

**EVALUACIÓN PRUEBA DE HABILIDADES PRACTICAS CCNA**

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INGENIERÍA ELECTRONICA/SISTEMAS/TELECO**

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**Nota de aceptación**

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**Firma del jurado**

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**Firma del jurado**

Medellín, 07 de diciembre de 2022

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## GLOSARIO

VLAN: (red de área local virtual o LAN virtual) es una red de área local que agrupa computadoras de forma lógica y no física. De hecho, la arquitectura física administra la comunicación entre diferentes computadoras en una red de área local.

DHCP: (Protocolo de configuración dinámica de host). Protocolo de configuración de servidor dinámico. Un protocolo que usan las computadoras para obtener información de configuración. DHCP permite asignar direcciones IP a las computadoras sin necesidad de que los administradores configuren la información de la computadora en la base de datos del servidor.

DNS: Sistema de nombres de dominio. DNS es un servicio que asocia nombres de dominio con sus direcciones IP asociadas.

OSPF: Open Shortest Path First (OSPF) es un protocolo de enrutamiento de estado de enlace desarrollado para redes IP y basado en el algoritmo Shortest Path First (SPF).

IP: Una dirección IP es una serie de interfaces de red (elementos de comunicación/conexión) de dispositivos (computadoras, tabletas, portátiles, teléfonos inteligentes, etc.) que se identifican lógicamente y jerárquicamente mediante protocolos y (protocolos de Internet). Significa números.

SERVIDOR: Un servidor es una computadora u otro tipo de dispositivo informático que sirve información a un conjunto de clientes, que pueden ser tanto personas como otros dispositivos conectados a él. La información que puede transmitir puede variar desde archivos de texto, imagen o video hasta programas de computadora, bases de datos y más.



## **RESUMEN**

El documento actual presenta el trabajo desarrollado como una opción de grado en telecomunicaciones e ingeniería Electrónica, aplicando habilidades prácticas CCNA en el marco del escenario propuesto. Ese ensamblaje se ejecuta en un GNS3 simulado utilizando dispositivos CISCO. La propuesta de escenario es simple, pero los requisitos de configuración requeridos del tutorial varían para simular la red a nivel profesional. Pone a prueba las habilidades del estudiante en el conocimiento de redes de datos. Primero, configure algunos protocolos para la conmutación en la Capa 2 y configure los protocolos para establecer el enrutamiento entre la propia LAN (la red corporativa) y otro Sistema Autónomo (ISP) en paralelo en la Capa 3. Configurar), por lo que la red unificada se comunicará entre sí simulando la situación de política de seguridad establecida a la que se enfrentarán los futuros egresados.

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

## **ABSTRACT**

The current document presents the work developed as a degree option in telecommunications and electronic engineering, applying CCNA practical skills within the framework of the proposed scenario. That assembly runs on a GNS3 simulator using CISCO devices. The scenario proposal is simple, but the required configuration requirements of the tutorial vary to simulate the network at a professional level. It tests the student's skills in knowledge of data networks. First, configure some protocols for Layer 2 switching, and configure the protocols for routing between your own LAN (the corporate network) and another parallel Autonomous System (ISP) at Layer 3. Configure), so the unified network will communicate with each other simulating the established security policy situation that future graduates will face.

Keywords: CISCO, CCNA, Routing, Switching, Networking, Electronics.

## INTRODUCCIÓN

Este trabajo se realiza para que los futuros ingenieros de telecomunicaciones y electrónicos entiendan las redes y aprendan a configurar los diferentes protocolos que permiten la interconexión de ellas. El escenario incluye tres enrutadores, tres interruptores y cuatro PC que simulan las redes a las que el ingeniero se encontrara en el futuro.

Inicialmente, las direcciones IP IPv4 e IPv6 se crearon en todos los dispositivos, y luego se utilizaron 2 claves múltiples. Por lo general, la esencia de la red de clientes en el segundo piso del cliente debe estar conectada a los protocolos y LACP. LAN IPv6; Los hilos IPv4 y MP-BGP conectan sistemas independientes con dos grupos cargados en la dirección de IPv6. La primera parte garantiza el servicio de uso del dispositivo LAN de la compañía.

La segunda parte utiliza direcciones IP virtuales para configurar la redundancia de primer salto con HSRP y mejorar la seguridad de los dispositivos manejables para la consolidación de la red. Además, la sincronización de tiempo NTP se configura entre todos los dispositivos y la administración de la red mediante el protocolo SNMPv2 para el monitoreo de la red en tiempo real.

## ESCENARIO 1

En este escenario se pide configurar la topología de red que se muestra en la figura 1, configurar los ajustes básicos y el direccionamiento de la interfaz como según la tabla 1.

Figura 1 Escenario 1

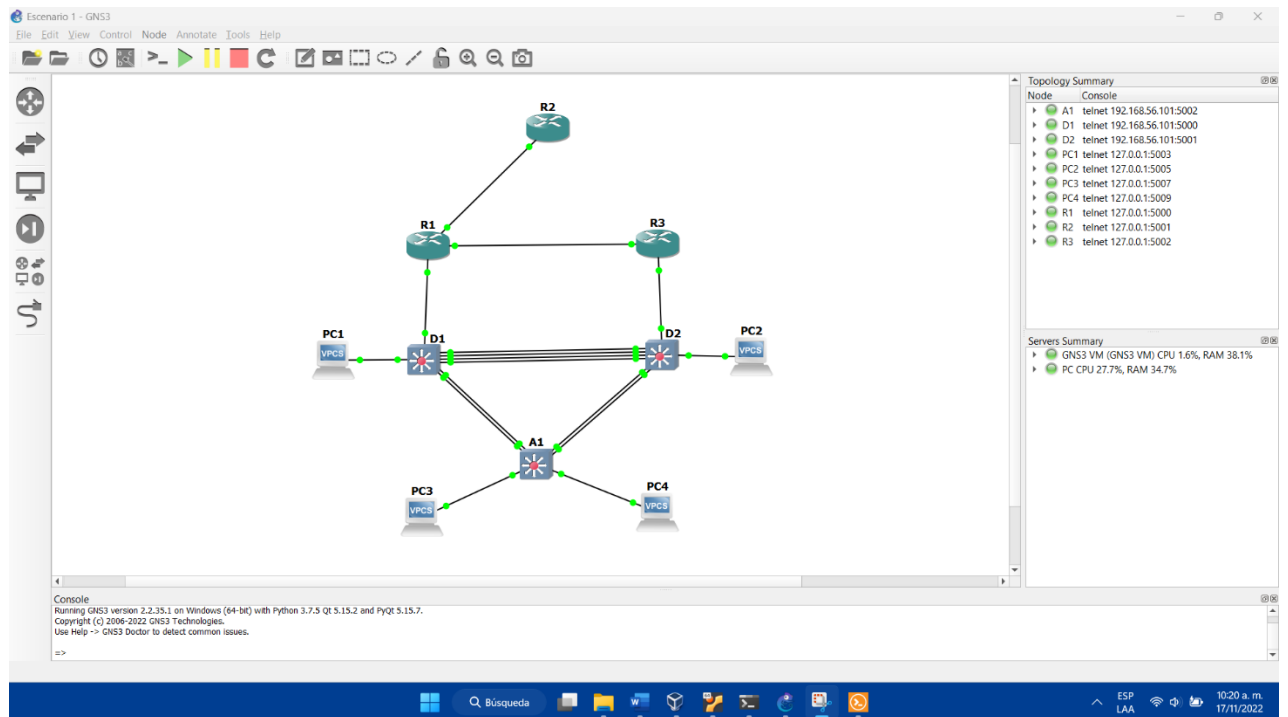


Tabla 1 Tabla de direccionamiento IP

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
R1	E1/2	10.68.10.1/24	2001:db8:100:1010::1/64	fe80::1:2
R1	E1/1	10.68.13.1/24	2001:db8:100:1013::1/64	fe80::1:3

