

DIPLOMADO DE PROFUNDIZACION CISCO
PRUBA DE HABILIDADES PRACTICAS CCNP

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UNIVERSIDAD NACIONAL ABIERTA Y A DISTANCIA UNAD
ESCUELA DE CIENCIAS BÁSICAS TECNOLOGÍA E INGENIERÍA
INGENIERIA DE TELECOMUNICACIONES
VALLEDUPAR
2022

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Diplomado de opción de grado presentado para optar el título de
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CONTENIDO

	Pág.
CONTENIDO.....	4
LISTA DE TABLAS.....	5
LISTA DE FIGURAS.....	6
GLOSARIO	8
RESUMEN	9
ABSTRACT	9
INTRODUCCIÓN	10
DESARROLLO.....	11
Instalación de la VM (Máquina Virtual)	11
Topología	15
Objectives.....	16
Background / Scenario	17
Configure basic settings for each device.	18
Comprobación de la tabla Task # 2.1 – 2.8	31
Configuraciones y verificaciones	37
Comandos utilizados en la comprobación.	39
COMADOS DE VERIFICACIÓN.....	57
CONCLUSIONES.....	64
BIBLIOGRAFÍA	65

LISTA DE TABLAS

	Pág.
Tabla 1. Direccionamiento.....	16
Tabla 2. Tareas.....	30

LISTA DE FIGURAS

	Pág
Figura 1. Máquina virtual GNS3 en Virtual Box.....	12
Figura 2. Servidor GNS3	12
Figura 3. Interfaz de GNS3.....	13
Figura 4. Configuración de VM en GNS3.....	13
Figura 5. Ambiente local y servidor sincronizados en GNS3.....	14
Figura 6. Características del router instalado.....	14
Figura 7. Características del switch instalado	15
Figura 8. Pantallazo Escenario propio	18
Figura 9. configuración del router R1.....	20
Figura 10. Configuración del router R2	21
Figura 11. Configuración del router R3	22
Figura 12. Configuración del switch D1	24
Figura 13. Configuración del switch D1	26
Figura 14. Configuración del switch A1	27
Figura 15. Configuración de PC1	28
Figura 16. Configuración de PC4.....	29
Figura 17. Configuración de PC3.....	29
Figura 18. Configuración de PC2.....	30
Figura 19. Configuración en D1 a D2 - Port channel 12	32
Figura 20. Configuración en D1 a D2 - Port channel 1	33
Figura 21. A1 a D1 – Port channel 1, y de A1 a D2 – Port channel 2	35
Figura 22. A1 de spanning-tree, VLAN, trunk, Port Channel 1 y 2.....	36
Figura 23. Configuración PC1	37
Figura 24. Verificación en D1 spanning-tree, VLAN, trunk, Port Channel.....	37
Figura 25. Verificación en A1 spanning-tree, VLAN, trunk, Port Channel.....	38
Figura 26. Verificación en A1, D1 y D2 (Spanning-tree).....	38
Figura 27. Verificación en A1, D1 y D2 (Interfaces Trunk).....	39
Figura 28. Configuración PC2 y PC3	42
Figura 29. Verificación protocolo enrutamiento en R1.....	52

Figura 30.	Verificación protocolo enrutamiento en R2.....	52
Figura 31.	Verificación protocolo enrutamiento en R3.....	53
Figura 32.	Verificación configuración de SLA y HSRPv2 en D1	55
Figura 33.	Configuración D1	56
Figura 34.	Ping en PC1.....	57
Figura 35.	Ping en PC4.....	57
Figura 36.	show run section ^router ospf on R1 y R3	58
Figura 37.	show run section ^ipv6 route on R1 y R3	58
Figura 38.	show run section bgp and show run include route on R2.....	58
Figura 39.	show run section bgp on R1	59
Figura 40.	show ip route include O B on R1	59
Figura 41.	show ipv6 route command on R1	60
Figura 42.	show ip route ospf begin Gateway on R3.....	60
Figura 43.	show run section ip sla command on D1	61
Figura 44.	show standby brief command on D1	61
Figura 45.	show run section ip sla command on D2	61
Figura 46.	show run section ^router ospf on D1 and D2.....	62
Figura 47.	show run section ^ipv6 route on D1 and D2	62
Figura 48.	show ipv6 ospf interface brief on R1, R3, D1, and D2	63

GLOSARIO

ETHERCHANNEL: EtherChannel es una tecnología de Cisco construida de acuerdo con los estándares 802.3 full-duplex Fast Ethernet.

GNS3: Es un simulador gráfico de red lanzado en 2008, que te permite diseñar topologías de red complejas y poner en marcha simulaciones sobre ellos, permitiendo la combinación de dispositivos tanto reales como virtuales.

LACP: Es un término que indica el establecimiento de una red de datos que describe cómo utilizar varios enlaces Ethernet full-dúplex en la comunicación entre dos equipos, repartiendo el tráfico entre ellos.

ROUTER: Es un dispositivo de enrutamiento que permite interconectar redes con distintos prefijos en su dirección.

SLAAC (Stateless Address Autoconfiguration): Es un mecanismo muy cómodo y potente propio de IPv6 y que no tiene un equivalente en IPv4, que permite la autoconfiguración de los nodos.

STP (Spanning Tree Protocol): Es un protocolo de red de capa 2 del modelo OSI. Su función es la de gestionar la presencia de bucles en topologías de red debido a la existencia de enlaces redundantes

SWITCH: Es un dispositivo que permite la conexión de computadoras y periféricas a la red pueden comunicarse entre si y otras redes.

VLAN: Conocidas como redes de área local virtuales, es una tecnología de redes que nos permite crear redes lógicas independientes dentro de la misma red física.

RESUMEN

A continuación, se mostrarán los conocimientos obtenidos en el transcurso del diplomado y otras asignaturas referentes a redes de datos, para ello se explicará paso a paso, la instalación y configuración de los dispositivos que intervienen en un escenario hipotético, con ayuda del simulador gráfico GNS3 y de la máquina virtual "VirtualBox" se realizarán todas las pruebas y simulaciones requeridas.

En dicho escenario se estructuran redes conmutadas mediante el uso del protocolo STP y la configuración de VLANs.

Además, se muestran imágenes de los resultados de cada una de las etapas que se van desarrollando del proyecto.

PALABRAS CLAVE: CCNP, Cisco, Conmutación, Enrutamiento, Router, Simulador, Protocolo.

ABSTRACT

In the present work, the knowledge obtained in the course of the diploma and other subjects related to data networks will be shown, for this, the installation and configuration of the devices that intervene in a hypothetical scenario will be explained step by step, with the help of the GNS3 graphic simulator. and from the virtual machine "VirtualBox" all the required tests and simulations will be carried out.

In this scenario, switched networks are structured through the use of the STP protocol and the configuration of VLANs.

In addition, images of the results of each of the stages that are being developed in the project are shown.

KEY WORDS: CCNP, Cisco, Protocol, Router, Routing, Simulator, Switching.

INTRODUCCIÓN

El presente trabajo tiene como finalidad la construcción y configuración de la red para que haya una accesibilidad completa de extremo a extremo, para que los hosts tengan soporte de puerta de enlace predeterminado confiable y para que los protocolos de administración estén operativos dentro de la parte "Red de la empresa" de la topología, además se deben configurar los ajustes básicos del dispositivo y el direccionamiento de la interfaz. Luego se hará una verificación de sus configuraciones para analizar que cumplan con las especificaciones proporcionadas y que los dispositivos funcionen según sea necesario.

Para ello se deben desarrollar una serie de etapas como: configurar las interfaces troncales IEEE 802.1Q en los enlaces de conmutación interconectados, cambiar la VLAN nativa en los enlaces troncales y habilitar el protocolo Rapid Spanning Tree en los conmutadores; configurar los switches D1 y D2 como raíz para las VLAN adecuadas con prioridades de apoyo mutuo en caso de fallo del conmutador, entre otras.

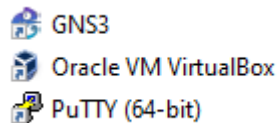
DESARROLLO

Para el desarrollo del proyecto se tuvieron los siguientes requisitos iniciales

- Verificación de estar habilitado en BIOS la opción de virtualización

Pausado			
Uso	Velocidad	Velocidad de base:	3,41 GHz
46%	3,63 GHz	Sockets:	1
Procesos	Subprocesos	Identificadores	Núcleos: 4
202	2192	76811	Procesadores lógicos: 4
Tiempo activo			Virtualización: Habilitado
0:01:02:37			Caché L1: 256 kB
			Caché L2: 1,0 MB
			Caché L3: 6,0 MB

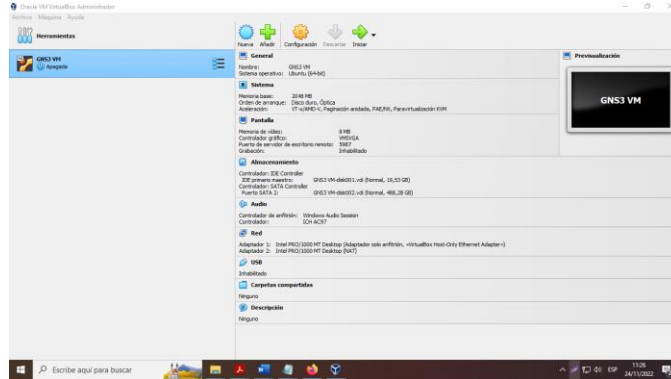
- Instalar los softwares y herramientas (Virtual Box, Putty, GNS3), descargar y cargar la máquina virtual GNS3 en Virtual Box



INSTALACIÓN DE LA VM (MÁQUINA VIRTUAL)

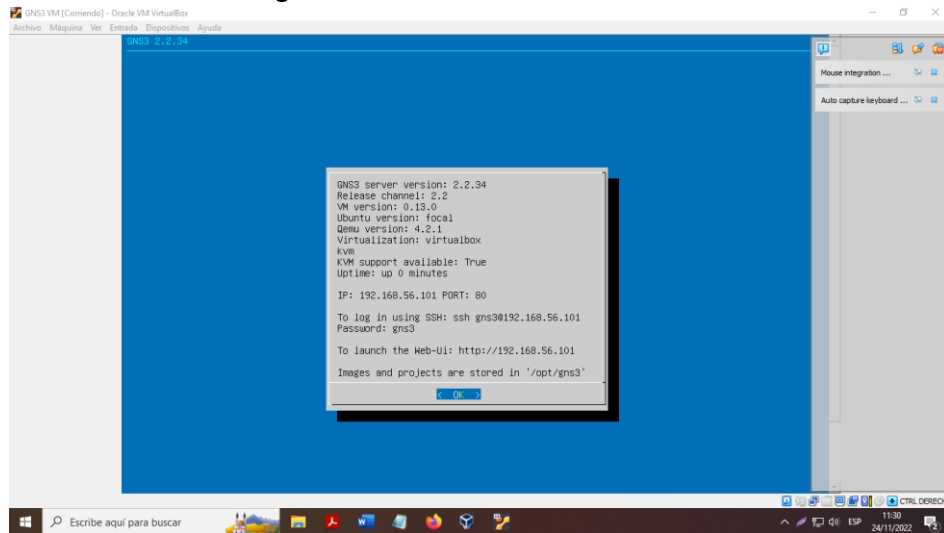
Se descarga y carga la máquina virtual GNS3 en Virtual Box, se ajusta la configuración dependiendo los recursos del equipo de cómputo.

