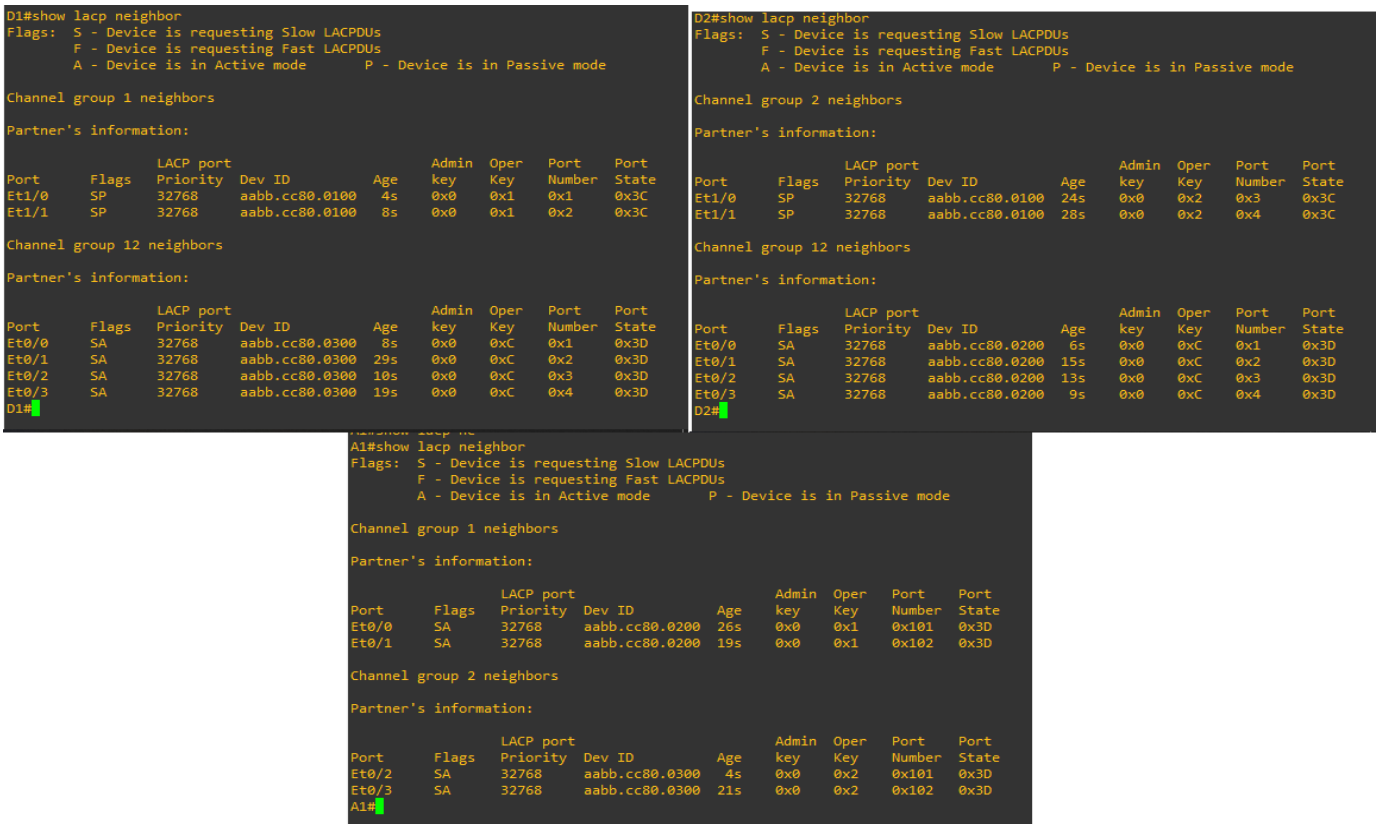
Switch D1:

D1(config)# interface e4/0
D1(config-if) #switchport mode access
D1(config-if) #switchport access vlan 100

Switch D2:
D2(config)# interface e4/0
D2(config-if) #switchport mode access
D2(config-if) #switchport access vlan 102