Device	Interface	IPv4 Address	IPv6 Address	IPv6 Link-Local
R2	E1/0	209.165.200.226/27	2001:db8:200::2/64	fe80::2:1
R2	Loopback0	2.2.2.2/32	2001:db8:2222::1/128	fe80::2:3
R3	E1/0	10.68.11.1/24	2001:db8:100:1011::1/64	fe80::3:2
R3	E1/1	10.68.13.3/24	2001:db8:100:1013::3/64	fe80::3:3
D1	E1/2	10.68.10.2/24	2001:db8:100:1010::2/64	fe80::d1:1
D1	VLAN 100	10.68.100.1/24	2001:db8:100:100::1/64	fe80::d1:2
D1	VLAN 101	10.68.101.1/24	2001:db8:100:101::1/64	fe80::d1:3
D1	VLAN 102	10.68.102.1/24	2001:db8:100:102::1/64	fe80::d1:4
D2	E1/0	10.68.11.2/24	2001:db8:100:1011::2/64	fe80::d2:1
D2	VLAN 100	10.68.100.2/24	2001:db8:100:100::2/64	fe80::d2:2
D2	VLAN 101	10.68.101.2/24	2001:db8:100:101::2/64	fe80::d2:3
D2	VLAN 102	10.68.102.2/24	2001:db8:100:102::2/64	fe80::d2:4
A1	VLAN 100	10.68.100.3/23	2001:db8:100:100::3/64	fe80::a1:1
PC1	NIC	10.68.100.5/24	2001:db8:100:100::5/64	EUI-64
PC2	NIC	DHCP	SLAAC	EUI-64
PC3	NIC	DHCP	SLAAC	EUI-64
PC4	NIC	10.68.100.6/24	2001:db8:100:100::6/64	EUI-64

En la primera parte se inicia configurando los router y switches de la red según la tabla de direccionamiento IP, a continuación, se muestra el listado de comandos de cada dispositivo:

### Router R1

```
config t
```

```
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 10.68.10.1 255.255.255.0
  ipv6 address fe80::1:2 link-local
  ipv6 address 2001:db8:100:1010::1/64
  no shutdown
  exit
interface e1/1
  ip address 10.68.13.1 255.255.255.0
  ipv6 address fe80::1:3 link-local
  ipv6 address 2001:db8:100:1013::1/64
  no shutdown
  exit
```

```
exit
copy running-config startup-config
```

## **Router R2**

```
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
exit
copy running-config startup-config
```

### **Router R3**

```
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 10.68.11.1 255.255.255.0
ipv6 address fe80::3:2 link-local
ipv6 address 2001:db8:100:1011::1/64
no shutdown
exit
interface e1/1
ip address 10.68.13.3 255.255.255.0
ipv6 address fe80::3:3 link-local
ipv6 address 2001:db8:100:1010::2/64
```

```
no shutdown
exit
exit
copy running-config startup-config
```

### **Switch D1**

```
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 10.68.10.2 255.255.255.0
ipv6 address fe80::d1:1 link-local
ipv6 address 2001:db8:100:1010::2/64
no shutdown
exit
interface vlan 100
ip address 10.68.100.1 255.255.255.0
ipv6 address fe80::d1:2 link-local
ipv6 address 2001:db8:100:100::1/64
no shutdown
exit
interface vlan 101
ip address 10.68.101.1 255.255.255.0
ipv6 address fe80::d1:3 link-local
ipv6 address 2001:db8:100:101::1/64
no shutdown
exit
interface vlan 102
```

```
ip address 10.68.102.1 255.255.255.0
ipv6 address fe80::d1:4 link-local
ipv6 address 2001:db8:100:102::1/64
no shutdown
exit
ip dhcp excluded-address 10.68.101.1 10.68.101.109
ip dhcp excluded-address 10.68.101.141 10.68.101.254
ip dhcp excluded-address 10.68.102.1 10.68.102.109
ip dhcp excluded-address 10.68.102.141 10.68.102.254
ip dhcp pool VLAN-101
network 10.68.101.0 255.255.255.0
default-router 10.68.101.254
exit
ip dhcp pool VLAN-102
network 10.68.102.0 255.255.255.0
default-router 10.68.102.254
exit
interface range e0/3,e1/0-1,e1/3,e3/0-3
shutdown
exit
exit
copy running-config startup-config
```

## **Switch D2**

```
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 10.68.11.2 255.255.255.0
ipv6 address fe80::d2:1 link-local
ipv6 address 2001:db8:100:1011::2/64
no shutdown
exit
interface vlan 100
ip address 10.68.100.2 255.255.255.0
ipv6 address fe80::d2:2 link-local
ipv6 address 2001:db8:100:100::2/64
no shutdown
exit
interface vlan 101
ip address 10.68.101.2 255.255.255.0
ipv6 address fe80::d2:3 link-local
ipv6 address 2001:db8:100:101::2/64
no shutdown
exit
interface vlan 102
ip address 10.68.102.2 255.255.255.0
ipv6 address fe80::d2:4 link-local
ipv6 address 2001:db8:100:102::2/64
no shutdown
exit
ip dhcp excluded-address 10.68.101.1 10.68.101.209
```

```
ip dhcp excluded-address 10.68.101.241 10.68.101.254
ip dhcp excluded-address 10.68.102.1 10.68.102.209
ip dhcp excluded-address 10.68.102.241 10.68.102.254
ip dhcp pool VLAN-101
network 10.68.101.0 255.255.255.0
default-router 10.68.101.254
exit
ip dhcp pool VLAN-102
network 10.68.102.0 255.255.255.0
default-router 10.68.102.254
exit
interface range e0/1-3,e1/3,e3/0-3
shutdown
exit
exit
copy running-config startup-config
```

### **Switch A1**

```
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 10.68.100.3 255.255.255.0
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
exit
```

```
copy running-config startup-config
```

Luego de configurar los Routers y los switches se configura el direccionamiento de host de PC1 y PC4 con los siguientes comandos.