Figura 1. Máquina virtual GNS3 en Virtual Box



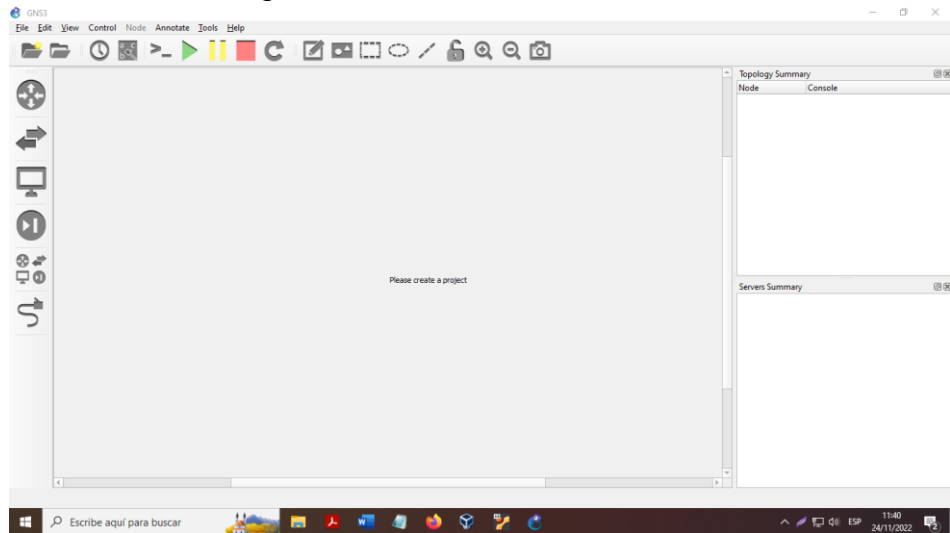
Empieza a correr el servidor GNS3 en la máquina virtual mostrando alguna información de configuración

Figura 2. Servidor GNS3



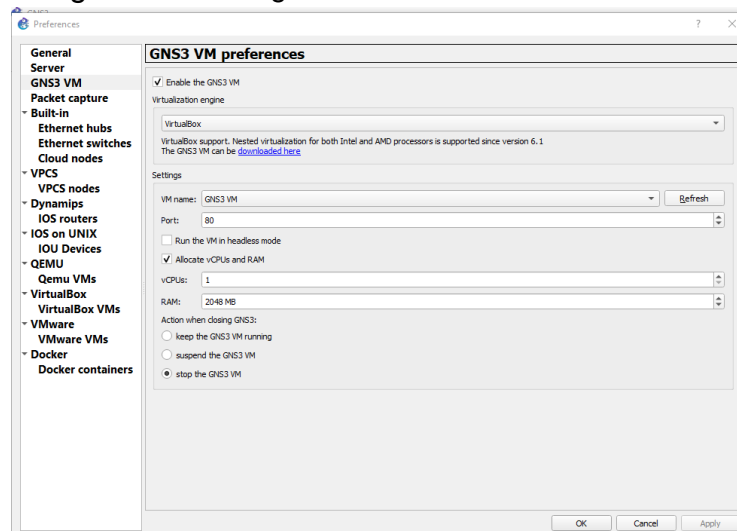
Se ejecuta el software GNS3 para acoplar el entorno local con el servidor que es donde van a correr los escenarios que se van a trabajar

Figura 3. Interfaz de GNS3



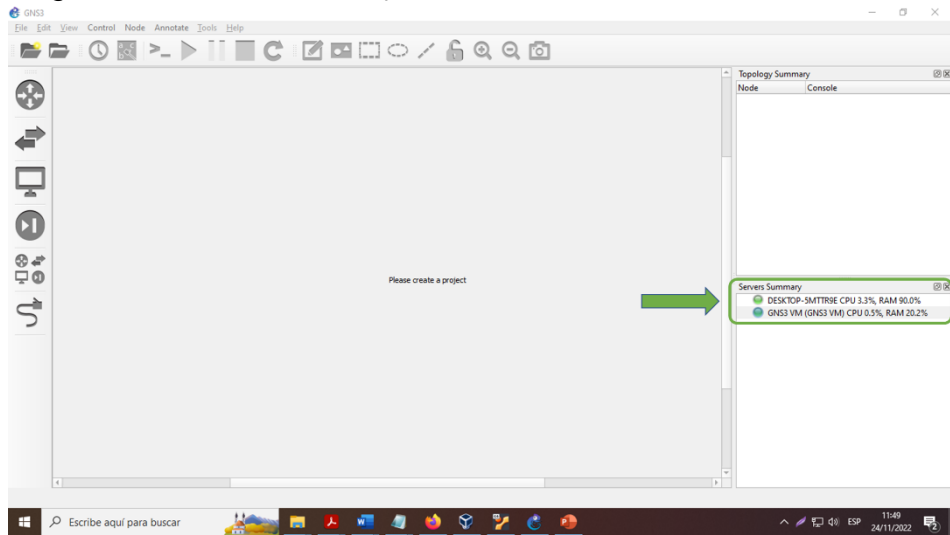
Se configura GNS3 para habilitar el servidor local, configurar los recursos a designar a la VM,

Figura 4. Configuración de VM en GNS3



Una vez hecho todo este proceso se puede observar en el área de trabajo que se tiene el ambiente local y el servidor, indicando que ya se encuentran sincronizados.

Figura 5. Ambiente local y servidor sincronizados en GNS3



Ahora se procede a instalar el router y switch de capa 2 en el servidor GNS3 que está corriendo en la VM de Virtual Box

Figura 6. Características del router instalado

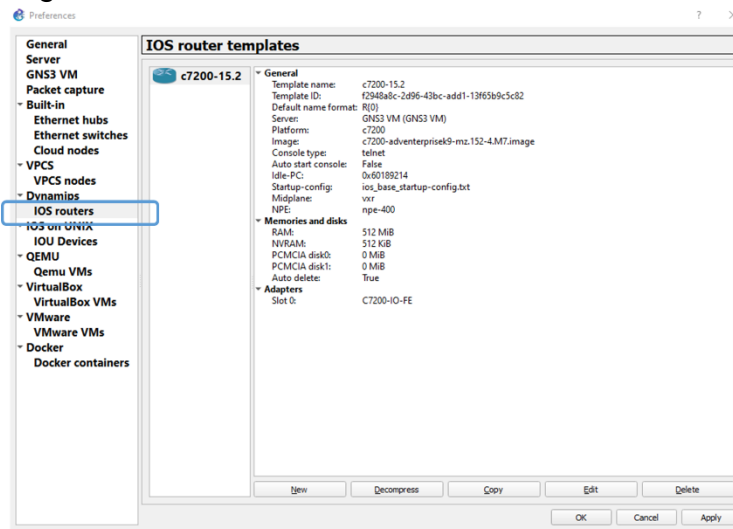
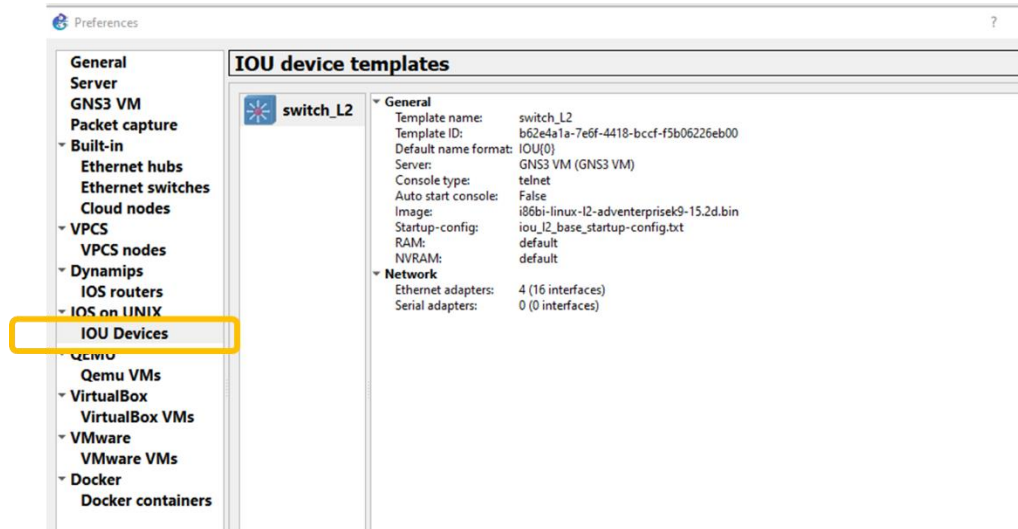


Figura 7. Características del switch instalado



Ya con todo listo se procede a desarrollar la siguiente topología

TOPOLOGÍA

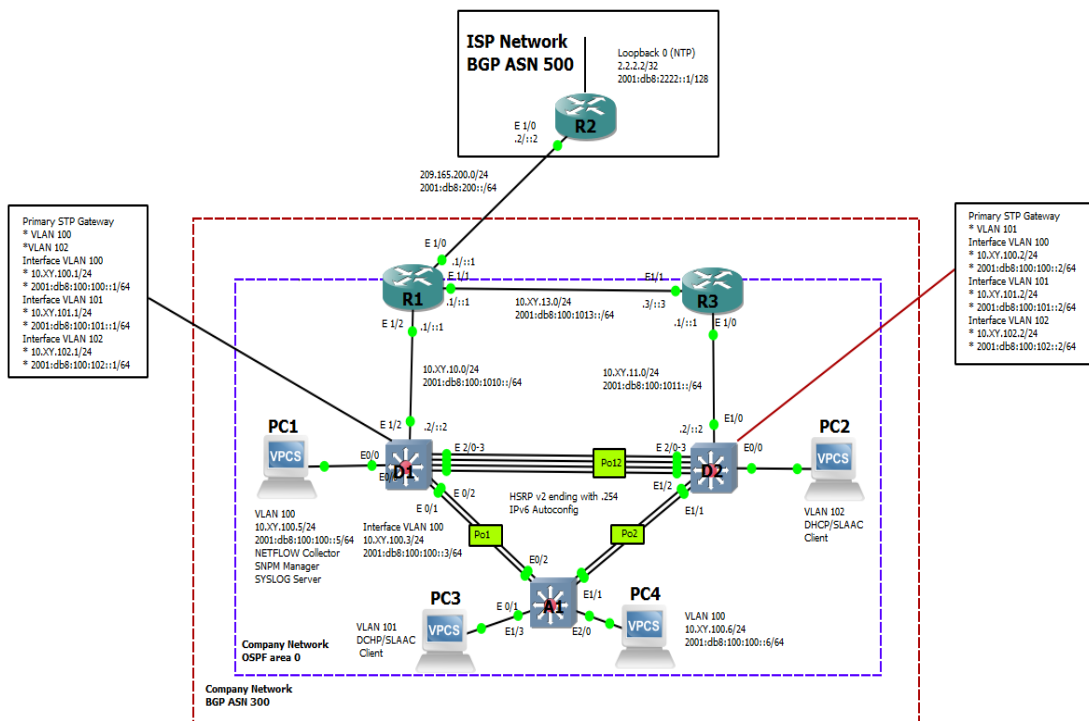


Tabla 1. Direcccionamiento

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	10.91.10.1/24	2001:db8:100:1010::1/64	fe80::1:2
	E1/1	10.91.13.1/24	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	10.91.11.1/24	2001:db8:100:1011::1/64	fe80::3:2
	E1/1	10.91.13.3/24	2001:db8:100:1013::3/64	fe80::3:3
D1	E1/2	10.91.10.2/24	2001:db8:100:1010::2/64	fe80::d1:1
	VLAN 100	10.91.100.1/24	2001:db8:100:100::1/64	fe80::d1:2
	VLAN 101	10.91.101.1/24	2001:db8:100:101::1/64	fe80::d1:3
	VLAN 102	10.91.102.1/24	2001:db8:100:102::1/64	fe80::d1:4
D2	E1/0	10.91.11.2/24	2001:db8:100:1011::2/64	fe80::d2:1
	VLAN 100	10.91.100.2/24	2001:db8:100:100::2/64	fe80::d2:2
	VLAN 101	10.91.101.2/24	2001:db8:100:101::2/64	fe80::d2:3
	VLAN 102	10.91.102.2/24	2001:db8:100:102::2/64	fe80::d2:4
A1	VLAN 100	10.91.100.3/23	2001:db8:100:100::3/64	fe80::a1:1
PC1	NIC	10.91.100.5/24	2001:db8:100:100::5/64	EUI-64
PC2	NIC	DHCP	SLAAC	EUI-64
PC3	NIC	DHCP	SLAAC	EUI-64
PC4	NIC	10.91.100.6/24	2001:db8:100:100::6/64	EUI-64

OBJECTIVES

Part 1: Build the Network and Configure Basic Device Settings and Interface Addressing

Part 2: Configure the Layer 2 Network and Host Support

Part 3: Configure Routing Protocols

Part 4: Configure First-Hop Redundancy

BACKGROUND / SCENARIO

In this skills assessment, you are responsible for completing the configuration of the network so there is full end-to-end reachability, so the hosts have reliable default gateway support, and so that management protocols are operational within the “Company Network” part of the topology. Be careful to verify that your configurations meet the provided specifications and that the devices perform as required.

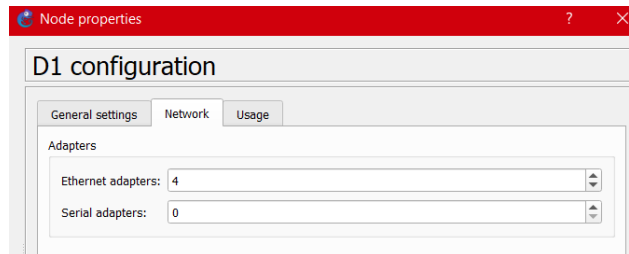
Note: The routers used with CCNP hands-on labs are Cisco 7200 routers. The switches used in the labs are Cisco Catalyst L2 switches. Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and the output produced might vary from what is shown in the labs.

