# Avance Final - Proyecto

# Semana: 9

**Estudiante:**

Víctor Isaías Romero Núñez – 12211079

Kevin André Banegas Meza - 12211129

**Sede de estudio:**

UNITEC TGU

**Docente:**

Ing. Jose David Reyes Matute

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# 1. INTRODUCCIÓN

## 1.1 Contexto del Proyecto

Grupo Arrieta, empresa líder en logística y tecnología con sede principal en Tegucigalpa, Honduras, ha experimentado un crecimiento exponencial que demanda una transformación integral de su infraestructura tecnológica. Con 200 empleados distribuidos en seis ubicaciones estratégicas y servicios que abarcan logística, soporte técnico, desarrollo de software y operaciones administrativas, la organización requiere una solución de red robusta que soporte su expansión nacional y garantice continuidad operativa.

La empresa ha ampliado recientemente sus oficinas centrales a un nuevo edificio corporativo y establecido un Data Center de respaldo en San Pedro Sula, creando la necesidad de consolidar su red nacional mediante la interconexión de cinco sucursales regionales con capacidades de redundancia y failover automático.

## 1.2 Situación Actual de la Infraestructura

- **Limitaciones Identificadas:**
  - Conectividad punto a punto básica sin redundancia
  - Ausencia de segmentación de red por departamentos
  - Falta de implementación de protocolo IPv6
  - Carencia de medidas de seguridad LAN estructuradas
  - Ausencia de protocolos de enrutamiento dinámico
  - Sin capacidades de failover o recuperación ante desastres

- **Ubicaciones Corporativas:**
  - ***Sede Principal:*** *Tegucigalpa (Edificio Corporativo)*
  - ***Data Center Secundario:*** *San Pedro Sula*
  - ***Sucursales Regionales:*** *La Ceiba, Choluteca, Comayagua, Santa Rosa de Copán*

## 1.3 Objetivos

### 1.3.1 Objetivo General

Diseñar e implementar una infraestructura de red empresarial escalable y resiliente que garantice conectividad segura entre todas las ubicaciones de Grupo Arrieta, implementando redundancia hacia el Data Center secundario y segmentación departamental en la sede principal.

### 1.3.2 Objetivos Específicos

a) **Implementar topología jerárquica Core-Distribución-Acceso** en la sede principal
b) **Establecer segmentación VLAN** por departamentos en oficinas centrales
c) **Configurar enrutamiento dual-stack** (IPv4/IPv6) con protocolos OSPF y EIGRP
d) **Garantizar redundancia** mediante rutas de respaldo hacia Data Center SPS
e) **Implementar medidas de seguridad LAN** incluyendo Port Security y acceso controlado
f) **Documentar solución técnica** con justificación de diseño y procedimientos