### **PC1**

```
ip 10.68.100.5/24 255.255.255.0
```

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

```
save
```

### **PC4**

```
ip 10.68.100.6/24 255.255.255.0
```

```
ip 2001:db8:100:100::6/64
```

```
save
```

En la segunda parte se configura la red de capa 2 y la compatibilidad con el host, estas configuraciones se realizan en los switches con los siguientes comandos:

### **Switch D1**

```
Config t
```

```
interface range e2/0-3, e0/1-2
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

```
no shutdown
```

```
exit
```

```
interface range e2/0-3, e0/1-2
```

```
switchport trunk native vlan 999
exit
spanning-tree mode rapid-pvst
spanning-tree vlan 100 root primary
spanning-tree vlan 102 root primary
spanning-tree vlan 101 root secondary
interface range e2/0-3
channel-protocol lacp
channel-group 12 mode active
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 e0/1-2
channel-protocol lacp
channel-group 1 mode active
exit
interface port-channel 1
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
```



```
switchport trunk allowed vlan 100-102
exit
interface e0/0
switchport mode access
switchport access vlan 100
spanning-tree portfast
no shutdown
exit
```

## **Switch D2**

```
config t
interface range e2/0-3, e1/1-2
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface range e2/0-3, e1/1-2
switchport trunk native vlan 999
exit
spanning-tree mode rapid-pvst
spanning-tree vlan 101 root primary
spanning-tree vlan 100 root secondary
spanning-tree vlan 102 root secondary
interface range e2/0-3
```

```
channel-protocol lacp
channel-group 12 mode active
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 e1/1-2
channel-protocol lacp
channel-group 2 mode active
exit
interface port-channel 2
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk native vlan 999
switchport trunk allowed vlan 100-102
exit
interface e0/0
switchport mode access
switchport access vlan 102
spanning-tree portfast
no shutdown
```

exit

### **Switch A1**

config t

interface range e0/1-2, e1/1-2

switchport trunk encapsulation dot1q

switchport mode trunk

no shutdown

exit

interface range e0/1-2, e1/1-2

switchport trunk native vlan 999

exit

spanning-tree mode rapid-pvst

interface range e0/1-2

channel-protocol lacp

channel-group 1 mode passive

exit

interface port-channel 1

switchport trunk native vlan 999

switchport trunk allowed vlan 100-102

switchport mode trunk

exit

interface range e1/1-2

channel-protocol lacp

```
channel-group 2 mode passive
exit
interface port-channel 2
switchport mode trunk
switchport trunk native vlan 999
switchport trunk allowed vlan 100-102
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
```

Al finalizar las configuraciones se realiza la verificación de cada una de ellas, en cada uno de los dispositivos como se muestra en las siguientes figuras.

Figura 2 Verificación de los enlaces troncales en el Switch D1

```

Nov 17 15:23:51.028: SLTMC-3-CHANGED: Interface Vlan1, changed state to administratively down
Nov 17 15:23:51.159: SLTMC-3-UPDOWN: Interface Vlan10, changed state to up
Nov 17 15:23:59.787: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Ethernet1/2, changed state to up
Nov 17 15:23:59.885: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Vlan100, c
changed state to up
Nov 17 15:23:59.727: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Port-channel 111, changed state to up
Nov 17 15:23:59.889: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Port-channel 112, changed state to up
Nov 17 15:23:59.890: RCDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
net1/2 (not full duplex), with R3 Ethernet1/2 (full duplex).
Nov 17 15:23:42.076: SLTMC-3-UPDOWN: Interface Vlan101, changed state to up
Nov 17 15:23:42.074: RCDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
net1/2 (not full duplex), with R3 Ethernet1/2 (full duplex).
Nov 17 15:23:42.076: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Vlan101, c
changed state to up
Nov 17 15:23:46.873: RCDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
net1/2 (not full duplex), with ENCOM Skills Assessment (duplex).
Interface List Trunk
Port      Mode      Encapsulation  Status      Native vlan
Po1       on        802.1q         trunking    999
Po12      on        802.1q         trunking    999

Port      Vlans allowed on trunk
Po1       100-102
Po12      100-102

Port      Vlans allowed and active in management domain
Po1       100-102
Po12      100-102

Port      Vlans in spanning tree forwarding state and not pruned
Po1       100-102
Po12      100-102
Po12      101

Nov 17 15:23:33.739: SLTMC-3-UPDOWN: Interface Vlan102, changed state to up
Nov 17 15:23:34.453: WGRP-5-STATECHANGE: Vlan100 Grp 104 state Standby -> Active
Nov 17 15:23:34.744: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Vlan102, changed state to up
Nov 17 15:23:36.134: WGRP-5-STATECHANGE: Vlan101 Grp 116 state Standby -> Active
DUE

```

Figura 3 Verificación de los enlaces troncales en el Switch D2

```

Nov 17 15:23:32.141: WGRP-5-STATECHANGE: Vlan106 Grp 106 state Standby -> list
on
Nov 17 15:23:33.446: WGRP-5-STATECHANGE: Vlan102 Grp 120 state Standby -> Acti
ve
Nov 17 15:23:33.889: SLTMC-3-UPDOWN: Interface Vlan101, changed state to up
Nov 17 15:23:33.947: WGRP-5-STATECHANGE: Vlan102 Grp 124 state Standby -> Acti
ve
Nov 17 15:23:34.889: SLTNEPROTO-5-UPDOWN: Line protocol on Interface Vlan101, c
changed state to up
Nov 17 15:23:39.961: WGRP-5-STATECHANGE: Vlan102 Grp 124 state Active -> Speak
Nov 17 15:23:41.583: WGRP-5-STATECHANGE: Vlan102 Grp 126 state Active -> Speak
Nov 17 15:23:43.723: WGRP-5-STATECHANGE: Vlan101 Grp 130 state Listen -> Acti
ve
Nov 17 15:23:43.834: NSDPOD-5-ADDON: Process 6, Nr 0.0.6.3 on Ethernet1/0 fr
om LOM100 to Full, Loading done
Nov 17 15:23:51.118: WGRP-5-STATECHANGE: Vlan102 Grp 124 state Speak -> Standb
y
Nov 17 15:23:52.067: WGRP-5-STATECHANGE: Vlan102 Grp 124 state Speak -> Standb
y
Nov 17 15:23:54.373: WGRP-5-STATECHANGE: Vlan100 Grp 104 state Speak -> Standb
y
Nov 17 15:23:55.721: RCDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
net1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
Nov 17 15:24:08.100: WGRP-5-STATECHANGE: Vlan101 Grp 116 state Standby -> Acti
ve
Nov 17 15:24:08.268: WGRP-5-STATECHANGE: Vlan100 Grp 106 state Speak -> standb
y
DUE
Interface List Trunk
Port      Mode      Encapsulation  Status      Native vlan
Po1       on        802.1q         trunking    999
Po12      on        802.1q         trunking    999