Note: Make sure that the switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

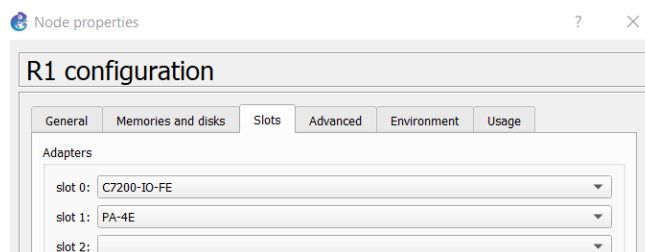
Note: The letters "X, Y" represent the last two digits of your ID number (cédula).

Required Resources

- 3 Routers (Cisco 7200). [Click on the download link of the images for GNS3.](#)
- 3 Switches (Cisco IOU L2). [Click on the download link of the images for GNS3.](#)
- 4 PCs (Use the GNS3's VPCS)
- After the configuration of devices in GNS3, the Slots of the network adapters of the SW must be configured as follows:



And of the Routers like this:



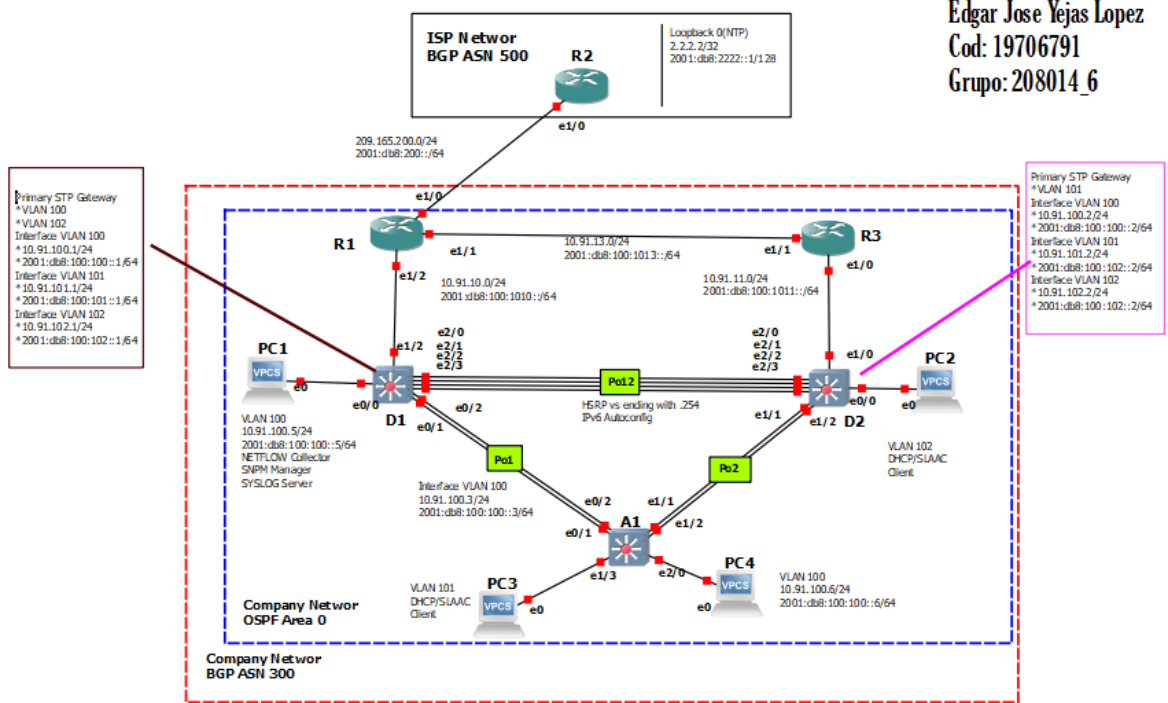
Build the Network and Configure Basic Device Settings and Interface Addressing

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 8. Pantallazo Escenario propio



CONFIGURE BASIC SETTINGS FOR EACH DEVICE.

- 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
configure 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 10.91.10.1 255.255.255.0
ipv6 address fe80::1:2 link-local
ipv6 address 2001:db8:100:1010::1/64
no shutdown
exit
interface e1/1
ip address 10.91.13.1 255.255.255.0
ipv6 address fe80::1:3 link-local
ipv6 address 2001:db8:100:1013::1/64
no shutdown
exit
```

Figura 9. configuración del router R1

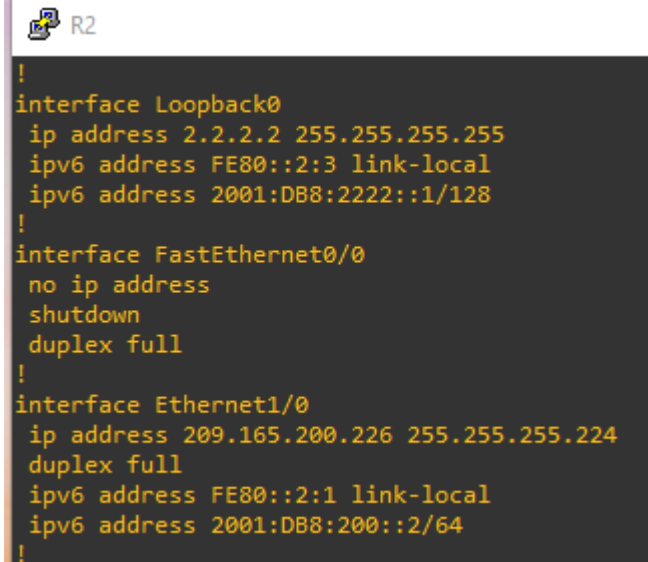
```
R1
!
interface Ethernet1/0
 ip address 209.165.200.225 255.255.255.224
 duplex full
 ipv6 address FE80::1:1 link-local
 ipv6 address 2001:DB8:200::1/64
!
interface Ethernet1/1
 ip address 10.91.13.1 255.255.255.0
 duplex full
 ipv6 address FE80::1:3 link-local
 ipv6 address 2001:DB8:100:1013::1/64
!
interface Ethernet1/2
 ip address 10.91.10.1 255.255.255.0
 duplex full
 ipv6 address FE80::1:2 link-local
 ipv6 address 2001:DB8:100:1010::1/64
!
```

Router R2

```
enable
config t
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
```

Figura 10. Configuración del router R2



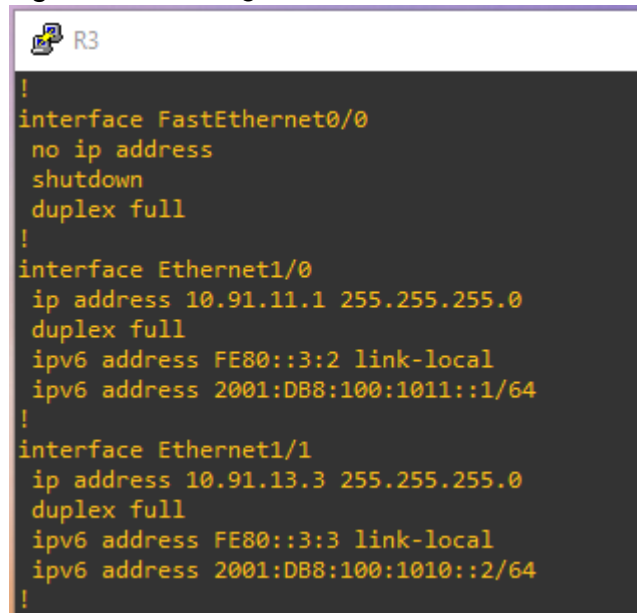
```
R2
!
interface Loopback0
 ip address 2.2.2.2 255.255.255.255
 ipv6 address FE80::2:3 link-local
 ipv6 address 2001:DB8:2222::1/128
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex full
!
interface Ethernet1/0
 ip address 209.165.200.226 255.255.255.224
 duplex full
 ipv6 address FE80::2:1 link-local
 ipv6 address 2001:DB8:200::2/64
!
```

Router R3

```
Enable
Config t
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 10.91.11.1 255.255.255.0
 ipv6 address fe80::3:2 link-local
 ipv6 address 2001:db8:100:1011::1/64
 no shutdown
 exit
```

```
interface e1/1
ip address 10.91.13.3 255.255.255.0
ipv6 address fe80::3:3 link-local
ipv6 address 2001:db8:100:1010::2/64
no shutdown
exit
```

Figura 11. Configuración del router R3



```
R3
!
interface FastEthernet0/0
no ip address
shutdown
duplex full
!
interface Ethernet1/0
ip address 10.91.11.1 255.255.255.0
duplex full
ipv6 address FE80::3:2 link-local
ipv6 address 2001:DB8:100:1011::1/64
!
interface Ethernet1/1
ip address 10.91.13.3 255.255.255.0
duplex full
ipv6 address FE80::3:3 link-local
ipv6 address 2001:DB8:100:1010::2/64
!
```

Switch D1

```
Enable
Config t
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 10.91.10.2 255.255.255.0
ipv6 address fe80::d1:1 link-local
ipv6 address 2001:db8:100:1010::2/64
no shutdown
exit
interface vlan 100
ip address 10.91.100.1 255.255.255.0
ipv6 address fe80::d1:2 link-local
ipv6 address 2001:db8:100:100::1/64
no shutdown
exit
interface vlan 101
ip address 10.91.101.1 255.255.255.0
ipv6 address fe80::d1:3 link-local
ipv6 address 2001:db8:100:101::1/64
no shutdown
exit
interface vlan 102
ip address 10.91.102.1 255.255.255.0
ipv6 address fe80::d1:4 link-local
ipv6 address 2001:db8:100:102::1/64
no shutdown
exit
ip dhcp excluded-address 10.91.101.1 10.91.101.109
```

```

ip dhcp excluded-address 10.91.101.141 10.91.101.254
ip dhcp excluded-address 10.91.102.1 10.91.102.109
ip dhcp excluded-address 10.91.102.141 91.0.102.254
ip dhcp pool VLAN-101
network 10.91.101.0 255.255.255.0
default-router 10.91.101.254
exit
ip dhcp pool VLAN-102
network 10.91.102.0 255.255.255.0
default-router 10.91.102.254
exit
interface range e0/0-3,e1/0-1,e1/3,e2/0-3,e3/0-3
shutdown
exit

```

Figura 12. Configuración del switch D1

```

!
interface Vlan100
 ip address 10.91.100.1 255.255.255.0
 ipv6 address FE80::D1:2 link-local
 ipv6 address 2001:DB8:100:100::1/64
!
interface Vlan101
 ip address 10.91.101.1 255.255.255.0
 ipv6 address FE80::D1:3 link-local
 ipv6 address 2001:DB8:100:101::1/64
!
interface Vlan102
 ip address 10.91.102.1 255.255.255.0
 ipv6 address FE80::D1:4 link-local
 ipv6 address 2001:DB8:100:102::1/64
!

```

Switch D2

```

Enable
Config t
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 10.91.11.2 255.255.255.0
ipv6 address fe80::d1:1 link-local
ipv6 address 2001:db8:100:1011::2/64
no shutdown
exit
interface vlan 100
ip address 10.91.100.2 255.255.255.0
ipv6 address fe80::d2:2 link-local
ipv6 address 2001:db8:100:100::2/64
no shutdown
exit
interface vlan 101
ip address 10.91.101.2 255.255.255.0
ipv6 address fe80::d2:3 link-local
ipv6 address 2001:db8:100:101::2/64
no shutdown
exit
```

```

interface vlan 102
ip address 10.91.102.2 255.255.255.0
ipv6 address fe80::d2:4 link-local
ipv6 address 2001:db8:100:102::2/64
no shutdown
exit
ip dhcp excluded-address 10.91.101.1 10.91.101.209
ip dhcp excluded-address 10.91.101.241 10.91.101.254
ip dhcp excluded-address 10.91.102.1 10.91.102.209
ip dhcp excluded-address 10.91.102.241 10.91.102.254
ip dhcp pool VLAN-101
network 10.91.101.0 255.255.255.0
default-router 91.0.101.254
exit
ip dhcp pool VLAN-102
network 10.91.102.0 255.255.255.0
default-router 10.91.102.254
exit
interface range e0/0-3,e1/1-3,e2/0-3,e3/0-3
shutdown
exit

```

Figura 13. Configuración del switch D1

```

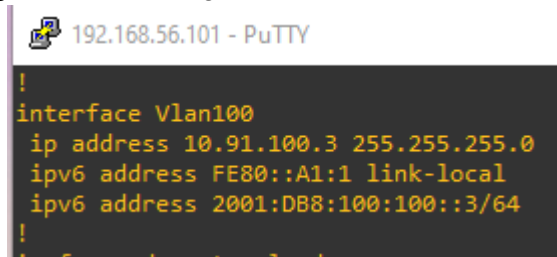
192.168.56.101 - PuTTY
!
interface Vlan100
ip address 10.91.100.2 255.255.255.0
ipv6 address FE80::D2:2 link-local
ipv6 address 2001:DB8:100:100::2/64
!
interface Vlan101
--None--
*Nov 26 16:21:34.910: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethernet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
ip address 10.91.101.2 255.255.255.0
ipv6 address FE80::D2:3 link-local
ipv6 address 2001:DB8:100:101::2/64
!
interface Vlan102
ip address 10.91.102.2 255.255.255.0
ipv6 address FE80::D2:4 link-local
ipv6 address 2001:DB8:100:102::2/64
!

```

Switch A1
 Enable
 Config t

```
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 10.91.100.3 255.255.255.0
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 14. Configuración del switch A1



```
!
interface Vlan100
ip address 10.91.100.3 255.255.255.0
ipv6 address FE80::A1:1 link-local
ipv6 address 2001:DB8:100:100::3/64
!
```

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

copy running-config startup-config

- c. Configure PC 1 and PC 4 host addressing as shown in the addressing table. Assign a default gateway address of 10.91.100.254 which will be the HSRP virtual IP address used in Part 4.