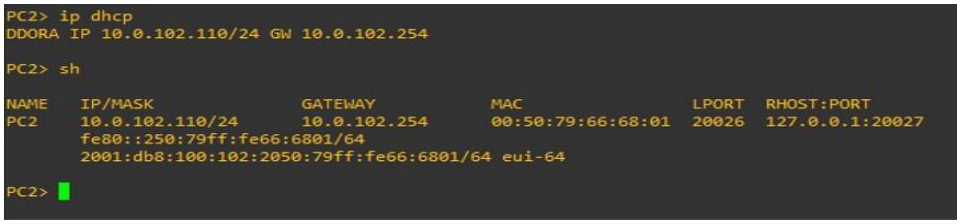
Switch A1:
A1(config)# interface e2/0
A1(config-if) #switchport mode access
A1(config-if) #switchport access vlan 101
A1(config-if) #exit
A1(config)# interface e2/1
A1(config-if) #switchport mode access
A1(config-if) #switchport access vlan 100
A1(config-if) #exit
A1(config)#

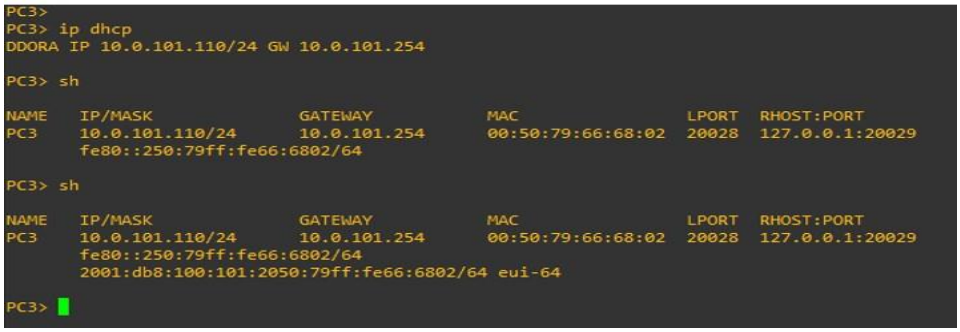
Figura 5. Verificación de las LACP



**Paso 7: Verificar los PC en DHCP:**

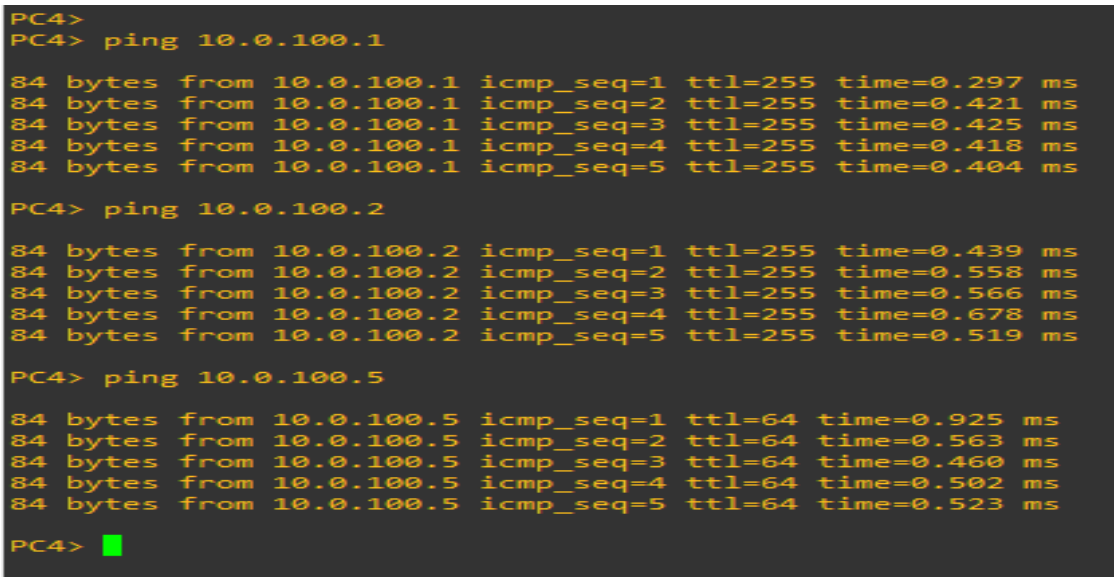
*Figura 6. IP de los PC en DHCP*



**Paso 8: Verificación de la conectividad de la LAN local**

*Figura 7. Ping entre los dispositivos de la red local*



Scenario 2.  Parte 1: Configure Routing Protocol

Router 1.

```
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
interface g1/0
ipv6 ospf 6 area 0
exit
interface s3/0
ipv6 ospf 6 area 0
exit

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
no neighbor 2001:db8:200::2 activate
network 10.0.0.0 mask 255.0.0.0
exit-address-family
```