Port      Vlans allowed on trunk
Po1       100-102
Po12      100-102

Port      Vlans allowed and active in management domain
Po1       100-102
Po12      100-102

Port      Vlans in spanning tree forwarding state and not pruned
Po1       100-102
Po12      100-102
Po12      101

```

Figura 4 Verificación de los enlaces troncales en el Switch A1

```

Nov 17 15:22:58.899: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet1/3, changed state to up
Nov 17 15:22:58.918: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet2/0, changed state to up
Nov 17 15:22:58.928: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet2/1, changed state to down
Nov 17 15:22:58.949: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet2/2, changed state to down
Nov 17 15:22:58.959: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet2/3, changed state to down
Nov 17 15:22:58.981: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet3/0, changed state to down
Nov 17 15:22:58.787: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet3/1, changed state to down
Nov 17 15:22:58.722: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet3/2, changed state to down
Nov 17 15:22:58.744: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet3/3, changed state to down
Nov 17 15:22:58.883: %LINK-5-CHANGED: Interface Vlan1, changed state to administratively down
Nov 17 15:22:58.831: %LINK-3-UPDOWN: Interface Vlan100, changed state to up
Nov 17 15:22:58.831: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan100, c
changed state to up
Nov 17 15:23:04.725: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-chan
e11, changed state to up
Nov 17 15:23:06.879: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-chan
e12, changed state to u.A., ENCR S&L1: assessment
!
show int trunk

Port      Mode          Encapsulation  Status        Native vlan
Po1       on             802.1q         trunking     999
Po2       on             802.1q         trunking     999

Port      Vlans allowed on trunk
Po1       100-102
Po2       100-102

Port      Vlans allowed and active in management domain
Po1       100-102
Po2       100-102

Port      Vlans in spanning tree forwarding state and not pruned
Po1       100,102
Po2       101
!

```

Figura 5 Verificación de spanning-tree en el Switch D1

```

Nov 17 15:24:21.568: %SWRP-5-STATECHANGE: Vlan101 grp 114 state Speak -> Standb
y
D1#
Nov 17 15:24:47.454: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#
Nov 17 15:25:47.163: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#
show run | include spanning-tree
spanning-tree mode rapid-pst
spanning-tree extend system-id
spanning-tree vlan 100,102 priority 24576
spanning-tree vlan 101 priority 26072
spanning-tree portfast edge
D1#

```

Figura 6 Verificación de spanning-tree en el Switch D2

```

Nov 17 15:25:43.479: RCDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
net11/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
D2#
Nov 17 15:26:37.773: RCDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
net12/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
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 24736
spanning-tree portfast edge
D2#

```

Figura 7 Verificación del LACP en Switch D1

```

D1#
Nov 17 15:27:34.848: Non-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethern
et1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#show lacp neighbor
Flags: S - Device is requesting Slow LACPDU
       T - Device is requesting Fast LACPDU
       A - Device is in Active mode       P - Device is in Passive mode

Channel group 1 neighbors
Partner's information:
Port    LACP port    Admin Oper    Port    Port
Et1/1   SP           32768  asbb.cc98.0100 20s  et0/
Et1/2   SP           32768  asbb.cc98.0100 21s  et0/

Channel group 12 neighbors
Partner's information:
Port    LACP port    Admin Oper    Port    Port
Et1/0   SA           32768  asbb.cc08.0100 0s   et0/
Et1/1   SA           32768  asbb.cc98.0200 4s   et0/
Et1/2   SA           32768  asbb.cc98.0200 4s   et0/
Et1/3   SA           32768  asbb.cc98.0200 22s  et0/
D1#

```

Figura 8 Verificación del LACP en Switch D2

```

Thu 17 15:27:12.771: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Eth1/0 (not full duplex), with R3 Ethernet0/0 (full duplex).
028
Thu 17 15:28:21.332: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Eth1/0 (not full duplex), with R3 Ethernet0/0 (full duplex).
028
show lacp neighbor
Flags: S - Device is requesting Slow LACPDU
      F - Device is requesting Fast LACPDU
      A - Device is in Active mode      P - Device is in Passive mode

Channel group 2 neighbors
Partner's information:
Port    Flags Priority Dev ID      Age    Admin Oper  Port  Port
(t1/1)  S/F    32768  aabb.cc00.8100  11s   a/b   b/c  0x102 0x1C
(t1/2)  S/F    32768  aabb.cc00.8100  27s   a/b   b/c  0x103 0x1C

Channel group 12 neighbors
Partner's information:
Port    Flags Priority Dev ID      Age    Admin Oper  Port  Port
(t12/0) SA    32768  aabb.cc00.8100  12s   a/b   b/c  0x201 0x3D
(t12/1) SA    32768  aabb.cc00.8100  17s   a/b   b/c  0x202 0x3D
(t12/2) SA    32768  aabb.cc00.8100  18s   a/b   b/c  0x203 0x3D
(t12/3) SA    32768  aabb.cc00.8100  14s   a/b   b/c  0x204 0x3D
028

```

Figura 9 Verificación del LACP en Switch A1

```

show lacp neighbor
Flags: S - Device is requesting Slow LACPDU
      F - Device is requesting Fast LACPDU
      A - Device is in Active mode      P - Device is in Passive mode

Channel group 1 neighbors
Partner's information:
Port    Flags Priority Dev ID      Age    Admin Oper  Port  Port
(t6/1)  SA    32768  aabb.cc00.8100  22s   a/b   b/c  0x10  0x3D
(t6/2)  SA    32768  aabb.cc00.8100  17s   a/b   b/c  0x1  0x3D

Channel group 2 neighbors
Partner's information:
Port    Flags Priority Dev ID      Age    Admin Oper  Port  Port
(t11/1) SA    32768  aabb.cc00.8200  28s   a/b   b/c  0x102 0x3D
(t11/2) SA    32768  aabb.cc00.8200  17s   a/b   b/c  0x103 0x3D
A1#

```

Figura 10 Ping entre los dispositivos de la red local desde el PC1



```

Welcome to Virtual PC Simulator, version 0.6.2
Dedicated to Dalings
Build time: Apr 10 2019 02:42:20
Copyright (c) 2007-2014, Paul Heng (mirnsh@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.
Executing the startup file

Checking for duplicate address...
PC1 : 10.68.100.5 255.255.255.0
PC1 : 2001:d00:100:100:5/64

PC1> ping 10.68.100.1
64 bytes from 10.68.100.1 icmp_seq=1 ttl=255 time=2.320 ms
64 bytes from 10.68.100.1 icmp_seq=2 ttl=255 time=1.365 ms
64 bytes from 10.68.100.1 icmp_seq=3 ttl=255 time=1.823 ms
64 bytes from 10.68.100.1 icmp_seq=4 ttl=255 time=1.200 ms
64 bytes from 10.68.100.1 icmp_seq=5 ttl=255 time=1.193 ms