PC1>

PC1> ip 10.91.100.5/24 255.255.255.0 10.91.100.254

ip 2001:db8:100:100::5/64

sh

Figura 15. Configuración de PC1



```
VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

VPCS> ip 10.91.100.5/24 255.255.255.0 10.91.100.254
Checking for duplicate address...
VPCS : 10.91.100.5 255.255.255.0 gateway 10.91.100.254

VPCS> ip 2001:db8:100:100::5/64
PC1 : 2001:db8:100:100::5/64

VPCS> sh

NAME      IP/MASK          GATEWAY          MAC              LPORT  RHOST:PO
RT
VPCS1    10.91.100.5/24   10.91.100.254    00:50:79:66:68:00 20044  127.0.0.
1:20045
          fe80::250:79ff:fe66:6800/64
          2001:db8:100:100::5/64
```

PC4>

PC4> ip 10.91.100.6/24 255.255.255.0 10.91.100.254

PC4> ip 2001:db8:100:100::6/64

PC4> sh

Figura 16. Configuración de PC4

```
VPCS>
VPCS> ip 10.91.100.6/24 255.255.255.0 10.91.100.254
Checking for duplicate address...
VPCS : 10.91.100.6 255.255.255.0 gateway 10.91.100.254

VPCS> ip 2001:db8:100:100::6/64
PC1 : 2001:db8:100:100::6/64

VPCS> sh

NAME      IP/MASK          GATEWAY          MAC              LPORT  RHOST:PORT
RT
VPCS1    10.91.100.6/24   10.91.100.254    00:50:79:66:68:03 20050   127.0.0.
1:20051
          fe80::250:79ff:fe66:6803/64
          2001:db8:100:100::6/64
```

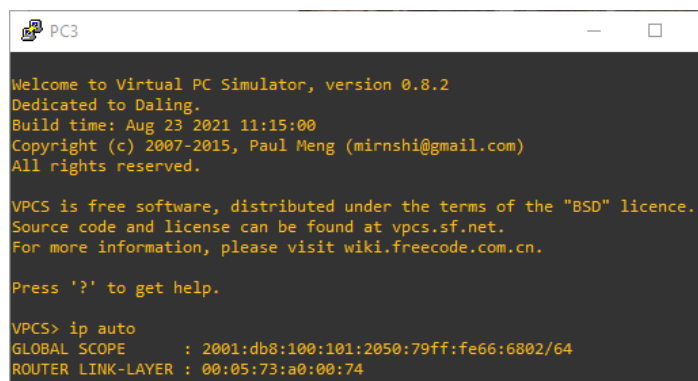
Configure the Layer 2 Network and Host Support

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.

```
PC3> ip auto
GLOBAL SCOPE      : 2001:db8:100:101:2050:79ff:fe66:6802/64
ROUTER LINK-LAYER : 00:05:73:a0:00:74

PC2> ip auto
GLOBAL SCOPE      : 2001:db8:100:102:2050:79ff:fe66:6801/64
ROUTER LINK-LAYER : 00:05:73:a0:00:6a
```

Figura 17. Configuración de PC3



```
PC3
Welcome to Virtual PC Simulator, version 0.8.2
Dedicated to Daling.
Build time: Aug 23 2021 11:15:00
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
All rights reserved.

VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

VPCS> ip auto
GLOBAL SCOPE      : 2001:db8:100:101:2050:79ff:fe66:6802/64
ROUTER LINK-LAYER : 00:05:73:a0:00:74
```

Figura 18. Configuración de PC2

```

Welcome to Virtual PC Simulator, version 0.8.2
Dedicated to Daling.
Build time: Aug 23 2021 11:15:00
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
All rights reserved.

VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

VPCS> ip auto
GLOBAL SCOPE      : 2001:db8:100:102:2050:79ff:fe66:6801/64
ROUTER LINK-LAYER : 00:05:73:a0:00:6a
    
```

Tabla 2. Tareas

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

Task#	Task	Specification	Points
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
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: 10.91.100.1 • D2: 10.91.100.2 • PC4: 10.91.100.6 PC2 should successfully ping: <ul style="list-style-type: none"> • D1: 10.91.102.1 • D2: 10.91.102.2 PC3 should successfully ping: <ul style="list-style-type: none"> • D1: 10.91.101.1 • D2: 10.91.101.2 PC4 should successfully ping: <ul style="list-style-type: none"> • D1: 10.91.100.1 • D2: 10.91.100.2 • PC1: 10.91.100.5 	1

COMPROBACIÓN DE LA TABLA TASK # 2.1 – 2.8

Al realizar las pertinentes investigaciones y consultas en el libro, se logra la configuración y así las respectivas soluciones de los ítems mencionados en la tabla anterior:

Switch D1

Configuración en D1 a D2 - Port channel 12

```

Enable
Config t
interface ethernet1/2
duplex full

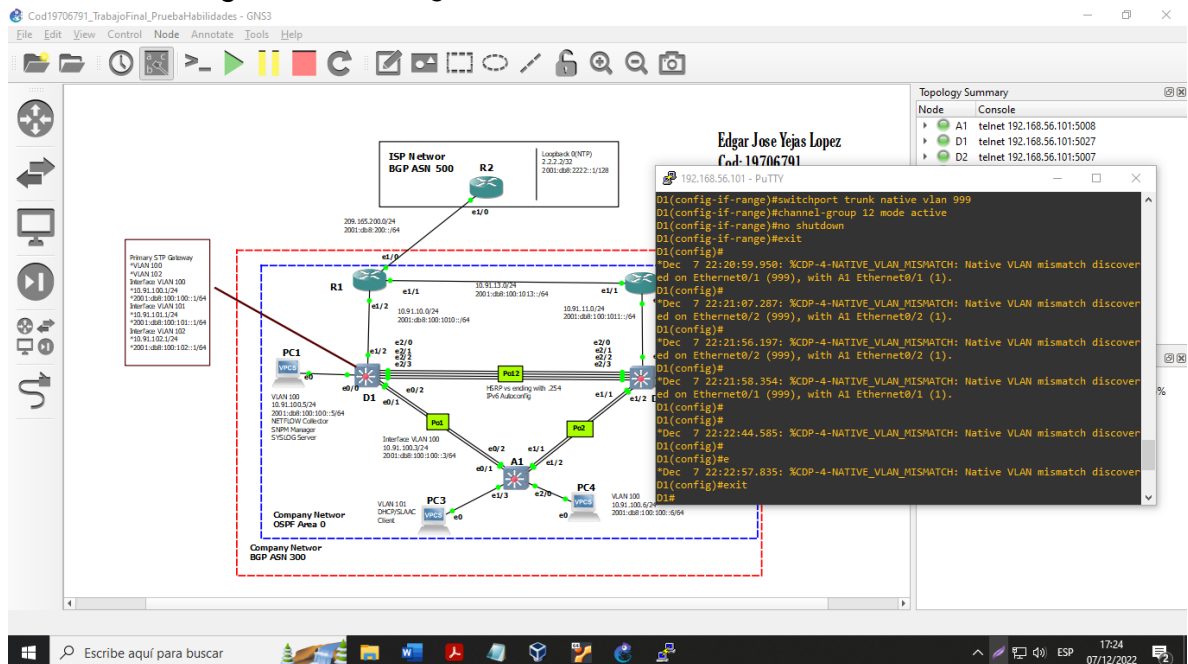
```

```

interface range ethernet2/0-3
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
channel-group 12 mode active
no shutdown
exit

```

Figura 19. Configuración en D1 a D2 - Port channel 12



Configuración en D1 a D2 - Port channel 1

```

Enable
Config t
interface range ethernet0/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode active
switchport trunk native vlan 999
no shutdown
exit

```


Figura 20. Configuración en D1 a D2 - Port channel 1

The screenshot shows a GNS3 network simulation. The main window displays a network topology with three routers (R1, R2, R3) and two switches (D1, D2). R1 and R2 are connected to each other and to R3. R1 and R2 are also connected to switch D1, and R3 is connected to switch D2. Switch D1 is connected to switch D2. There are four PCs (PC1, PC2, PC3, PC4) connected to the switches. The console window shows the following configuration commands for switch D2:

```

D2#
D2#enable
D2#configure terminal
D2(config)#interface ethernet1/0
D2(config-if)#duplex full
D2(config-if)#interface range ethernet2/0-3
D2(config-if-range)#switchport trunk encapsulation dot1q
D2(config-if-range)#switchport mode trunk
D2(config-if-range)#channel-group 12 mode active
D2(config-if-range)#switchport trunk native vlan 999
D2(config-if-range)#no shutdown
D2(config-if-range)#exit
D2(config)#interface range ethernet1/1-2
D2(config-if-range)#switchport trunk encapsulation dot1q
D2(config-if-range)#switchport mode trunk
D2(config-if-range)#channel-group 2 mode active
D2(config-if-range)#switchport trunk native vlan 999
D2(config-if-range)#no shutdown
D2(config-if-range)#exit
  
```

Switch D2

```

Enable
Config t
interface ethernet1/0
duplex full
interface range ethernet2/0-3
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 12 mode active
switchport trunk native vlan 999
no shutdown
exit
interface range ethernet1/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 2 mode active
switchport trunk native vlan 999
no shutdown
exit
  
```

```
spanning-tree mode rapid-pvst
spanning-tree vlan 101 root primary
spanning-tree vlan 102,102 root secondary
interface ethernet0/0
switchport mode access
switchport access vlan 102
SPanning-tree portfast
no shutdown
exit
end
```

Figura 21. A1 a D1 – Port channel 1, y de A1 a D2 – Port channel 2

The screenshot displays a network configuration environment. On the left, a terminal window shows the configuration for Switch D2. The configuration includes setting spanning-tree mode to rapid-pvst, creating VLANs 100, 101, and 102, and configuring port channels 1 and 2. The terminal output shows the configuration being applied and the resulting state of the interfaces. On the right, a network diagram illustrates the topology. It shows a central switch D2 connected to switches A1, D1, R1, R2, and R3. A1 and D1 are connected via a port channel (1). A1 and D2 are connected via another port channel (2). The diagram also shows the connections to various PCs and the configuration of VLANs and interfaces.