Router 2

```
ip route 0.0.0.0.0.0.0.0 loopback 0
ipv6 route ::/0 loopback 0
router bgp 500
bgp router-id 2.2.2.2
no bgp default ipv4-unicast
neighbor 209.165.200.255 remote-as 300
neighbor 2001: db8:200::1 remote-as 300
address-family ipv4 unicast
neighbor 209.165.200.225 activate
network 2.2.2.2 mask 255.255.255.255
network 0.0.0.0 mask 0.0.0.0
exit
address-family ipv6 unicast
neighbor 2001:db8:200::1 activate
```

network 2001:db8:2222::1/128
network: :/0

Router 3

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
ipv6 router ospf 6
router-id 0.0.6.3
exit
interface g0/0/1
ipv6 ospf 6 area 0
exit
interface s0/1/0
ipv6 ospf 6 area 0
exit.

Switch D1:

D1(config)#router ospf 4
D1(config-router)#router-id 0.0.4.131
D1(config-router)#network 10.0.10.0 0.0.0.255 area 0
D1(config-router)#network 10.0.100.0 0.0.0.255 area 0
D1(config-router)#network 10.0.101.0 0.0.0.255 area 0
D1(config-router)#network 10.0.102.0 0.0.0.255 area 0
D1(config-router)#passive-interface default
D1(config-router)#no passive-interface e6/0

Switch D2:

D2(config)#router ospf 4
D2(config-router)#router-id 0.0.4.132
D2(config-router)#network 10.0.11.0 0.0.0.255 area 0
D2(config-router)#network 10.0.100.0 0.0.0.255 area 0
D2(config-router)#network 10.0.101.0 0.0.0.255 area 0
D2(config-router)#network 10.0.102.0 0.0.0.255 area 0
D2(config-router)#passive-interface default
D2(config-router)#no passive-interface e6/0

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

Router R1

```
ipv6 router ospf 6
router-id 0.0.6.1
exit
interface s2/0
ipv6 ospf 6 area 0
interface g1/0
ipv6 ospf 6 area 0
exit
ipv6 route ::/0 g0/0
ipv6 router ospf 6
default-information originate
```

Router R3:

```
ipv6 router ospf 6
router-id 0.0.6.3
exit
interface s2/0
ipv6 ospf 6 area 0
interface g1/0
ipv6 ospf 6 area 0PA
```

Switch D1:

```
ipv6 router ospf 6
router-id 0.0.6.131
interface e6/0
ipv6 ospf 6 area 0
exit
interface vlan 100
ipv6 ospf 6 area 0
interface vlan 101
ipv6 ospf 6 area 0
interface vlan 102
ipv6 ospf 6 area 0
```

Switch D2:

```
ipv6 router ospf 6
router-id 0.0.6.132
interface e6/0
```

```
ipv6 ospf 6 area 0
interface vlan 100
ipv6 ospf 6 area 0
interface vlan 101
ipv6 ospf 6 area 0
interface vlan 102
ipv6 ospf 6 area 0
```

3.3 On R2 in the “ISP Network”, configure MP-BGP.

Router R2:

```
ip route 0.0.0.0 0.0.0.0 loopback 0
ipv6 route ::/0 loopback 0
router bgp 500
bgp router-id 2.2.2.2
no bgp default ipv4-unicast
neighbor 209.165.200.225 remote-as 300
neighbor 2001:db8:200::1 remote-as 300
address-family ipv4 unicast
neighbor 209.165.200.225 activate
network 2.2.2.2 mask 255.255.255.255
network 0.0.0.0 mask 0.0.0.0
exit
address-family ipv6 unicast
neighbor 2001:db8:200::1 activate
network 2001:db8:2222::1/128
network ::/0
exit
```