PC1> ping 10.68.100.2
64 bytes from 10.68.100.2 icmp_seq=1 ttl=255 time=1.063 ms
64 bytes from 10.68.100.2 icmp_seq=2 ttl=255 time=1.059 ms
64 bytes from 10.68.100.2 icmp_seq=3 ttl=255 time=3.436 ms
64 bytes from 10.68.100.2 icmp_seq=4 ttl=255 time=1.598 ms
64 bytes from 10.68.100.2 icmp_seq=5 ttl=255 time=1.626 ms

PC1> ping 10.68.100.6
64 bytes from 10.68.100.6 icmp_seq=1 ttl=64 time=3.667 ms
64 bytes from 10.68.100.6 icmp_seq=2 ttl=64 time=2.557 ms
64 bytes from 10.68.100.6 icmp_seq=3 ttl=64 time=2.586 ms
64 bytes from 10.68.100.6 icmp_seq=4 ttl=64 time=2.882 ms
64 bytes from 10.68.100.6 icmp_seq=5 ttl=64 time=3.150 ms

PC1>

```

Figura 11 IP de los PC en DHCP y Ping entre los dispositivos de la red local desde el PC2

```

PC2> ip dhcp
DHCP IP 10.68.100.110/24 GW 10.68.100.254

PC2> ping 10.68.100.1
64 bytes from 10.68.100.1 icmp_seq=1 ttl=255 time=1.648 ms
64 bytes from 10.68.100.1 icmp_seq=2 ttl=255 time=1.927 ms
64 bytes from 10.68.100.1 icmp_seq=3 ttl=255 time=1.710 ms
64 bytes from 10.68.100.1 icmp_seq=4 ttl=255 time=1.756 ms
64 bytes from 10.68.100.1 icmp_seq=5 ttl=255 time=2.077 ms

PC2> ping 10.68.100.2
64 bytes from 10.68.100.2 icmp_seq=1 ttl=255 time=1.800 ms
64 bytes from 10.68.100.2 icmp_seq=2 ttl=255 time=1.572 ms
64 bytes from 10.68.100.2 icmp_seq=3 ttl=255 time=1.394 ms
64 bytes from 10.68.100.2 icmp_seq=4 ttl=255 time=1.768 ms
64 bytes from 10.68.100.2 icmp_seq=5 ttl=255 time=1.790 ms

PC2>

```

Figura 12 IP de los PC en DHCP y Ping entre los dispositivos de la red local desde el PC3

```
PC3 -> ip dhcp
000A IP 10.68.101.110/24 GM 10.68.101.254

PC3> ping 10.68.101.1
04 bytes from 10.68.101.1: icmp_seq=1 ttl=255 time=2.009 ms
04 bytes from 10.68.101.1: icmp_seq=2 ttl=255 time=3.186 ms
04 bytes from 10.68.101.1: icmp_seq=3 ttl=255 time=2.597 ms
04 bytes from 10.68.101.1: icmp_seq=4 ttl=255 time=2.489 ms
04 bytes from 10.68.101.1: icmp_seq=5 ttl=255 time=2.248 ms

PC3> ping 10.68.101.2
04 bytes from 10.68.101.2: icmp_seq=1 ttl=255 time=1.584 ms
04 bytes from 10.68.101.2: icmp_seq=2 ttl=255 time=1.523 ms
04 bytes from 10.68.101.2: icmp_seq=3 ttl=255 time=1.597 ms
04 bytes from 10.68.101.2: icmp_seq=4 ttl=255 time=1.809 ms
04 bytes from 10.68.101.2: icmp_seq=5 ttl=255 time=2.138 ms

PC3> |
```

Figura 13 Ping entre los dispositivos de la red local desde el PC4

```
PC4> ping 10.68.100.1
04 bytes from 10.68.100.1: icmp_seq=1 ttl=255 time=1.902 ms
04 bytes from 10.68.100.1: icmp_seq=2 ttl=255 time=1.568 ms
04 bytes from 10.68.100.1: icmp_seq=3 ttl=255 time=1.419 ms
04 bytes from 10.68.100.1: icmp_seq=4 ttl=255 time=1.771 ms
04 bytes from 10.68.100.1: icmp_seq=5 ttl=255 time=1.631 ms

PC4> ping 10.68.100.2
04 bytes from 10.68.100.2: icmp_seq=1 ttl=255 time=2.218 ms
04 bytes from 10.68.100.2: icmp_seq=2 ttl=255 time=3.076 ms
04 bytes from 10.68.100.2: icmp_seq=3 ttl=255 time=2.208 ms
04 bytes from 10.68.100.2: icmp_seq=4 ttl=255 time=2.031 ms
04 bytes from 10.68.100.2: icmp_seq=5 ttl=255 time=2.183 ms

PC4> ping 10.68.100.5
04 bytes from 10.68.100.5: icmp_seq=1 ttl=64 time=2.299 ms
04 bytes from 10.68.100.5: icmp_seq=2 ttl=64 time=2.083 ms
04 bytes from 10.68.100.5: icmp_seq=3 ttl=64 time=2.218 ms
04 bytes from 10.68.100.5: icmp_seq=4 ttl=64 time=1.799 ms
04 bytes from 10.68.100.5: icmp_seq=5 ttl=64 time=2.941 ms

PC4> |
```

## ESCENARIO 2

Este escenario es la continuación del escenario 1.

Aquí se configura los protocolos de enrutamiento y la redundancia de primer salto.

La primera parte es configurar los protocolos de enrutamiento IPv4 e IPv6, a continuación, se indican los comandos usados para dicha configuración:

### Router R1

Config t

```
router ospf 4
```

```
router-id 0.0.4.1
```

```
network 10.68.10.0 0.0.0.255 area 0
```

```
network 10.68.13.0 0.0.0.255 area 0
```

```
default-information originate
```

```
exit
```

```
ipv6 router ospf 6
```

```
router-id 0.0.6.1
```

```
default-information originate
```

```
exit
```

```
interface e1/2
```

```
ipv6 ospf 6 area 0
```

```
exit
```

```
interface e1/1
```

```
ipv6 ospf 6 area 0
```

```
exit
```

```
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
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
address-family ipv6 unicast
no neighbor 209.165.200.226 activate
neighbor 2001:db8:200::2 activate
network 2001:db8:100::/48
exit-address-family
```

## **Router R2**

Config t

```
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
neighbor 209.165.200.225 remote-as 300
```

```
neighbor 2001:db8:200::1 remote-as 300
address-family ipv4
neighbor 209.165.200.225 activate
no neighbor 2001:db8:200::1 activate
network 2.2.2.2 mask 255.255.255.255
network 0.0.0.0
exit-address-family
address-family ipv6
no neighbor 209.165.200.225 activate
neighbor 2001:db8:200::1 activate
network 2001:db8:2222::1/128
network ::/0
exit-address-family
```

### **Router R3**

Config t