## 1.4 Alcance del Proyecto

### 1.4.1 Infraestructura Contemplada:

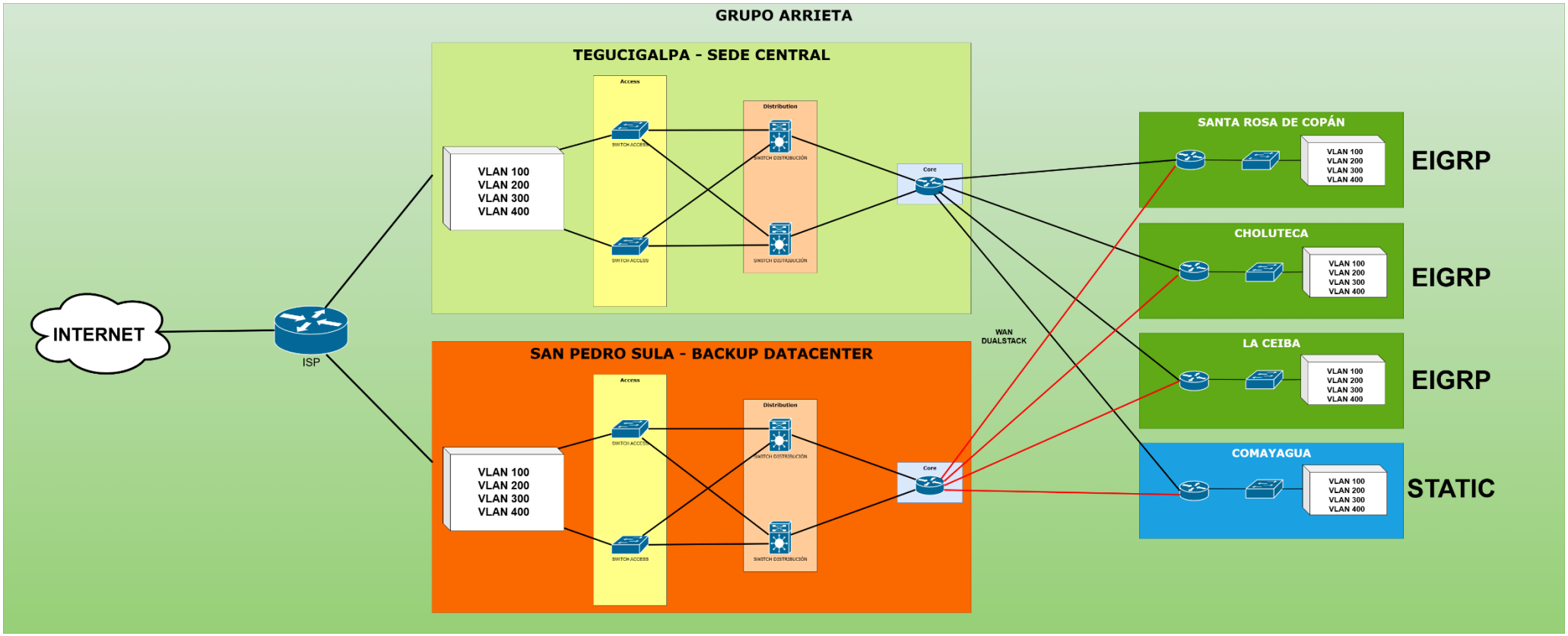
- Red LAN jerárquica en sede principal con 4 VLANs departamentales
- Enlaces WAN simulados entre 6 ubicaciones
- Data Center principal (Tegucigalpa) y secundario (San Pedro Sula)
- Implementación de protocolos OSPF, EIGRP y enrutamiento estático
- Configuración de redundancia y failover automático
- Medidas de seguridad perimetral y de acceso

# 2. ARQUITECTURA DE RED

## 2.1 Descripción Breve

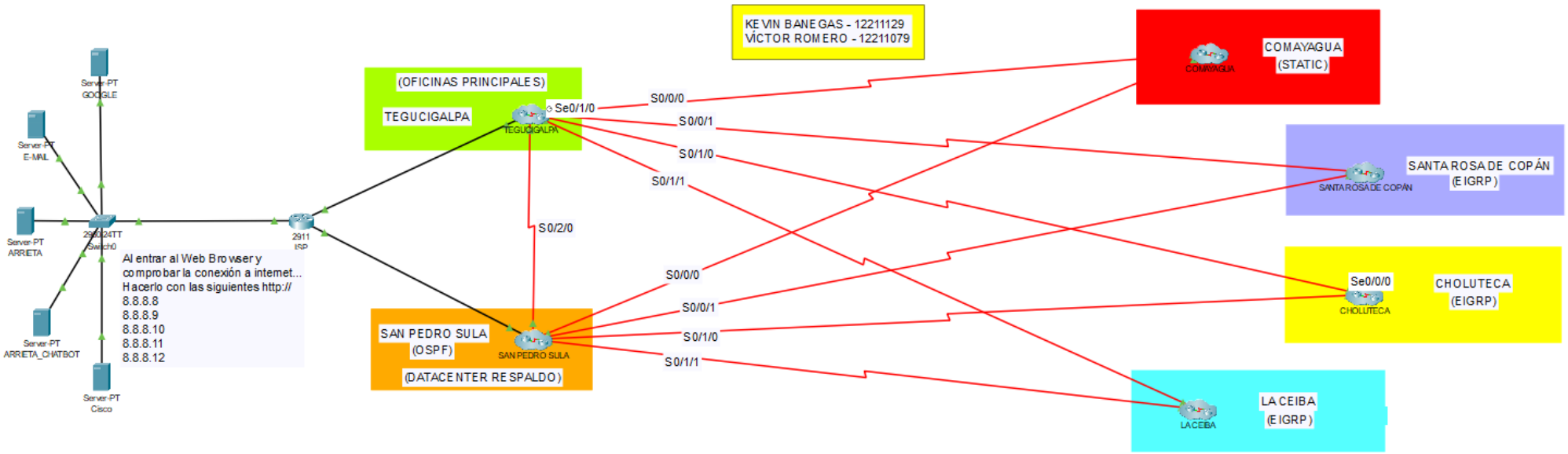
El presente documento detalla el esquema de asignación de direcciones IP para una infraestructura de red empresarial que incluye un datacenter principal en Tegucigalpa (TGU), un datacenter secundario en San Pedro Sula (SPS), y cinco sucursales distribuidas geográficamente. La arquitectura implementa dual-stack (IPv4 e IPv6) para garantizar compatibilidad y escalabilidad futura, siguiendo las mejores prácticas de la industria y estándares RFC establecidos.