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

Router R1:

```
ip route 10.0.0.0 255.0.0.0 null 0
ipv6 route 2001:db8:100::/48 null 0
router bgp 300
bgp router-id 1.1.1.1
no bgp default ipv4-unicast
neighbor 209.165.200.226 remote-as 500
neighbor 2001:db8:200::2 remote-as 500
```

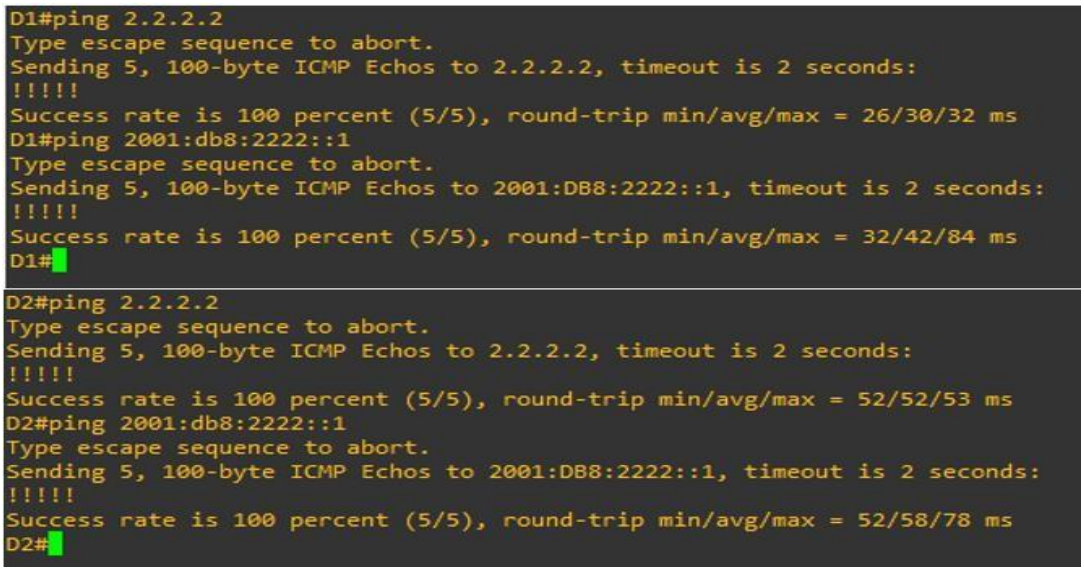
address-family ipv4 unicast
neighbor 209.165.200.226 activate
network 10.0.0.0 mask 255.0.0.0
exit
address-family ipv6 unicast
neighbor 2001:db8:200::2 activate
network 2001:db8:100::/48