```
router ospf 4
router-id 0.0.4.3
network 10.68.11.0 0.0.0.255 area 0
network 10.68.13.0 0.0.0.255 area 0
exit
ipv6 router ospf 6
router-id 0.0.6.3
exit
```

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

### **Switch D1**

Config t

```
router ospf 4
router-id 0.0.4.131
network 10.68.10.0 0.0.0.255 area 0
network 10.68.100.0 0.0.0.255 area 0
network 10.68.101.0 0.0.0.255 area 0
network 10.68.102.0 0.0.0.255 area 0
passive-interface default
no passive-interface e1/2
exit
ipv6 router ospf 6
router-id 0.0.6.131
passive-interface default
no passive-interface e1/2
exit
interface e1/2
```

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

## **Switch D2**

Config t

```
router ospf 4
router-id 0.0.4.132
network 10.68.11.0 0.0.0.255 area 0
network 10.68.100.0 0.0.0.255 area 0
network 10.68.101.0 0.0.0.255 area 0
network 10.68.102.0 0.0.0.255 area 0
passive-interface default
no passive-interface e1/0
exit
ipv6 router ospf 6
```

```
router-id 0.0.6.132
passive-interface default
no passive-interface e1/0
exit
interface e1/0
ipv6 ospf 6 area 0
exit
interface vlan 100
ipv6 ospf 6 area 0
exit
interface vlan 101
ipv6 ospf 6 area 0
exit
interface vlan 102
ipv6 ospf 6 area 0
exit
```

Después de realizar las configuraciones se pasa a verificar la tabla de enrutamiento IPv4 y hacer ping desde los switch D1 y D2 hacia el Loopback 0 como se muestra en las siguientes figuras



Figura 14 Verificación de la tabla de ruta IPv4 en R1

```
R1
*Nov 17 11:03:29.131: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
*Nov 17 11:04:10.347: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
*Nov 17 11:05:13.283: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
*Nov 17 11:06:05.919: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
*Nov 17 11:07:05.835: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
*Nov 17 11:08:04.799: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
*Nov 17 11:09:46.467: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not half duplex), with D1 Ethernet1/2 (half duplex).
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, I - LISP
+ - replicated route, % - next hop override

Gateway of last resort is 209.165.200.226 to network 0.0.0.0

R1#
O* 0.0.0.0 [20/0] via 209.165.200.226, 00:19:41
B 2.2.2.2 [20/0] via 209.165.200.226, 00:19:41
0 10.0.0.0/8 is variably subnetted, 9 subnets, 3 masks
S 10.0.0.0/8 is directly connected, Null0
C 10.68.10.0/24 is directly connected, Ethernet1/2
L 10.68.10.1/32 is directly connected, Ethernet1/2
O 10.68.11.0/24 [110/20] via 10.68.13.3, 00:19:57, Ethernet1/1
C 10.68.13.0/24 is directly connected, Ethernet1/1
O 10.68.13.1/32 is directly connected, Ethernet1/1
O 10.68.100.0/24 [110/11] via 10.68.10.2, 00:17:31, Ethernet1/2
O 10.68.101.0/24 [110/11] via 10.68.10.2, 00:17:31, Ethernet1/2
O 10.68.102.0/24 [110/11] via 10.68.10.2, 00:17:31, Ethernet1/2
0 209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C 209.165.200.224/27 is directly connected, Ethernet1/0
C 209.165.200.225/32 is directly connected, Ethernet1/0
R1#
```

Figura 15 Verificación de la tabla de ruta IPv4 en R3

```
R3
*Nov 17 11:01:22.615: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:02:10.071: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:03:11.067: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:04:02.767: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:04:53.815: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:05:42.419: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:06:38.603: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:07:24.603: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:08:23.815: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:09:22.127: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
*Nov 17 11:10:14.711: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not half duplex), with D2 Ethernet1/0 (half duplex).
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, I - LISP
+ - replicated route, % - next hop override

Gateway of last resort is 10.68.13.1 to network 0.0.0.0

R3#
O*E2 0.0.0.0 [110/1] via 10.68.13.1, 00:20:25, Ethernet1/1
0 10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 10.68.10.0/24 [110/20] via 10.68.13.1, 00:20:41, Ethernet1/1
O 10.68.11.0/24 is directly connected, Ethernet1/0
L 10.68.11.1/32 is directly connected, Ethernet1/0
O 10.68.13.0/24 is directly connected, Ethernet1/1
L 10.68.13.3/32 is directly connected, Ethernet1/1
O 10.68.100.0/24 [110/11] via 10.68.11.2, 00:12:14, Ethernet1/0
O 10.68.101.0/24 [110/11] via 10.68.11.2, 00:12:14, Ethernet1/0
O 10.68.102.0/24 [110/11] via 10.68.11.2, 00:12:14, Ethernet1/0
R3#
```

Figura 16 Verificación de la tabla de ruta IPv4 en D1

```

rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:05:58.122: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:06:40.138: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:07:36.042: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:08:35.477: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:09:32.120: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:10:23.169: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:11:11.774: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:12:09.301: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
*Nov 17 16:13:08.376: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
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, I - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 10.68.10.1 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 10.68.10.1, 00:21:12, Ethernet1/2
10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
C 10.68.10.0/24 is directly connected, Ethernet1/2
L 10.68.10.2/32 is directly connected, Ethernet1/2
O 10.68.11.0/24 [110/30] via 10.68.10.1, 00:21:12, Ethernet1/2
O 10.68.13.0/24 [110/20] via 10.68.10.1, 00:21:12, Ethernet1/2
C 10.68.100.0/24 is directly connected, Vlan100
L 10.68.100.1/32 is directly connected, Vlan100
C 10.68.101.0/24 is directly connected, Vlan101
L 10.68.101.1/32 is directly connected, Vlan101
C 10.68.102.0/24 is directly connected, Vlan102
L 10.68.102.1/32 is directly connected, Vlan102
D1#
```

Figura 17 Verificación de la tabla de ruta IPv4 en D2

```

rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:07:04.770: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:07:57.623: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:08:46.374: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:09:36.709: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:10:27.191: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:11:24.795: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:12:24.232: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:13:16.776: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
*Nov 17 16:14:15.183: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
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, I - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 10.68.11.1 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 10.68.11.1, 00:16:08, Ethernet1/0
10.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
O 10.68.10.0/24 [110/30] via 10.68.11.1, 00:16:08, Ethernet1/0
C 10.68.11.0/24 is directly connected, Ethernet1/0
L 10.68.11.2/32 is directly connected, Ethernet1/0
O 10.68.13.0/24 [110/20] via 10.68.11.1, 00:16:08, Ethernet1/0
C 10.68.100.0/24 is directly connected, Vlan100
L 10.68.100.2/32 is directly connected, Vlan100
C 10.68.101.0/24 is directly connected, Vlan101
L 10.68.101.2/32 is directly connected, Vlan101
C 10.68.102.0/24 is directly connected, Vlan102
L 10.68.102.2/32 is directly connected, Vlan102
D2#
```

Figura 18 Ping desde D1 hacia Loopback 0