## 2.2 Gráfico Topología de Red

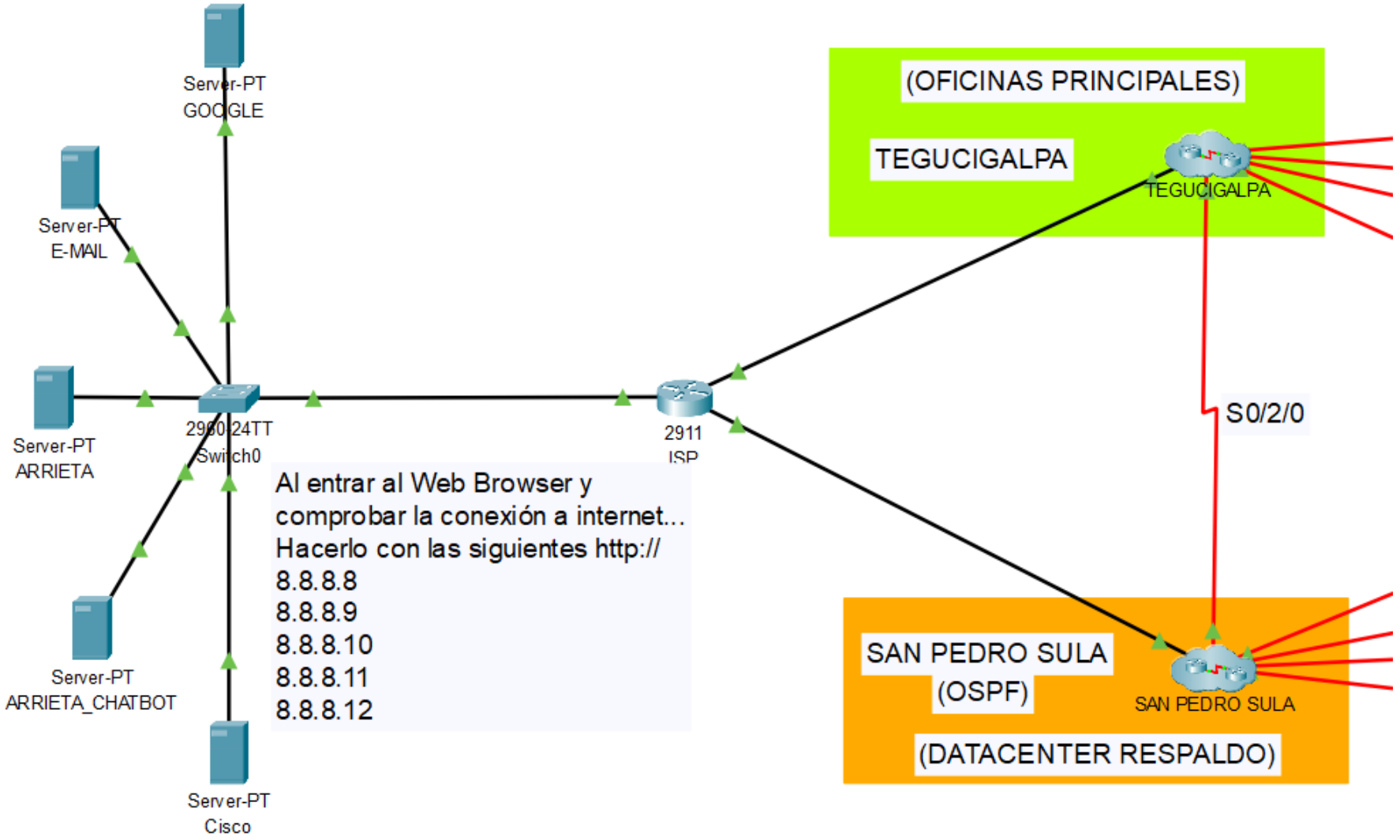


## 2.3 Topología en