Figura 8. Tabla ruta ipv4

```
D1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 10.0.10.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.0.10.1, 01:04:40, Ethernet6/0
      10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
C        10.0.10.0/24 is directly connected, Ethernet6/0
L        10.0.10.2/32 is directly connected, Ethernet6/0
O        10.0.11.0/24 [110/75] via 10.0.10.1, 01:04:40, Ethernet6/0
O        10.0.13.0/24 [110/74] via 10.0.10.1, 01:04:40, Ethernet6/0
C        10.0.100.0/24 is directly connected, Vlan100
L        10.0.100.1/32 is directly connected, Vlan100
C        10.0.101.0/24 is directly connected, Vlan101
L        10.0.101.1/32 is directly connected, Vlan101
C        10.0.102.0/24 is directly connected, Vlan102
L        10.0.102.1/32 is directly connected, Vlan102
D1#
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S*    0.0.0.0/0 is directly connected, GigabitEthernet0/0
      10.0.0.0/8 is variably subnetted, 9 subnets, 3 masks
S        10.0.0.0/8 is directly connected, Null0
C        10.0.10.0/24 is directly connected, GigabitEthernet1/0
L        10.0.10.1/32 is directly connected, GigabitEthernet1/0
O        10.0.11.0/24 [110/65] via 10.0.13.3, 01:05:42, Serial2/0
C        10.0.13.0/24 is directly connected, Serial2/0
L        10.0.13.1/32 is directly connected, Serial2/0
O        10.0.100.0/24 [110/2] via 10.0.10.2, 01:05:42, GigabitEthernet1/0
O        10.0.101.0/24 [110/2] via 10.0.10.2, 00:24:58, GigabitEthernet1/0
O        10.0.102.0/24 [110/2] via 10.0.10.2, 00:24:36, GigabitEthernet1/0
      209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C        209.165.200.224/27 is directly connected, GigabitEthernet0/0
```

```
D2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 10.0.11.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.0.11.1, 01:07:01, Ethernet6/0
      10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
O        10.0.10.0/24 [110/75] via 10.0.11.1, 01:07:01, Ethernet6/0
C        10.0.11.0/24 is directly connected, Ethernet6/0
L        10.0.11.2/32 is directly connected, Ethernet6/0
O        10.0.13.0/24 [110/74] via 10.0.11.1, 01:07:01, Ethernet6/0
C        10.0.100.0/24 is directly connected, Vlan100
L        10.0.100.2/32 is directly connected, Vlan100
C        10.0.101.0/24 is directly connected, Vlan101
L        10.0.101.2/32 is directly connected, Vlan101
C        10.0.102.0/24 is directly connected, Vlan102
L        10.0.102.2/32 is directly connected, Vlan102
D2#

R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 10.0.13.1 to network 0.0.0.0

O*E2  0.0.0.0/0 [110/1] via 10.0.13.1, 01:05:35, Serial2/0
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O        10.0.10.0/24 [110/65] via 10.0.13.1, 01:04:54, Serial2/0
C        10.0.11.0/24 is directly connected, GigabitEthernet1/0
L        10.0.11.1/32 is directly connected, GigabitEthernet1/0
C        10.0.13.0/24 is directly connected, Serial2/0
L        10.0.13.3/32 is directly connected, Serial2/0
O        10.0.100.0/24 [110/2] via 10.0.11.2, 00:26:42, GigabitEthernet1/0
O        10.0.101.0/24 [110/2] via 10.0.11.2, 00:25:17, GigabitEthernet1/0
O        10.0.102.0/24 [110/2] via 10.0.11.2, 01:04:54, GigabitEthernet1/0
R3#
```

*Figura 9. Ping D1 y D2 hacia Loopback 0*



Parte 2.  Configure First Hop Redundancy

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

Switch D1:
D1(config)#
ip sla 4 //Crea el SLA
icmp-echo 10.0.10.1 source-ip 10.0.10.2 //define el destino y la fuente
frequency 5 //define cada cuantos segundos
exit
ip sla schedule 4 start-time now life forever // inicia SLA ahora y siempre
track 4 ip sla 4 reachability //crea el objeto para saber si down o up
delay up 10 down 15 // se dan los retardos solicitados
exit
ip sla 6
icmp-echo 2001:db8:100:1010::1 source-interface e6/0
frequency 5
exit
ip sla schedule 6 start-time now life forever
track 6 ip sla 6 reachability
delay up 10 down 15
exit

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

Switch D2:

D2(config)#ip sla 4
icmp-echo 10.0.11.1 source-interface e6/0
frequency 5
exit
ip sla schedule 4 start-time now life forever
track 4 ip sla 4 reachability
delay up 10 down 15
exit
ip sla 6
icmp-echo 2001:db8:100:1011::1 source-interface e6/0
frequency 5
exit
ip sla schedule 6 start-time now life forever
track 6 ip sla 6 reachability
delay up 10 down 15
exit