```
LOADING to FULL, Loading Done
*Nov 17 16:54:41.138: NOSPv3-5-AD1CHG: Process 6, Nbr 0.0.6.1 on Ethernet1/2 fr
om LOADING to FULL, Loading Done
D1#
*Nov 17 16:54:46.457: %HSRP-5-STATECHANGE: Vlan101 Grp 114 state Standby -> Acti
ve
*Nov 17 16:54:46.720: %HSRP-5-STATECHANGE: Vlan100 Grp 104 state Standby -> Acti
ve
*Nov 17 16:54:47.200: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#
*Nov 17 16:54:47.254: %HSRP-5-STATECHANGE: Vlan100 Grp 100 state Standby -> Acti
ve
*Nov 17 16:54:47.287: %HSRP-5-STATECHANGE: Vlan101 Grp 110 state Standby -> Acti
ve
*Nov 17 16:54:47.686: %HSRP-5-STATECHANGE: Vlan102 Grp 124 state Standby -> Acti
ve
D1#
*Nov 17 16:54:51.656: %HSRP-5-STATECHANGE: Vlan101 Grp 114 state Active -> Speak
y
D1#
*Nov 17 16:54:53.100: %HSRP-5-STATECHANGE: Vlan101 Grp 110 state Active -> Speak
y
D1#
*Nov 17 16:54:57.525: %HSRP-5-STATECHANGE: Vlan102 Grp 126 state Standby -> Acti
ve
D1#
*Nov 17 16:55:01.874: %HSRP-5-STATECHANGE: Vlan101 Grp 114 state Speak -> Standb
y
D1#
*Nov 17 16:55:04.397: %HSRP-5-STATECHANGE: Vlan101 Grp 110 state Speak -> Standb
y
D1#
*Nov 17 16:55:30.926: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#ping 2.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 27/30/31 ms
D1#ping 2001:db8::2222::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:db8::2222::1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 29/30/31 ms
D1#
```

Figura 19 Ping desde D2 hacia Loopback 0

```
D2#ping 2.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 49/51/52 ms
D2#ping 2001:
*Nov 17 16:57:02.248: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethernet1/0 (not full du
plex), with R3 Ethernet1/0 (full duplex).
D2#ping 2001:db8::2222::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:db8::2222::1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 51/52/54 ms
D2#
```

Finalmente, en la parte dos se configura la redundancia del primer salto, para ello se configuro los switch D1 y D2 con los comandos que se muestran a continuación:

### **Switch D1**

```
config t
ip sla 4
icmp-echo 10.68.10.1
frequency 5
exit
ip sla 6
icmp-echo 2001:db8:100:1010::1
frequency 5
exit
ip sla Schedule 4 life forever start-time now
ip sla Schedule 6 life forever start-time now
track 4 ip sla 4
delay up 10 down 15
exit
track 6 ip sla 6
delay up 10 down 15
exit
interface vlan 100
standby version 2
```

```
standby 104 ip 10.68.100.254
standby 104 priority 150
standby 104 preempt
standby 104 track 4 decrement 60
standby 106 ipv6 autoconfig
standby 106 priority 150
standby 106 preempt
standby 106 track 6 decrement 60
exit
interface vlan 101
standby version 2
standby 114 ip 10.68.101.254
standby 114 preempt
standby 114 track 4 decrement 60
standby 116 ipv6 autoconfig
standby 116 preempt
standby 116 track 6 decrement 60
exit
interface vlan 102
standby version 2
standby 124 ip 10.68.102.254
standby 124 priority 150
standby 124 preempt
standby 124 track 4 decrement 60
```

```
standby 126 ipv6 autoconfig
standby 126 priority 150
standby 126 preempt
standby 126 track 6 decrement 60
exit
end
```

## **Switch D2**

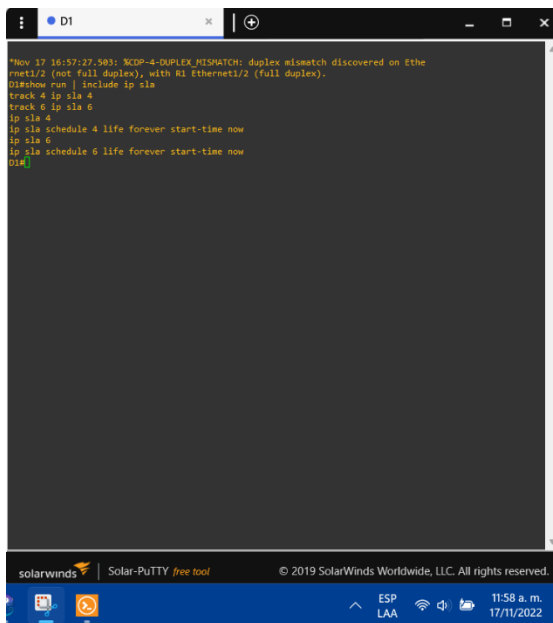
```
Config t
ip sla 4
icmp-echo 10.68.11.1
frequency 5
exit
ip sla 6
icmp-echo 2001:db8:100:1011::1
frequency 5
exit
ip sla schedule 4 life forever start-time now
ip sla schedule 6 life forever start-time now
track 4 ip sla 4
delay up 10 down 15
exit
track 6 ip sla 6
delay up 10 down 15
```

```
exit
interface vlan 100
standby version 2
standby 104 ip 10.68.100.254
standby 104 preempt
standby 104 track 4 decrement 60
standby 106 ipv6 autoconfig
standby 106 preempt
standby 106 track 6 decrement 60
exit
interface vlan 101
standby version 2
standby 114 ip 10.68.101.254
standby 114 priority 150
standby 114 preempt
standby 114 track 4 decrement 60
standby 116 ipv6 autoconfig
standby 116 priority 150
standby 116 preempt
standby 116 track 6 decrement 60
exit
interface vlan 102
standby version 2
standby 124 ip 10.68.102.254
```

```
standby 124 preempt
standby 124 track 4 decrement 60
standby 126 ipv6 autoconfig
standby 126 preempt
standby 126 track 6 decrement 60
exit
end
```

Y se pasa a verificar que las configuraciones de las SLAs y del Standby en cada uno de los Switch como se muestra en las siguientes figuras

*Figura 20 Verificación de las SLAs en D1*

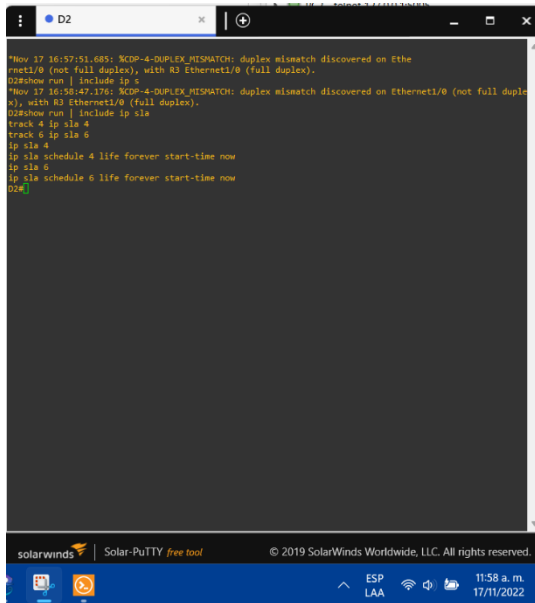