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Cod: 19706791
Grupo: 208014_6

Topology Summary

Node	Console
A1	telnet 192.168.56.101:5008
D1	telnet 192.168.56.101:5027
D2	telnet 192.168.56.101:5007
PC1	telnet 192.168.56.101:5009
PC2	telnet 192.168.56.101:5012
PC3	telnet 192.168.56.101:5013
PC4	telnet 192.168.56.101:5023
R1	telnet 192.168.56.101:5004
R2	telnet 192.168.56.101:5005
R3	telnet 192.168.56.101:5006

Servers Summary

- DESKTOP-SMTRISE CPU 27.7% RAM 87.5%
- GNS3 VM (GNS3 VM) CPU 100.0% RAM 52.7%

Switch A1

```

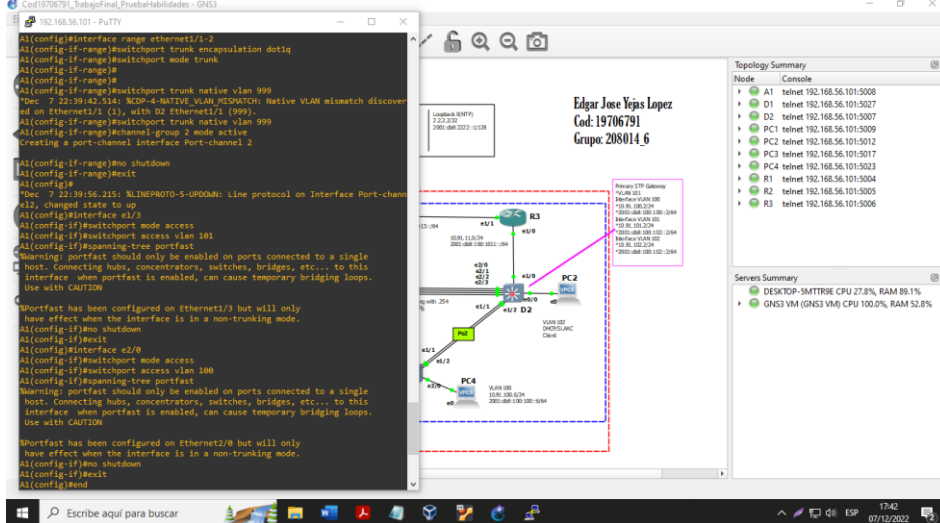
Enable
Config t
spanning-tree mode rapid-pvst
interface range ethernet0/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
channel-group 1 mode active
no shutdown
exit
interface range ethernet1/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
channel-group 2 mode active
no shutdown
exit
interface e1/3
  
```

```

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

```

Figura 22. A1 de spanning-tree, VLAN, trunk, Port Channel 1 y 2



Con los comandos suministrados anteriormente se pueden configurar correctamente cada dispositivo con los requerimientos de la guía, los cuales se muestran con sus respectivas imágenes, todo ello para configurar todos los switches, las interfaces troncales IEEE 802.1Q en los enlaces de conmutador de interconexión, se cambió la VLAN nativa en los enlaces troncales, se habilitó el protocolo Rapid Spanning-Tree, se configuró los puentes raíz RSTP apropiados según la información del diagrama de la topología, en todos los switches, se creó la LACP EtherChannels como se muestra en el diagrama de topología, así mismo se configuró los puertos de acceso de host que se conectan a PC1, PC2, PC3 y PC4.

CONFIGURACIONES Y VERIFICACIONES

Figura 23. Configuración PC1

Edgar Jose Yejas Lopez
Cod: 19706791
Grupo: 208014_6

```

192.168.56.101 - PuTTY
VPCS>
VPCS> host name pc1
Bad command: "host name pc1". Use ? for help.
VPCS> ip 10.91.100.5/24 255.255.255.0 10.91.100.254
Checking for duplicate address...
VPCS : 10.91.100.5 255.255.255.0 gateway 10.91.100.254
VPCS> ip 2001:db8:100:100::5/64
PC1 : 2001:db8:100:100::5/64
VPCS> sh

```

NAME	IP/MASK	GATEWAY	MAC	LPORT	RHOST:PORT
VPCS1	10.91.100.5/24	10.91.100.254	00:50:79:66:68:00	20044	127.0.0.1:1:20045

```

VPCS>
fe80::250:79ff:fe66:6800/64
2001:db8:100:100::5/64
VPCS> []

```

Primary STP Gateway
VLAN 100
*10.91.100.254
Interface VLAN 100
*2001:db8:100:100::104
*10.91.101.1/24
*2001:db8:100:100::104
Interface VLAN 102
*10.91.102.2/24
*2001:db8:100:102::204

Primary STP Gateway
VLAN 101
Interface VLAN 100
*10.91.100.2/24
*2001:db8:100:100::204
Interface VLAN 102
*10.91.102.2/24
*2001:db8:100:102::204

Company Network
OSPF Area 0
PC3
PC4

Company Network
BGP ASN 300

Toplogy Summary

Node	Console
A1	teinet 192.168.56.101:5008
D1	teinet 192.168.56.101:5027
D2	teinet 192.168.56.101:5007
PC1	teinet 192.168.56.101:5009
PC2	teinet 192.168.56.101:5012
PC3	teinet 192.168.56.101:5017
PC4	teinet 192.168.56.101:5023
R1	teinet 192.168.56.101:5004
R2	teinet 192.168.56.101:5005
R3	teinet 192.168.56.101:5006

Servers Summary

- DESKTOP-SMTTRSE CPU 27.0%, RAM 92.3%
- GNS3 VM (GNS3 VM) CPU 100.0%, RAM 51.9%

Figura 24. Verificación en D1 spanning-tree, VLAN, trunk, Port Channel

```

D1#show interface trunk

```

Port	Mode	Encapsulation	Status	Native vlan
Po1	on	802.1q	trunking	999
Po12	on	802.1q	trunking	999

```

Port
Po1
Po12

```

Vlans allowed on trunk

```

Port
Po1
Po12

```

Vlans allowed and active in management domain

```

Port
Po1
Po12

```

Vlans in spanning tree forwarding state and not pruned

```

Port
Po1
Po12
D1#

```

Figura 25. Verificación en A1 spanning-tree, VLAN, trunk, Port Channel

The screenshot shows the GNS3 interface with a terminal window for switch A1. The terminal displays the following configuration:

```

A1#enable
A1#show run interface e1/3
Building configuration...

Current configuration : 110 bytes
!
interface Ethernet1/3
 switchport access vlan 101
 switchport mode access
 spanning-tree portfast edge
end

A1#show run interface e2/0
Building configuration...

Current configuration : 110 bytes
!
interface Ethernet2/0
 switchport access vlan 100
 switchport mode access
 spanning-tree portfast edge
end
    
```

The network topology includes:

- Company Network OSPF Area 0:** A central switch A1 connected to PC3 and PC4.
- Company Network BGP ASN 300:** A server (S15DGS) connected to A1.
- VLAN 101:** Connected to A1 e1/3, PC3, and a DHCP/SLAAC Client.
- VLAN 100:** Connected to A1 e2/0, PC4, and a server (VLAN 100).

On the right, the **Topology Summary** shows:

Node	Console
A1	telnet 192.168.56.101:5008
D1	telnet 192.168.56.101:5027
D2	telnet 192.168.56.101:5007
PC1	telnet 192.168.56.101:5009
PC2	telnet 192.168.56.101:5012
PC3	telnet 192.168.56.101:5017
PC4	telnet 192.168.56.101:5023
R1	telnet 192.168.56.101:5004
R2	telnet 192.168.56.101:5005
R3	telnet 192.168.56.101:5006

Servers Summary:

- DESKTOP-SMTRT9E CPU 29.1%, RAM 88.5%
- GNS3 VM (GNS3 VM) CPU 100.0%, RAM 51.9%

Figura 26. Verificación en A1, D1 y D2 (Spanning-tree)

The screenshot shows the GNS3 interface with terminal windows for switches A1, D1, and D2. The configurations are as follows:

```

D1#
D1#show run | include spanning-tree
spanning-tree mode rapid-pvst
spanning-tree extend system-id
D1#show run interface e0/0
Building configuration...

Current configuration : 39 bytes
!
interface Ethernet0/0
 shutdown
end

D1#

D2#
D2#show run | include spanning-tree
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 101 priority 24576
spanning-tree vlan 102 priority 28672
spanning-tree portfast edge
D2#show run interface e0/0
Building configuration...

Current configuration : 110 bytes
!
interface Ethernet0/0
 switchport access vlan 102
 switchport mode access
 spanning-tree portfast edge
end

A1#
A1#show run | include spanning-tree
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree portfast edge
spanning-tree portfast edge
A1#show run interface e1/3
Building configuration...

Current configuration : 110 bytes
!
interface Ethernet1/3
 switchport access vlan 101
 switchport mode access
 spanning-tree portfast edge
end

A1#show run interface e2/0
Building configuration...

Current configuration : 110 bytes
!
interface Ethernet2/0
 switchport access vlan 100
 switchport mode access
 spanning-tree portfast edge
end
    
```

The network topology includes:

- Company Network OSPF Area 0:** Switches A1, D1, and D2 connected to PC1, PC2, PC3, and PC4.
- Company Network BGP ASN 300:** A server (S15DGS) connected to A1.
- VLAN 101:** Connected to A1 e1/3, D1 e0/1, D2 e0/2, PC3, and a DHCP/SLAAC Client.
- VLAN 102:** Connected to A1 e2/0, D1 e0/0, D2 e0/1, PC1, and a server (VLAN 102).

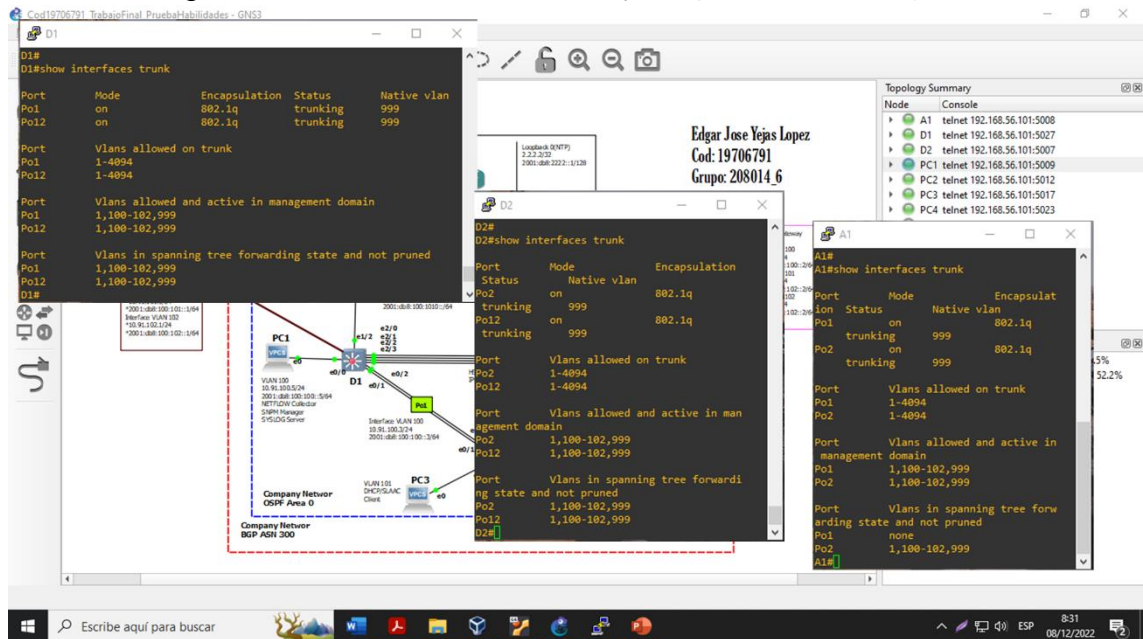
On the right, the **Topology Summary** shows:

Node	Console
A1	telnet 192.168.56.101:5008
D1	telnet 192.168.56.101:5027
D2	telnet 192.168.56.101:5007
PC1	telnet 192.168.56.101:5009
PC2	telnet 192.168.56.101:5012
PC3	telnet 192.168.56.101:5017
PC4	telnet 192.168.56.101:5023
R1	telnet 192.168.56.101:5004
R2	telnet 192.168.56.101:5005
R3	telnet 192.168.56.101:5006

Servers Summary:

- DESKTOP-SMTRT9E CPU 27.1%, RAM 91.4%
- GNS3 VM (GNS3 VM) CPU 100.0%, RAM 52.0%

Figura 27. Verificación en A1, D1 y D2 (Interfaces Trunk)



COMANDOS UTILIZADOS EN LA COMPROBACIÓN.