Figura 10. Verificación de las SLAs

```
D1# show run | section ip sl
track 4 ip sla 4 reachability
 delay down 15 up 10
track 6 ip sla 6 reachability
 delay down 15 up 10
ip sla 4
 icmp-echo 10.0.10.1 source-interface Ethernet6/0
 frequency 5
ip sla schedule 4 life forever start-time now
ip sla 6
 icmp-echo 2001:DB8:100:1010::1 source-interface Ethernet6/0
 frequency 5
ip sla schedule 6 life forever start-time now
D1#

D2#show run | section ip sla
track 4 ip sla 4 reachability
 delay down 15 up 10
track 6 ip sla 6 reachability
 delay down 15 up 10
ip sla 4
 icmp-echo 10.0.11.1 source-interface Ethernet6/0
 frequency 5
ip sla schedule 4 life forever start-time now
ip sla 6
 icmp-echo 2001:DB8:100:1011::1 source-interface Ethernet6/0
 frequency 5
ip sla schedule 6 life forever start-time now
D2#
```

4.3 On D1, configure HSRPv2.

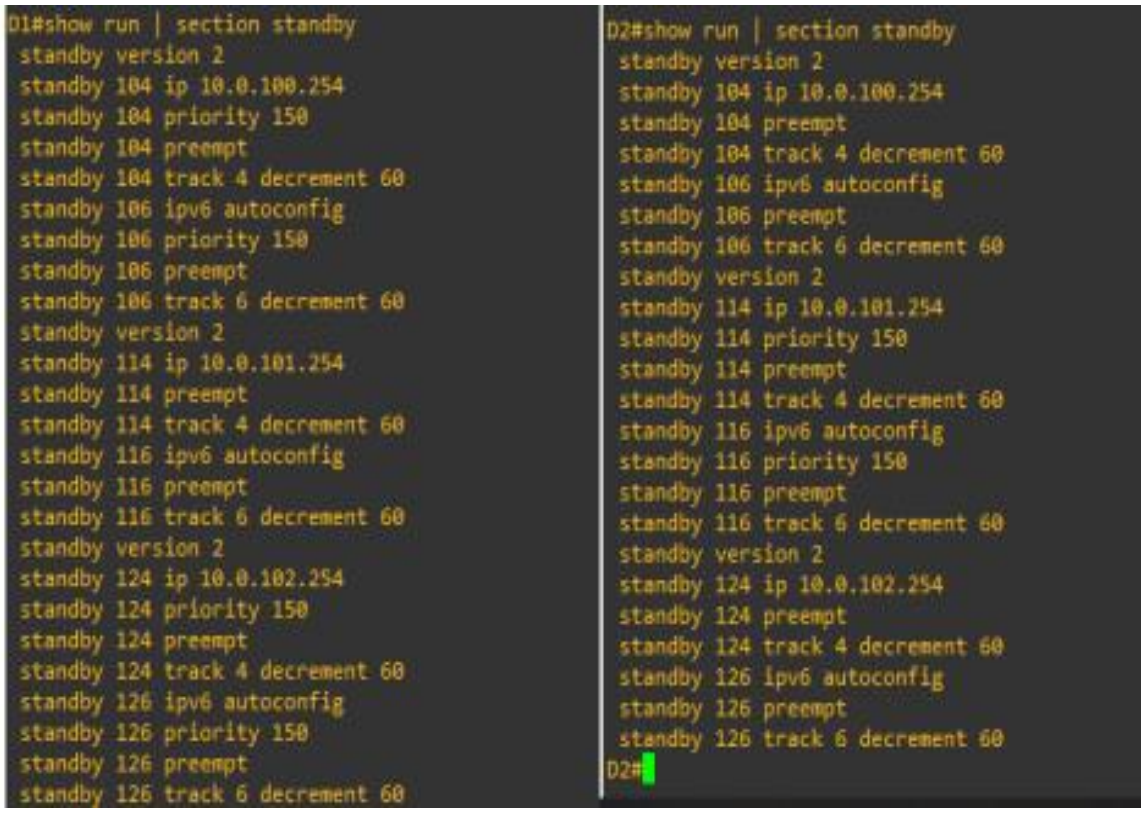
Switch D1:
D1(config)#interface vlan 100
D1(config-if)#standby version 2 //active la version 2 para ipv6
D1(config-if)#standby 104 ip 10.0.100.254 // crea el grupo con la ip virtual
D1(config-if)#standby 104 priority 150 // se cambia la prioridad defecto de 100
D1(config-if)#standby 104 preempt // sera el equipo principal
D1(config-if)#standby 104 track 4 decrement 60 //rastrea el objeto 4
D1(config-if)#standby 106 ipv6 autoconfig
D1(config-if)#standby 106 priority 150
D1(config-if)#standby 106 preempt
D1(config-if)#standby 106 track 6 decrement 60
D1(config-if)#exit
D1(config)#interface vlan 101
D1(config-if)#standby version 2
D1(config-if)#standby 114 ip 10.0.101.254
D1(config-if)#standby 114 preempt
D1(config-if)#standby 114 track 4 decrement 60

```
D1(config-if)#standby 116 ipv6 autoconfig
D1(config-if)#standby 116 preempt
D1(config-if)#standby 116 track 6 decrement 60
D1(config-if)#exit
D1(config)#interface vlan 102
D1(config-if)#standby version 2
D1(config-if)#standby 124 ip 10.0.102.254
D1(config-if)#standby 124 priority 150
D1(config-if)#standby 124 preempt
D1(config-if)#standby 124 track 4 decrement 60
D1(config-if)#standby 126 ipv6 autoconfig
D1(config-if)#standby 126 priority 150
D1(config-if)#standby 126 preempt
D1(config-if)#standby 126 track 6 decrement 60
D1(config-if)#exit
```