Packet Tracer

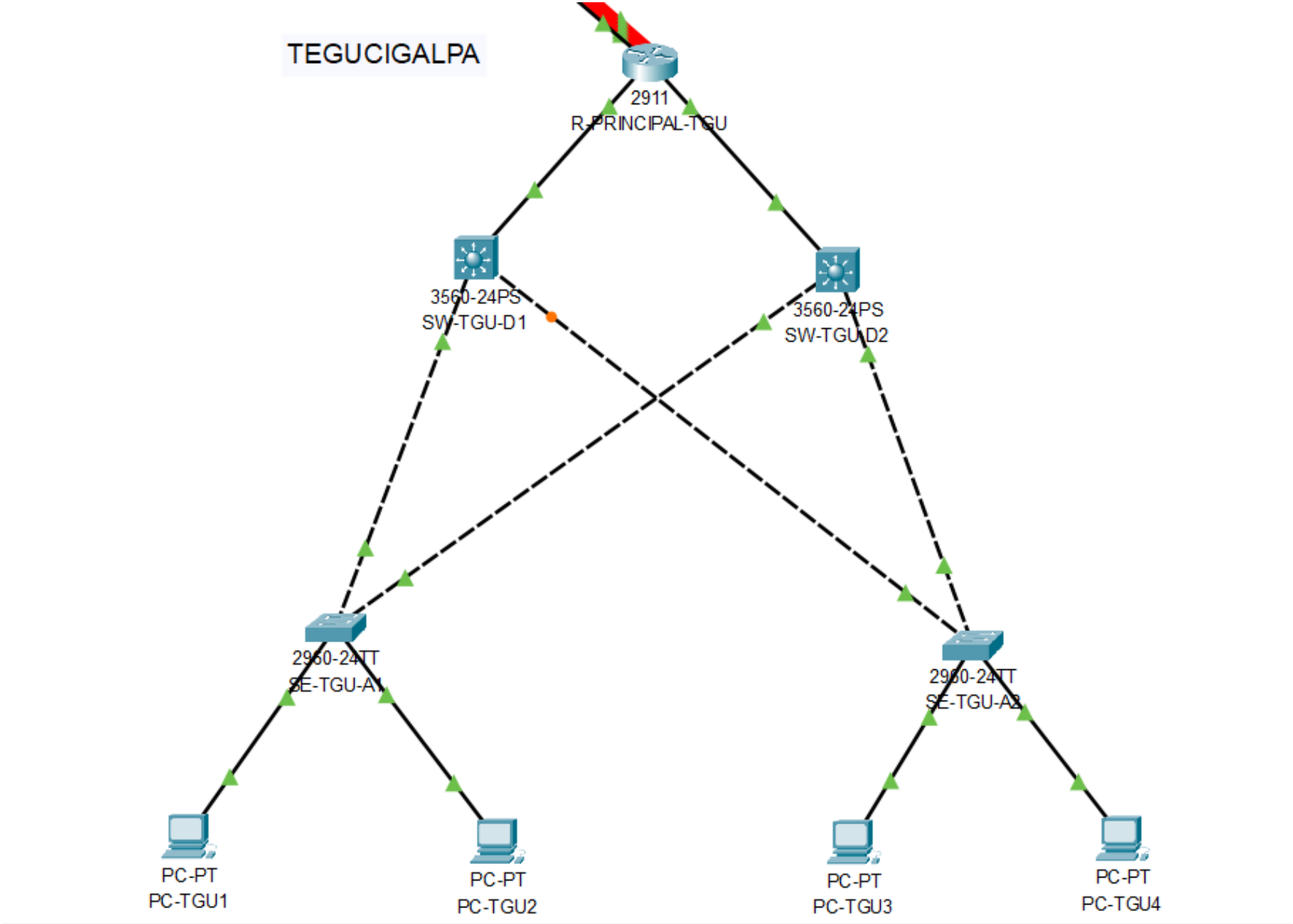
### 2.3.1 Topología Completa Clusterizada