2.1 On all switches, configure IEEE 802.1Q trunk interfaces on interconnecting switch links

interface range ethernet2/0-3
 switchport trunk encapsulation dot1q
 switchport mode trunk

2.2 On all switches, change the native VLAN on trunk links.

switchport trunk native vlan 999

2.3 On all switches, enable the Rapid Spanning-Tree Protocol.

spanning-tree mode rapid-pvst

2.4 On D1 and D2, configure the appropriate RSTP root bridges based on the information in the topology diagram.

D1

spanning-tree vlan 100,102 root primary

```
spanning-tree vlan 101 root secondary
```

D2

```
spanning-tree vlan 101 root primary
spanning-tree vlan 100,102 root secondary
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 24576
spanning-tree portfast edge
```

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

D1

```
interface range ethernet2/0-3
channel-group 12 mode active
no shutdown
interface range ethernet0/1-2
channel-group 1 mode active
no shutdown
```

D2

```
interface range ethernet2/0-3
channel-group 12 mode active
no shutdown
interface range ethernet1/1-2
channel-group 2 mode active
no shutdown
```

A1

```
interface range ethernet0/1-2
channel-group 1 mode active
no shutdown
interface range ethernet1/1-2
channel-group 2 mode active
no shutdown
```


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

D1

```
interface ethernet0/0
switchport mode access
switchport access vlan 100
spanning-tree portfast
no shutdown
```

D2

```
interface ethernet0/0
switchport mode access
switchport access vlan 102
spanning-tree portfast
no shutdown
```

A1

```
interface ethernet2/0
switchport mode access
switchport access vlan 100
spanning-tree portfast
no shutdown
interface ethernet1/3
switchport mode access
switchport access vlan 101
spanning-tree portfast
no shutdown
```

2.7 PC2 and PC3 are DHCP clients and should be receiving valid IPv4 addresses.

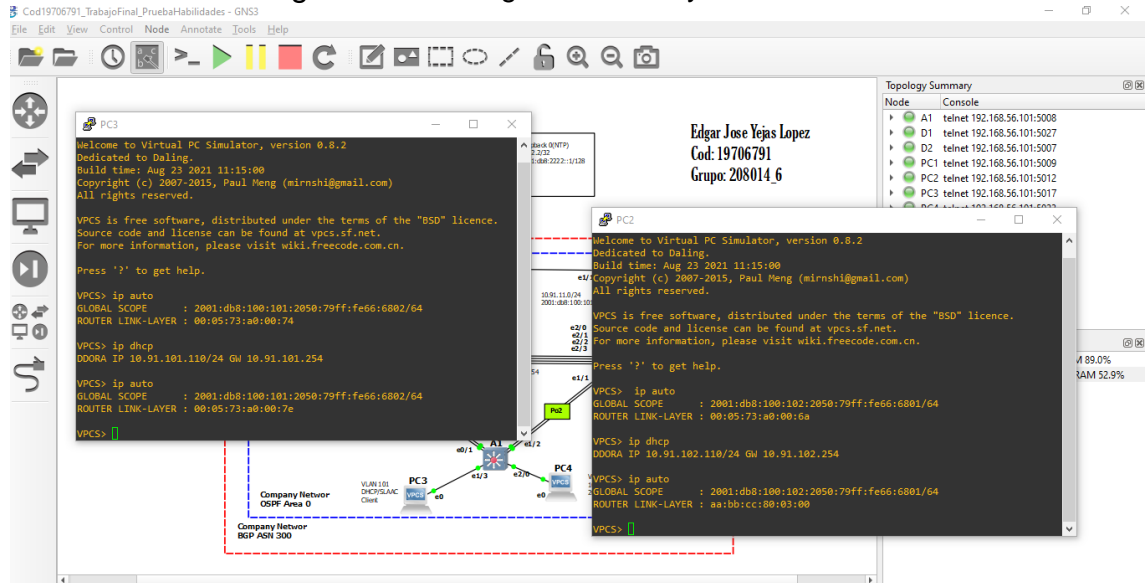
```
PC2> ip dhcp
DDORA IP 10.91.102.110/24 GW 10.91.102.254
PC2> ip auto
GLOBAL SCOPE : 2001:db8:100:102:2050:79ff:fe66:6801/64
ROUTER LINK-LAYER : aa:bb:cc:80:03:00
```

```

PC3> ip dhcp
DDORA IP 10.91.101.210/24 GW 10.91.101.254
PC3> ip auto
GLOBAL SCOPE : 2001:db8:100:101:2050:79ff:fe66:6802/64
ROUTER LINK-LAYER : 00:05:73:a0:00:7e

```

Figura 28. Configuración PC2 y PC3



2.8 Verify local LAN connectivity.

```

PC1> ping 10.91.100.1
PC1> ping 10.91.100.2
PC1> ping 10.91.100.6

```

```

PC4> ping 10.91.100.1
PC4> ping 10.91.100.2
PC4> ping 10.91.100.5

```

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

Use OSPF Process ID 4 and assign the following router-IDs:

- R1: 0.0.4.1

- ```
R1(config)#router ospf 4
R1(config-router)#router-id 0.0.4.1
```
- R3: 0.0.4.3

```
R3(config)#router ospf 4
R3(config-router)#router-id 0.0.4.3
```
  - D1: 0.0.4.131

```
router ospf 4
router-id 0.0.4.131
```
  - D2: 0.0.4.132

```
D2(config)#router ospf 4
D2(config-router)#router-id 0.0.4.132
```

On R1, R3, D1, and D2, advertise all directly connected networks / VLANs in Area 0.

```
R1(config-router)#network 10.91.10.0 0.0.0.255 area 0
R1(config-router)#network 10.91.13.0 0.0.0.255 area 0
```

```
R3(config-router)#network 10.91.11.0 0.0.0.255 area 0
R3(config-router)#network 10.91.13.0 0.0.0.255 area 0
```

```
D1(config-router)#network 10.91.100.0 0.0.0.255 area 0
D1(config-router)#network 10.91.101.0 0.0.0.255 area 0
D1(config-router)#network 10.91.102.0 0.0.0.255 area 0
D1(config-router)#network 10.91.10.0 0.0.0.255 area 0
```

```
D2(config-router)#network 10.91.100.0 0.0.0.255 area 0
D2(config-router)#network 10.91.101.0 0.0.0.255 area 0
D2(config-router)#network 10.91.102.0 0.0.0.255 area 0
D2(config-router)#network 10.91.11.0 0.0.0.255 area 0
```

- On R1, do not advertise the R1 – R2 network.

```
R1(config-router)#default-information originate
```
- On R1, propagate a default route. Note that the default route will be provided by BGP.

```
D1(config-router)#passive-interface default
```

```
D1(config-router)#no passive-interface e1/2
```

```
D2(config-router)#passive-interface default
D2(config-router)#no passive-interface e1/0
```

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

Use OSPF Process ID 6 and assign the following router-IDs:

```
R1(config)#ipv6 router ospf 6
```

```
D2(config)#ipv6 router ospf 6
```

```
R3(config)#ipv6 router ospf 6
```

```
D1(config)#ipv6 router ospf 6
```

- R1: 0.0.6.1  
R1(config-rtr)#router-id 0.0.6.1
- R3: 0.0.6.3  
R3(config-rtr)#router-id 0.0.6.3
- D1: 0.0.6.131  
D1(config-rtr)#router-id 0.0.6.131
- D2: 0.0.6.132  
D2(config-rtr)#router-id 0.0.6.132

On R1, R3, D1, and D2, advertise all directly connected networks / VLANs in Area 0.

```
R1(config)#interface e1/1
R1(config-if)#ipv6 ospf 6 area 0
R1(config-if)#exit
R1(config)#interface e1/2
R1(config-if)#ipv6 ospf 6 area 0
```

```
R3(config)#interface e1/1
R3(config-if)#ipv6 ospf 6 area 0
R3(config-if)#exit
R3(config)#interface e1/0
```

```
R3(config-if)#ipv6 ospf 6 area 0
```

```
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
```

```
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
```

Disable OSPFv3 advertisements on:

- D1: All interfaces except E1/2  
D1(config-router)#passive-interface default  
D1(config-router)#no passive-interface e1/2
- D2: All interfaces except E1/0  
D2(config-rtr)#passive-interface default

```
D2(config-rtr)#no passive-interface e1/0
```

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

Configure two default static routes via interface Loopback 0:

- An IPv4 default static route.  
R2(config)#ip route 0.0.0.0 0.0.0.0 loopback 0

- An IPv6 default static route.  
R2(config)#ipv6 route ::/0 loopback 0

Configure R2 in BGP ASN **500** and use the router-id 2.2.2.2.

```
R2(config)#router bgp 500
R2(config-router)#bgp router-id 2.2.2.2
```

Configure and enable an IPv4 and IPv6 neighbor relationship with R1 in ASN 300.

```
R2(config-router)#neighbor 209.165.200.225 remote-as 300
R2(config-router)#neighbor 2001:db8:200::1 remote-as 300
```

In IPv4 address family, advertise:

```
R2(config-router)#address-family ipv4
R2(config-router-af)#neighbor 209.165.200.225 activate
R2(config-router-af)#no neighbor 2001:db8:200::1 activate
```

- The Loopback 0 IPv4 network (/32).  
R2(config-router-af)#network 2.2.2.2 mask 255.255.255.255
- The default route (0.0.0.0/0).  
R2(config-router-af)#network 0.0.0.0

In IPv6 address family, advertise:

```
R2(config-router)#address-family ipv6
R2(config-router-af)#no neighbor 209.165.200.225 activate
R2(config-router-af)#neighbor 2001:db8:200::1 activate
```

- The Loopback 0 IPv4 network (/128).  
R2(config-router-af)#network 2001:db8:2222::1/128
- The default route (::/0).  
R2(config-router-af)#network ::/0

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

Configure two static summary routes to interface Null 0:

- A summary IPv4 route for 10.91.0.0/8.

```
R1(config)#ip route 10.91.0.0 255.255.0.0 null0
```

- A summary IPv6 route for 2001:db8:100::/48.  
R1(config)#ipv6 route 2001:db8:100::/48 null0

Configure R1 in BGP ASN **300** and use the router-id 1.1.1.1.

```
R1(config)#router bgp 300
R1(config-router)#bgp router-id 1.1.1.1
```

Configure an IPv4 and IPv6 neighbor relationship with R2 in ASN 500.

```
R1(config-router)#neighbor 209.165.200.226 remote-as 500
R1(config-router)#neighbor 2001:db8:200::2 remote-as 500
```

In IPv4 address family:

```
R1(config-router)#address-family ipv4 unicast
```

- Disable the IPv6 neighbor relationship.  
R1(config-router-af)#neighbor 209.165.200.226 activate
- Enable the IPv4 neighbor relationship.  
R1(config-router-af)#no neighbor 2001:db8:200::2 activate
- Advertise the 10.91.0.0/8 network.  
R1(config-router-af)#network 10.91.0.0 mask 255.255.0.0

In IPv6 address family:

```
R1(config-router)#address-family ipv6 unicast
```

- Disable the IPv4 neighbor relationship.  
R1(config-router-af)#no neighbor 209.165.200.226 activate
- Enable the IPv6 neighbor relationship.  
R1(config-router-af)#neighbor 2001:db8:200::2 activate
- Advertise the 2001:db8:100::/48 network.  
R1(config-router-af)#network 2001:db8:100::/48

## **Configure First Hop Redundancy**

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

Create two IP SLAs.

- Use SLA number **4** for IPv4.  
ip SLA 4
- Use SLA number **6** for IPv6.  
ip SLA 6

The IP SLAs will test availability of R1 E1/2 interface every 5 seconds.

```
icmp-echo 10.91.10.1
frequency 5
icmp-echo 2001:db8:100:1010::1
frequency 5
```

Schedule the SLA for immediate implementation with no end time.

```
D1(config)#ip sla schedule 4 life forever start-time now
D1(config)#ip sla schedule 6 life forever start-time now
```

D1(config)#ip sla schedule 6 life forever start-time now

Create an IP SLA object for IP SLA 4 and one for IP SLA 6.

- Use track number **4** for IP SLA 4.  
D1(config)#track 4 ip sla 4
- Use track number **6** for IP SLA 6.  
D1(config)#track 6 ip sla 6

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.

```
D1(config-track)#delay down 10 up 15
```

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

Create two IP SLAs.

- Use SLA number **4** for IPv4.  
ip SLA 4
- Use SLA number **6** for IPv6.  
ip SLA 6

The IP SLAs will test availability of R3 E1/0 interface every 5 seconds.

```
icmp-echo 10.91.11.1
frequency 5
icmp-echo 2001:db8:100:1011::1
frequency 5
```

Schedule the SLA for immediate implementation with no end time.

```
D2(config)#ip sla schedule 4 life forever start-time now
D2(config)#ip sla schedule 6 life forever start-time now
```



```
D1(config)#ip sla schedule 6 life forever start-time now
```

Create an IP SLA object for IP SLA 4 and one for IP SLA 6.