4.4 On D2, configure HSRPv2

```
D2(config)#interface vlan 100
D2(config-if)#standby version 2
D2(config-if)#standby 104 ip 10.0.100.254
D2(config-if)#standby 104 preempt
D2(config-if)#standby 104 track 4 decrement 60
D2(config-if)#standby 106 ipv6 autoconfig
D2(config-if)#standby 106 preempt
D2(config-if)#standby 106 track 6 decrement 60
D2(config-if)#exit
D2(config)#interface vlan 101
D2(config-if)#standby version 2
D2(config-if)#standby 114 ip 10.0.101.254
D2(config-if)#standby 114 priority 150
D2(config-if)#standby 114 preempt
D2(config-if)#standby 114 track 4 decrement 60
D2(config-if)#standby 116 ipv6 autoconfig
D2(config-if)#standby 116 priority 150
D2(config-if)#standby 116 preempt
D2(config-if)#standby 116 track 6 decrement 60
D2(config-if)#exit
D2(config)#interface vlan 102
D2(config-if)#standby version 2
D2(config-if)#standby 124 ip 10.0.102.254
D2(config-if)#standby 124 preempt
D2(config-if)#standby 124 track 4 decrement 60
D2(config-if)#standby 126 ipv6 autoconfig
D2(config-if)#standby 126 preempt
D2(config-if)#standby 126 track 6 decrement 60
D2(config-if)#exit
```

Figura 11. Verificacion del Standby



## CONCLUSIONES

Se logró desarrollar un protocolo de enrutamiento el cual nos permitió comprender conceptos y configuraciones, en este escenario OSPF y BGP son los más comunes que se pueden encontrar en un entorno real, muchas organizaciones utilizan el OSPF para enrutar como protocolo interno porque permite que se conozca toda la red a través de la tabla de enrutamiento de cada routers evitando loops, también actualizan automáticamente las tables con cualquier cambio en la topología; el BGP para interconectar sistemas autónomos porque es normal que no todas las organizaciones utilicen el mismo protocolo de enrutamiento interno como lo es el ISP.

La importancia de las redundancias a nivel de capa 3 también se utilizan para evitar que los dispositivos locales queden fuera de red por algún fallo en el Gateway, utilizando SLAs para monitorear continuamente las interfaces del Gateway y el protocolo HSRP para tener un routers activo con la interfaz virtual y el otro de reserva.

Gracias a software de simulación como lo es GNS3 logramos implementar protocolos de enrutamiento simulando entornos reales que nos permiten ser competitivos en un ambiente laboral, A causa de la gran cantidad de amenazas que existen las redes es importante utilizar protocolos para reforzar la seguridad e integridad de los dispositivos de interconexión locales, en este escenario se utiliza la familia AAA donde verifica que un usuario de ingreso es quien dice decir, le da unos privilegios preestablecidos por el administrador y además registra todos los eventos en modo de logs para poder determinar las acciones realizadas.

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