```
Nov 17 16:57:27.593: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#show run | include ip sla
track 4 ip sla 4
track 6 ip sla 6
ip sla 4
ip sla schedule 4 life forever start-time now
ip sla 6
ip sla schedule 6 life forever start-time now
D1#
```

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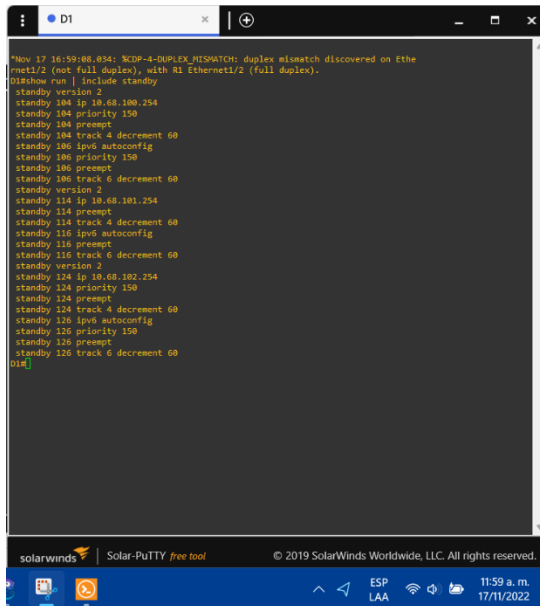


Figura 21 Verificación de las SLAs en D2



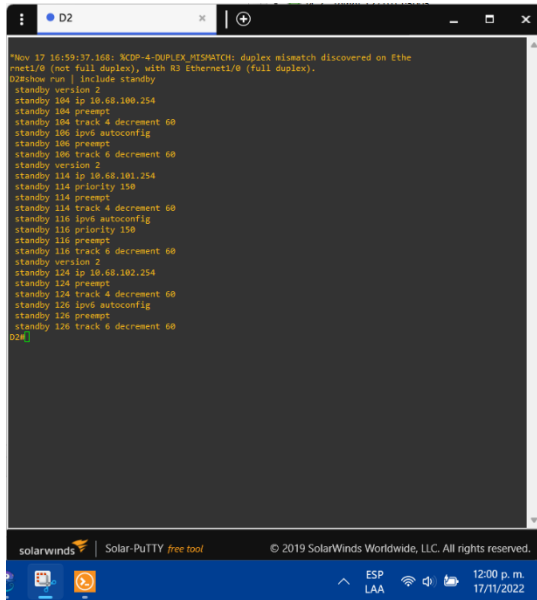
```
Nov 17 16:57:51.685: %CDP-4-DUPLX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
D2#show run | include ip s
Nov 17 16:58:47.178: %CDP-4-DUPLX_MISMATCH: duplex mismatch discovered on Ethern
et1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
D2#show run | include ip sla
track 4 ip sla 4
ip sla 4
ip sla schedule 4 life forever start-time now
ip sla 6
ip sla schedule 6 life forever start-time now
D2#
```

Figura 22 Verificación del Standby en D1



```
Nov 17 16:59:08.034: %CDP-4-DUPLX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/2 (not full duplex), with R1 Ethernet1/2 (full duplex).
D1#show run | include standby
standby version 2
standby 104 ip 10.68.100.254
standby 104 priority 150
standby 104 preempt
standby 104 track 4 decrement 60
standby 106 ipv6 autoconfig
standby 106 priority 150
standby 106 preempt
standby 106 track 6 decrement 60
standby version 2
standby 114 ip 10.68.101.254
standby 114 preempt
standby 114 track 4 decrement 60
standby 116 ipv6 autoconfig
standby 116 preempt
standby 116 track 6 decrement 60
standby version 2
standby 124 ip 10.68.102.254
standby 124 priority 150
standby 124 preempt
standby 124 track 4 decrement 60
standby 126 ipv6 autoconfig
standby 126 priority 150
standby 126 preempt
standby 126 track 6 decrement 60
D1#
```

Figura 23 Verificación del Standby en D2



```
Nov 17 16:59:37:108: NCP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethe
rnet1/0 (not full duplex), with R3 Ethernet1/0 (full duplex).
D2#show run | include standby
standby version 2
standby 104 ip 10.68.100.254
standby 104 preempt
standby 104 track 4 decrement 60
standby 100 ipv6 autoconfig
standby 106 preempt
standby 106 track 6 decrement 60
standby version 2
standby 114 ip 10.68.101.254
standby 114 priority 150
standby 114 preempt
standby 114 track 4 decrement 60
standby 116 ipv6 autoconfig
standby 116 priority 150
standby 116 preempt
standby 116 track 6 decrement 60
standby version 2
standby 124 ip 10.68.102.254
standby 124 preempt
standby 124 track 4 decrement 60
standby 126 ipv6 autoconfig
standby 126 preempt
standby 126 track 6 decrement 60
D2#
```

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ESP 12:00 p. m.  
LAA 17/11/2022

## CONCLUSIONES

Los protocolos de enrutamiento usados en este escenario, OSPF y BGP, son los protocolos más comunes en el mundo real, y muchas organizaciones usan OSPF como un protocolo de enrutamiento interno porque permite que la tabla de enrutamiento de cada enrutador conozca toda la red. También actualizan automáticamente la tabla para cualquier cambio estructural para evitar bucles; BGP conecta diferentes sistemas porque es normal que no todas las organizaciones utilicen el mismo protocolo de enrutamiento interno que el ISP.

Al utilizar una combinación de tecnologías y protocolos como Link Redundancy, Spanning Tree y LACP para lograr una conectividad de capa 2 óptima; el primero proporciona tolerancia a fallas y protección contra fallas, el segundo asegura que solo haya una ruta lógica y evita bucles en estas redundancias. Finalmente, LACP combina la redundancia física en un solo enlace lógico de alta velocidad; es una poderosa combinación que requiere un manejo cuidadoso para evitar fallas deliberadas en la red.

La redundancia de capa 3 es importante porque también son SLA para monitorear constantemente la interfaz de la puerta de enlace y usar HSRP para mantener un enrutador eficiente con una interfaz predeterminada y otra redundancia para evitar que las máquinas locales abandonen la red debido a un error de la puerta de enlace.

Dada la gran cantidad de amenazas en la red, es importante utilizar protocolos para mejorar la seguridad y la integridad de los dispositivos interconectados localmente.

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