- Use track number **4** for IP SLA 4.  
D2(config)#track 4 ip sla 4
- Use track number **6** for IP SLA 6.  
D2(config)#track 6 ip sla 6

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.

```
D2(config-track)#delay down 10 up 15
```

### 4.3 On D1, configure HSRPv2

D1 is the primary router for VLANs 100 and 102; therefore, their priority will also be changed to 150.

```
D1(config)#interface vlan 100
D1(config-if)#standby 104 priority 150
D1(config)#interface vlan 102
D1(config-if)#standby 124 priority 150
```

Configure HSRP version 2.

```
D1(config-if)#standby version 2
```

Configure IPv4 HSRP group **104** for VLAN 100:

```
D1(config)#interface vlan 100
D1(config-if)#standby version 2
D1(config-if)#standby 104 ip 10.91.100.254
D1(config-if)#standby 104 priority 150
D1(config-if)#standby 104 preempt
D1(config-if)#standby 104 track 4 decrement 60
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
```

- Assign the virtual IP address **10.91.100.254**.  
D1(config-if)#standby 104 ip 10.91.100.254
- Set the group priority to **150**.  
D1(config-if)#standby 104 priority 150
- Enable preemption.  
D1(config-if)#standby 104 preempt
- Track object 4 and decrement by 60.  
D1(config-if)#standby 104 track 4 decrement 60

```
D1(config-if)#standby 106 track 6 decrement 60
```

Configure IPv4 HSRP group **114** for VLAN 101:

```
D1(config)#interface vlan 101
D1(config-if)#standby version 2
D1(config-if)#standby 114 ip 10.91.101.254
D1(config-if)#standby 114 preempt
D1(config-if)#standby 114 track 4 decrement 60
```

- Assign the virtual IP address **10.91.101.254**.  
D1(config-if)#standby 114 ip 10.91.101.254
- Enable preemption.  
D1(config-if)#standby 114 preempt
- Track object 4 to decrement by 60.  
D1(config-if)#standby 114 track 4 decrement 60

Configure IPv4 HSRP group **124** for VLAN 102:

```
D1(config)#interface vlan 102
D1(config-if)#standby version 2
D1(config-if)#standby 124 ip 10.91.102.254
D1(config-if)#standby 124 priority 150
D1(config-if)#standby 124 preempt
D1(config-if)#standby 124 track 4 decrement 60
```

- Assign the virtual IP address **10.91.102.254**.  
D1(config-if)#standby 124 ip 10.91.102.254
- Set the group priority to **150**.  
D1(config-if)#standby 124 priority 150
- Enable preemption.  
D1(config-if)#standby 124 preempt
- Track object 4 to decrement by 60.  
D1(config-if)#standby 124 track 4 decrement 60

Configure IPv6 HSRP group **106** for VLAN 100:

```
D1(config)#interface vlan 100
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
```

- Assign the virtual IP address using **ipv6 autoconfig**.  
D1(config-if)#standby 106 ipv6 autoconfig
- Set the group priority to **150**.  
D1(config-if)#standby 106 priority 150
- Enable preemption.  
D1(config-if)#standby 106 preempt

- Track object 6 and decrement by 60.  
D1(config-if)#standby 106 track 6 decrement 60

Configure IPv6 HSRP group **116** for VLAN 101:

```
D1(config)#interface vlan 101
D1(config-if)#standby 116 ipv6 autoconfig
D1(config-if)#standby 116 preempt
D1(config-if)#standby 116 track 6 decrement 60
```

- Assign the virtual IP address using **ipv6 autoconfig**.  
D1(config-if)#standby 116 ipv6 autoconfig
- Enable preemption.  
D1(config-if)#standby 116 preempt
- Track object 6 and decrement by 60.  
D1(config-if)#standby 116 track 6 decrement 60

Configure IPv6 HSRP group **126** for VLAN 102:

```
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
```

- Assign the virtual IP address using **ipv6 autoconfig**.  
D1(config-if)#standby 126 ipv6 autoconfig
- Set the group priority to **150**.  
D1(config-if)#standby 126 priority 150
- Enable preemption.  
D1(config-if)#standby 126 preempt
- Track object 6 and decrement by 60.  
D1(config-if)#standby 126 track 6 decrement 60

Figura 29. Verificación protocolo enrutamiento en R1

**Edgar Jose Vejas Lopez  
Cod: 19706791  
Grupo: 208014\_6**

```

R1
router ospf 4
router-id 0.0.4.1
network 10.91.18.0 0.0.0.255 area 0
network 10.91.12.0 0.0.0.255 area 0
default-information originate

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
no neighbor 2001:DB8:200::2 activate
neighbor 209.165.200.226 activate
exit-address-family
}

address-family ipv6
network 2001:DB8:100::/48
neighbor 2001:DB8:200::2 activate
exit-address-family
}

ip forward-protocol nd
}

no ip http server
no ip http secure-server

ipv6 route 2001:DB8:100::/48 Null0
ipv6 router ospf 6

```

**Topology Summary**

| Node | Console                    |
|------|----------------------------|
| A1   | telnet 192.168.56.101:5008 |
| D1   | telnet 192.168.56.101:5027 |
| D2   | telnet 192.168.56.101:5007 |
| PC1  | telnet 192.168.56.101:5009 |
| PC2  | telnet 192.168.56.101:5012 |
| PC3  | telnet 192.168.56.101:5017 |
| PC4  | telnet 192.168.56.101:5023 |
| R1   | telnet 192.168.56.101:5004 |
| R2   | telnet 192.168.56.101:5005 |
| R3   | telnet 192.168.56.101:5006 |

**Servers Summary**

- DESKTOP-SMTRT9E CPU 27.4%, RAM 96.0%
- GNS3 VM (GNS3 VM) CPU 100.0%, RAM 52.3%

Figura 30. Verificación protocolo enrutamiento en R2

**Edgar Jose Vejas Lopez  
Cod: 19706791  
Grupo: 208014\_6**

```

R2
interface Ethernet1/1
no ip address
shutdown
duplex full
}
interface Ethernet1/2
no ip address
shutdown
duplex full
}
interface Ethernet1/3
no ip address
shutdown
duplex full
}

router bgp 300
bgp router-id 2.2.2.2
bgp log-neighbor-changes
neighbor 2001:DB8:200::1 remote-as 300
neighbor 209.165.200.225 remote-as 300
}

address-family ipv4
network 0.0.0.0
network 2.2.2.2 mask 255.255.255.255
neighbor 2001:DB8:200::1 activate
no neighbor 209.165.200.225 activate
exit-address-family
}

ip forward-protocol nd
}

no ip http server
no ip http secure-server
ip route 0.0.0.0 0.0.0.0 Loopback0
}

ipv6 route ::0 Loopback0
}

```

**Topology Summary**

| Node | Console                    |
|------|----------------------------|
| A1   | telnet 192.168.56.101:5008 |
| D1   | telnet 192.168.56.101:5027 |
| D2   | telnet 192.168.56.101:5007 |
| PC1  | telnet 192.168.56.101:5009 |
| PC2  | telnet 192.168.56.101:5012 |
| PC3  | telnet 192.168.56.101:5017 |
| PC4  | telnet 192.168.56.101:5023 |
| R1   | telnet 192.168.56.101:5004 |
| R2   | telnet 192.168.56.101:5005 |
| R3   | telnet 192.168.56.101:5006 |

**Servers Summary**

- DESKTOP-SMTRT9E CPU 28.8%, RAM 91.5%
- GNS3 VM (GNS3 VM) CPU 100.0%, RAM 52.4%



- Track object 4 and decrement by 60.  
D2(config-if)#standby 104 track 4 decrement 60

Configure IPv4 HSRP group **124** for VLAN 102:

```
D2(config)#interface vlan 102
D2(config-if)#standby version 2
D2(config-if)#standby 124 ip 10.91.102.254
D2(config-if)#standby 124 preempt
D2(config-if)#standby 124 track 4 decrement 60
```

- Assign the virtual IP address **10.91.102.254**.  
D2(config-if)#standby 124 ip 10.91.102.254
- Enable preemption.  
D2(config-if)#standby 124 preempt
- Track object 4 to decrement by 60.  
D2(config-if)#standby 124 track 4 decrement 60

Configure IPv4 HSRP group **106** for VLAN 100:

```
D2(config-if)#standby 106 ipv6 autoconfig
D2(config-if)#standby 106 preempt
D2(config-if)#standby 106 track 6 decrement 60
```

- Assign the virtual IP address using **ipv6 autoconfig**.  
D2(config-if)#standby 106 ipv6 autoconfig
- Set the group priority to **150**.  
D2(config-if)#standby 106 priority 150
- Enable preemption.  
D2(config-if)#standby 106 preempt
- Track object 6 and decrement by 60.  
D2(config-if)#standby 106 track 6 decrement 60

Configure IPv6 HSRP group **116** for VLAN 101:

```
D2(config)#interface vlan 101
D2(config-if)#standby 116 ipv6 autoconfig
D2(config-if)#standby 116 preempt
D2(config-if)#standby 116 track 6 decrement 60
```

- Assign the virtual IP address using **ipv6 autoconfig**.  
D2(config-if)#standby 116 ipv6 autoconfig
- Enable preemption.  
D2(config-if)#standby 116 preempt

- Track object 6 and decrement by 60.  
D2(config-if)#standby 116 track 6 decrement 60

Configure IPv6 HSRP group **126** for VLAN 102:

- D2(config-if)#standby 126 ipv6 autoconfig
- D2(config-if)#standby 126 priority 150
- D2(config-if)#standby 126 preempt
- D2(config-if)#standby 126 track 6 decrement 60

- Assign the virtual IP address using **ipv6 autoconfig**.  
D2(config-if)#standby 126 ipv6 autoconfig
- Set the group priority to **150**.  
D2(config-if)#standby 126 priority 150
- Enable preemption.  
D2(config-if)#standby 126 preempt
- Track object 6 and decrement by 60.  
D2(config-if)#standby 126 track 6 decrement 60

Figura 32. Verificación configuración de SLA y HSRPv2 en D1

The screenshot displays a GNS3 network simulation environment. The main window shows a terminal for Switch D1 with the following configuration and status:

```

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 10.91.10.1
 frequency 5
 ip sla schedule 4 life forever start-time now
ip sla 6
 icmp-echo 10.91.10.1
 frequency 5
 ip sla schedule 6 life forever start-time now
D1#show standby brief
P indicates configured to preempt.
Interface Grp Pri P State Active Standby Virtual IP
Vl100 104 150 P Active local 10.91.100.2 10.91.100.254 FE80::5:73FF:FEA0
Vl101 106 150 P Active local unknown 10.91.101.254
Vl101 114 100 P Active local unknown 10.91.101.254
Vl101 116 100 P Active local FE80::D2:3 FE80::5:73FF:FEA0
Vl101 126 150 P Active local FE80::D2:3 FE80::5:73FF:FEA0
Vl102 124 150 P Active local 10.91.102.2 10.91.102.254
D1#

```

The network topology diagram shows a central switch D1 connected to three other switches: A1, R3, and D2. Switch A1 is connected to PC3 and PC4. Switch R3 is connected to PC2. Switch D2 is connected to PC1. The diagram also shows VLAN configurations and IP addresses for each device. A text box in the diagram identifies the author: "Edgar Jose Vejas Lopez Cod: 19706791 Grupo: 208014\_6".

Summary panels on the right provide additional information:

- Topology Summary:** Lists nodes A1, D1, D2, PC1, PC2, PC3, PC4, R1, R2, and R3 with their respective IP addresses.
- Servers Summary:** Shows system statistics for the desktop and GNS3 VM, including CPU and RAM usage.

Figura 33. Configuración D1

Edgar Jose Yejas Lopez  
Cod: 19706791  
Grupo: 208014\_6

```

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 10.30.11.1
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#show standby brief
P indicates configured to preempt.

```

| Interface | Grp | Pri | P | State   | Active      | Standby | Virtual IP        |
|-----------|-----|-----|---|---------|-------------|---------|-------------------|
| Vl1100    | 104 | 90  | P | Standby | 10.91.100.1 | local   | 10.91.100.254     |
| Vl1101    | 116 | 100 | P | Standby | FE80::D1:3  | local   | FE80::5:73FF:FEA0 |
| Vl1101    | 126 | 150 | P | Standby | FE80::D1:3  | local   | FE80::5:73FF:FEA0 |
| Vl1102    | 106 | 150 | P | Active  | local       | unknown | FE80::5:73FF:FEA0 |
| Vl1102    | 124 | 40  | P | Standby | 10.91.102.1 | local   | 10.91.102.254     |

Topology Summary

| Node | Console                    |
|------|----------------------------|
| A1   | telnet 192.168.56.101:5008 |
| D1   | telnet 192.168.56.101:5027 |
| D2   | telnet 192.168.56.101:5007 |
| PC1  | telnet 192.168.56.101:5009 |
| PC2  | telnet 192.168.56.101:5012 |
| PC3  | telnet 192.168.56.101:5017 |
| PC4  | telnet 192.168.56.101:5023 |
| R1   | telnet 192.168.56.101:5004 |
| R2   | telnet 192.168.56.101:5005 |
| R3   | telnet 192.168.56.101:5006 |

Servers Summary

- DESKTOP-SMTTRJSE CPU 27.0%, RAM 91.7%
- GNS3 VM (GNS3 VM) CPU 100.0%, RAM 52.8%



## COMANDOS DE VERIFICACIÓN

Figura 34. Ping en PC1

```
PC1
VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

VPCS> ip 10.91.100.5/24 255.255.255.0 10.91.100.254
Checking for duplicate address...
VPCS : 10.91.100.5 255.255.255.0 gateway 10.91.100.254

VPCS> ip 2001:db8:100:100::5/64
PC1 : 2001:db8:100:100::5/64

VPCS> sh

NAME IP/MASK GATEWAY MAC LPORT RHOST:PO
RT
VPCS1 10.91.100.5/24 10.91.100.254 00:50:79:66:68:00 20044 127.0.0.1:20045
fe80::250:79ff:fe66:6800/64
2001:db8:100:100::5/64

VPCS> ping 10.91.100.1

84 bytes from 10.91.100.1 icmp_seq=1 ttl=255 time=0.197 ms
84 bytes from 10.91.100.1 icmp_seq=2 ttl=255 time=0.314 ms
84 bytes from 10.91.100.1 icmp_seq=3 ttl=255 time=0.265 ms
84 bytes from 10.91.100.1 icmp_seq=4 ttl=255 time=0.384 ms
84 bytes from 10.91.100.1 icmp_seq=5 ttl=255 time=0.356 ms

VPCS> ping 10.91.100.2

84 bytes from 10.91.100.2 icmp_seq=1 ttl=255 time=0.306 ms
84 bytes from 10.91.100.2 icmp_seq=2 ttl=255 time=0.324 ms
84 bytes from 10.91.100.2 icmp_seq=3 ttl=255 time=0.487 ms
84 bytes from 10.91.100.2 icmp_seq=4 ttl=255 time=0.376 ms
84 bytes from 10.91.100.2 icmp_seq=5 ttl=255 time=0.398 ms

VPCS> ping 10.91.100.6

84 bytes from 10.91.100.6 icmp_seq=1 ttl=64 time=0.443 ms
84 bytes from 10.91.100.6 icmp_seq=2 ttl=64 time=0.845 ms
84 bytes from 10.91.100.6 icmp_seq=3 ttl=64 time=0.552 ms
84 bytes from 10.91.100.6 icmp_seq=4 ttl=64 time=0.377 ms
84 bytes from 10.91.100.6 icmp_seq=5 ttl=64 time=0.538 ms
```

Figura 35. Ping en PC4

```
PC4
VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

VPCS> ip 10.91.100.6/24 255.255.255.0 10.91.100.254
Checking for duplicate address...
VPCS : 10.91.100.6 255.255.255.0 gateway 10.91.100.254

VPCS> ip 2001:db8:100:100::6/64
PC1 : 2001:db8:100:100::6/64

VPCS> sh

NAME IP/MASK GATEWAY MAC LPORT RHOST:PO
RT
VPCS1 10.91.100.6/24 10.91.100.254 00:50:79:66:68:03 20050 127.0.0.1:20051
fe80::250:79ff:fe66:6803/64
2001:db8:100:100::6/64

VPCS> ping 10.91.100.1

84 bytes from 10.91.100.1 icmp_seq=1 ttl=255 time=0.354 ms
84 bytes from 10.91.100.1 icmp_seq=2 ttl=255 time=0.479 ms
84 bytes from 10.91.100.1 icmp_seq=3 ttl=255 time=0.546 ms
84 bytes from 10.91.100.1 icmp_seq=4 ttl=255 time=0.394 ms
84 bytes from 10.91.100.1 icmp_seq=5 ttl=255 time=0.696 ms

VPCS> ping 10.91.100.2

84 bytes from 10.91.100.2 icmp_seq=1 ttl=255 time=0.755 ms
84 bytes from 10.91.100.2 icmp_seq=2 ttl=255 time=0.670 ms
84 bytes from 10.91.100.2 icmp_seq=3 ttl=255 time=0.588 ms
84 bytes from 10.91.100.2 icmp_seq=4 ttl=255 time=0.576 ms
84 bytes from 10.91.100.2 icmp_seq=5 ttl=255 time=0.493 ms

VPCS> ping 10.91.100.5

84 bytes from 10.91.100.5 icmp_seq=1 ttl=64 time=0.383 ms
84 bytes from 10.91.100.5 icmp_seq=2 ttl=64 time=0.434 ms
84 bytes from 10.91.100.5 icmp_seq=3 ttl=64 time=0.471 ms
84 bytes from 10.91.100.5 icmp_seq=4 ttl=64 time=0.382 ms
84 bytes from 10.91.100.5 icmp_seq=5 ttl=64 time=0.444 ms
```

Figura 36. show run | section ^router ospf on R1 y R3

```
R1#
R1#show run | section ^router ospf
router ospf 4
 router-id 0.0.4.1
 network 10.91.10.0 0.0.0.255 area 0
 network 10.91.13.0 0.0.0.255 area 0
 default-information originate
R1#
```

```
R3#
R3#show run | section ^router ospf
router ospf 4
 router-id 0.0.4.3
 network 10.91.11.0 0.0.0.255 area 0
 network 10.91.13.0 0.0.0.255 area 0
R3#
```

Figura 37. show run | section ^ipv6 route on R1 y R3

```
R1#
R1#show run | section ^ipv6 route
ipv6 route 2001:DB8:100::/48 Null0
ipv6 router ospf 6
 router-id 0.0.6.1
R1#
```

```
R3#
R3#show run | section ^ipv6 route
ipv6 router ospf 6
 router-id 0.0.6.3
R3#
```

Figura 38. show run | section bgp and show run | include route on R2

```
R2#
R2#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 209.165.200.225 remote-as 300
 !
 address-family ipv4
 network 0.0.0.0
 network 2.2.2.2 mask 255.255.255.255
 no neighbor 2001:DB8:200::1 activate
 neighbor 209.165.200.225 activate
 exit-address-family
 !
 address-family ipv6
 network ::/0
 network 2001:DB8:2222::1/128
 neighbor 2001:DB8:200::1 activate
 exit-address-family
R2#
```

```
R2#
R2#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
R2#
```

Figura 39. show run | section bgp on R1

```
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
 network 10.91.0.0 mask 255.255.0.0
 no neighbor 2001:DB8:200::2 activate
 neighbor 209.165.200.226 activate
 exit-address-family
 !
 address-family ipv6
 network 2001:DB8:100::/48
 neighbor 2001:DB8:200::2 activate
 exit-address-family
R1#
```

Figura 40. show ip route | include O|B on R1

```
R1#
R1#show ip route | include O|B
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
 o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
B* 0.0.0.0/0 [20/0] via 209.165.200.226, 00:18:54
B 2.2.2.2 [20/0] via 209.165.200.226, 00:18:54
O 10.91.11.0/24 [110/20] via 10.91.13.3, 00:31:17, Ethernet1/1
O 10.91.100.0/24 [110/11] via 10.91.10.2, 01:49:58, Ethernet1/2
O 10.91.101.0/24 [110/11] via 10.91.10.2, 01:49:58, Ethernet1/2
O 10.91.102.0/24 [110/11] via 10.91.10.2, 01:49:58, Ethernet1/2
R1#
```

Figura 41. show ipv6 route command on R1

```

R1#show ipv6 route
IPv6 Routing Table - default - 14 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
 B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
 I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
 EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
 NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
 OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, 1 - LISP
B ::/0 [20/0]
 via FE80::2:1, Ethernet1/0
S 2001:DB8:100::/48 [1/0]
 via Null0, directly connected
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, directly connected
L 2001:DB8:100:1010::1/128 [0/0]
 via Ethernet1/2, receive
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, directly connected
L 2001:DB8:100:1013::1/128 [0/0]
 via Ethernet1/1, receive
C 2001:DB8:200::/64 [0/0]
 via Ethernet1/0, directly connected
L 2001:DB8:200::1/128 [0/0]
 via Ethernet1/0, receive
B 2001:DB8:2222::1/128 [20/0]
 via FE80::2:1, Ethernet1/0
L FF00::/8 [0/0]
 via Null0, receive
R1#

```

Figura 42. show ip route ospf | begin Gateway on R3

```

R3#
R3#show ip route ospf | begin Gateway
Gateway of last resort is 10.91.13.1 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 10.91.13.1, 00:23:48, Ethernet1/1
 10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
O 10.91.10.0/24 [110/20] via 10.91.13.1, 00:36:35, Ethernet1/1
O 10.91.100.0/24 [110/11] via 10.91.11.2, 01:54:53, Ethernet1/0
O 10.91.101.0/24 [110/11] via 10.91.11.2, 01:54:53, Ethernet1/0
O 10.91.102.0/24 [110/11] via 10.91.11.2, 01:54:53, Ethernet1/0
R3#

```

show ipv6 route ospf on R3

```

R3#
R3#show ipv6 route ospf
IPv6 Routing Table - default - 9 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
 B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
 I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
 EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
 NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
 OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, 1 - LISP
O 2001:DB8:100:100::/64 [110/11]
 via FE80::D1:1, Ethernet1/0
O 2001:DB8:100:101::/64 [110/11]
 via FE80::D1:1, Ethernet1/0
O 2001:DB8:100:102::/64 [110/11]
 via FE80::D1:1, Ethernet1/0
O 2001:DB8:100:1013::/64 [110/10]
 via Ethernet1/1, directly connected
R3#

```

Figura 43. show run | section ip sla command on D1

```
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 6
 icmp-echo 2001:DB8:100:1010::1
 frequency 5
ip sla schedule 6 life forever start-time now
D1#
```

Figura 44. show standby brief command on D1

```
D1#
D1#show standby brief
 P indicates configured to preempt.
 |
Interface Grp Pri P State Active Standby Virtual IP
Vl100 104 90 P Standby 10.91.100.2 local 10.91.100.254
Vl100 106 150 P Active local unknown FE80::5:73FF:FEA0
:6A
Vl101 114 40 P Active local unknown 10.91.101.254
Vl101 116 100 P Active local FE80::D2:3 FE80::5:73FF:FEA0
:74
Vl101 126 150 P Active local FE80::D2:3 FE80::5:73FF:FEA0
:7E
Vl102 124 90 P Active local 10.91.102.2 10.91.102.254
D1#
```

Figura 45. show run | section ip sla command on D2

```
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 6
 icmp-echo 2001:DB8:100:1011::1
 frequency 5
ip sla schedule 6 life forever start-time now
D2#
```

Figura 46. show run | section ^router ospf on D1 and D2

```
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 10.91.10.0 0.0.0.255 area 0
network 10.91.100.0 0.0.0.255 area 0
network 10.91.101.0 0.0.0.255 area 0
network 10.91.102.0 0.0.0.255 area 0
D1#
```

```
D2#
D2#show run | section ^router ospf
router ospf 4
router-id 0.0.4.132
passive-interface default
no passive-interface Ethernet1/0
network 10.91.11.0 0.0.0.255 area 0
network 10.91.100.0 0.0.0.255 area 0
network 10.91.101.0 0.0.0.255 area 0
network 10.91.102.0 0.0.0.255 area 0
D2#
```

Figura 47. show run | section ^ipv6 route on D1 and D2

```
D1#
D1#show run | section ^ipv6 route
ipv6 router ospf 6
router-id 0.0.6.131
passive-interface default
no passive-interface Ethernet1/2
D1#
```

```
D2#
D2#show run | section ^ipv6 route
ipv6 router ospf 6
router-id 0.0.6.132
D2#
```

Figura 48. show ipv6 ospf interface brief on R1, R3, D1, and D2

```
R1#
R1#show ipv6 ospf interface brief
Interface PID Area Intf ID Cost State Nbrs F/C
Et1/2 6 0 5 10 DR 1/1
Et1/1 6 0 4 10 BDR 1/1
R1#
```

```
R3#
R3#show ipv6 ospf interface brief
Interface PID Area Intf ID Cost State Nbrs F/C
Et1/1 6 0 4 10 DR 1/1
Et1/0 6 0 3 10 BDR 1/1
R3#
```

```
D1#
D1#show ipv6 ospf interface brief
Interface PID Area Intf ID Cost State Nbrs F/C
Vl102 6 0 24 1 DR 0/0
Vl101 6 0 23 1 DR 0/0
Vl100 6 0 22 1 DR 0/0
Et1/2 6 0 21 10 BDR 1/1
D1#
```

```
D2#
D2#show ipv6 ospf interface brief
Interface PID Area Intf ID Cost State Nbrs F/C
Vl102 6 0 24 1 DR 0/0
Vl101 6 0 23 1 DR 0/0
Vl100 6 0 22 1 DR 0/0
Et1/0 6 0 21 10 DR 1/1
D2#
```

## CONCLUSIONES

Utilizando el simulador gráfico GNS3 junto con la máquina virtual Oracle VM VirtualBox se pudo implementar un escenario el cual dejó mucho enriquecimiento en el concepto de estructurar redes conmutadas mediante el uso del protocolo STP y la configuración de VLANs, para comprender las características de una infraestructura de red jerárquica convergente.

Se dieron soluciones de red escalables mediante la configuración básica y avanzada de protocolos de enrutamiento para la implementación de servicios IP con calidad de servicio en ambientes de red empresariales LAN y WAN paso a paso.

Se resolvió en su totalidad la actividad práctica propuesta del escenario hipotético, cumpliendo a cabalidad con cada uno de los requerimientos y mostrando tanto los códigos de ejecución como los resultados en los dispositivos configurados.



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