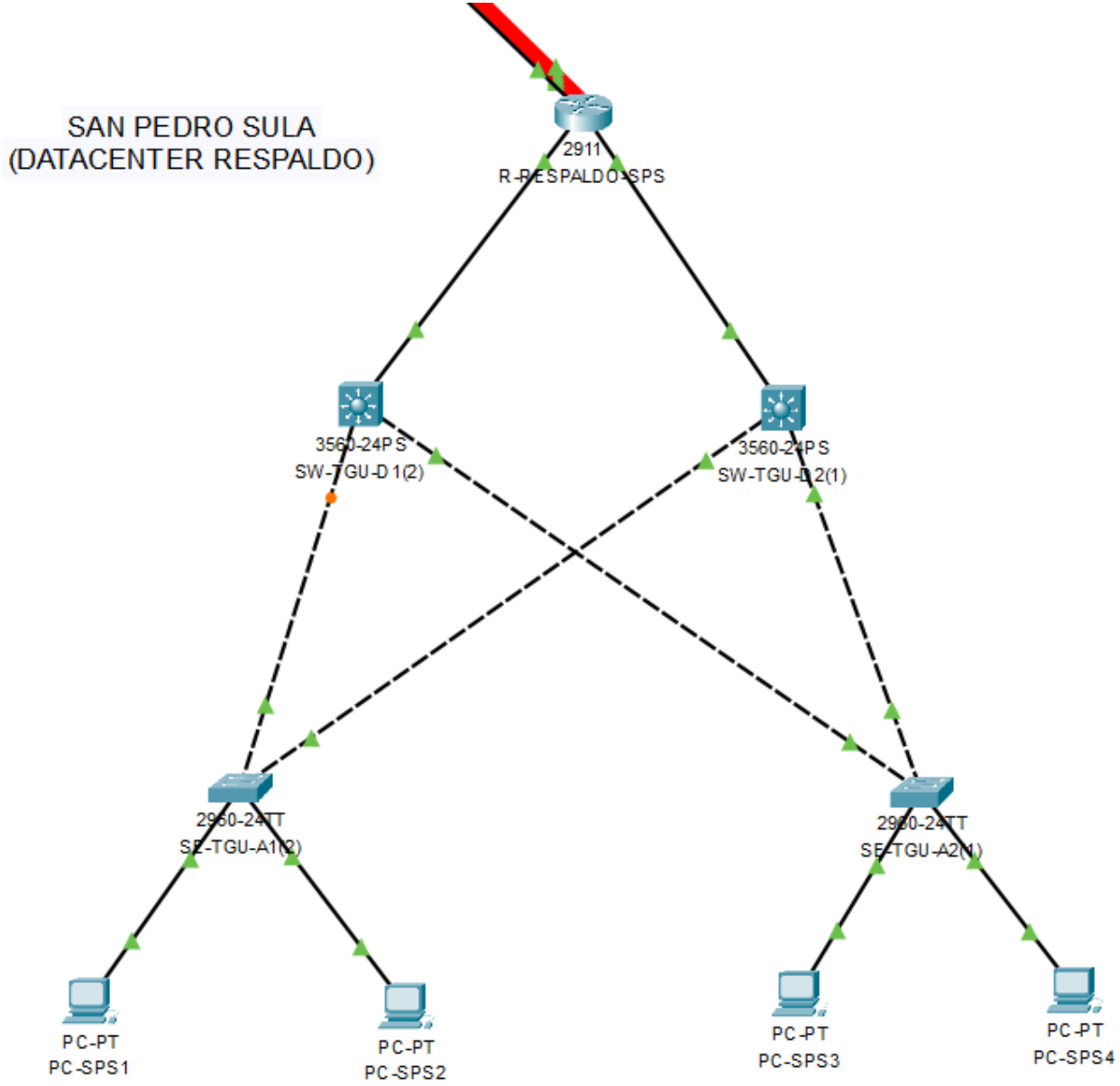
### 2.3.2 Topología TGU con SPS & ISP con NAT (OSPF)



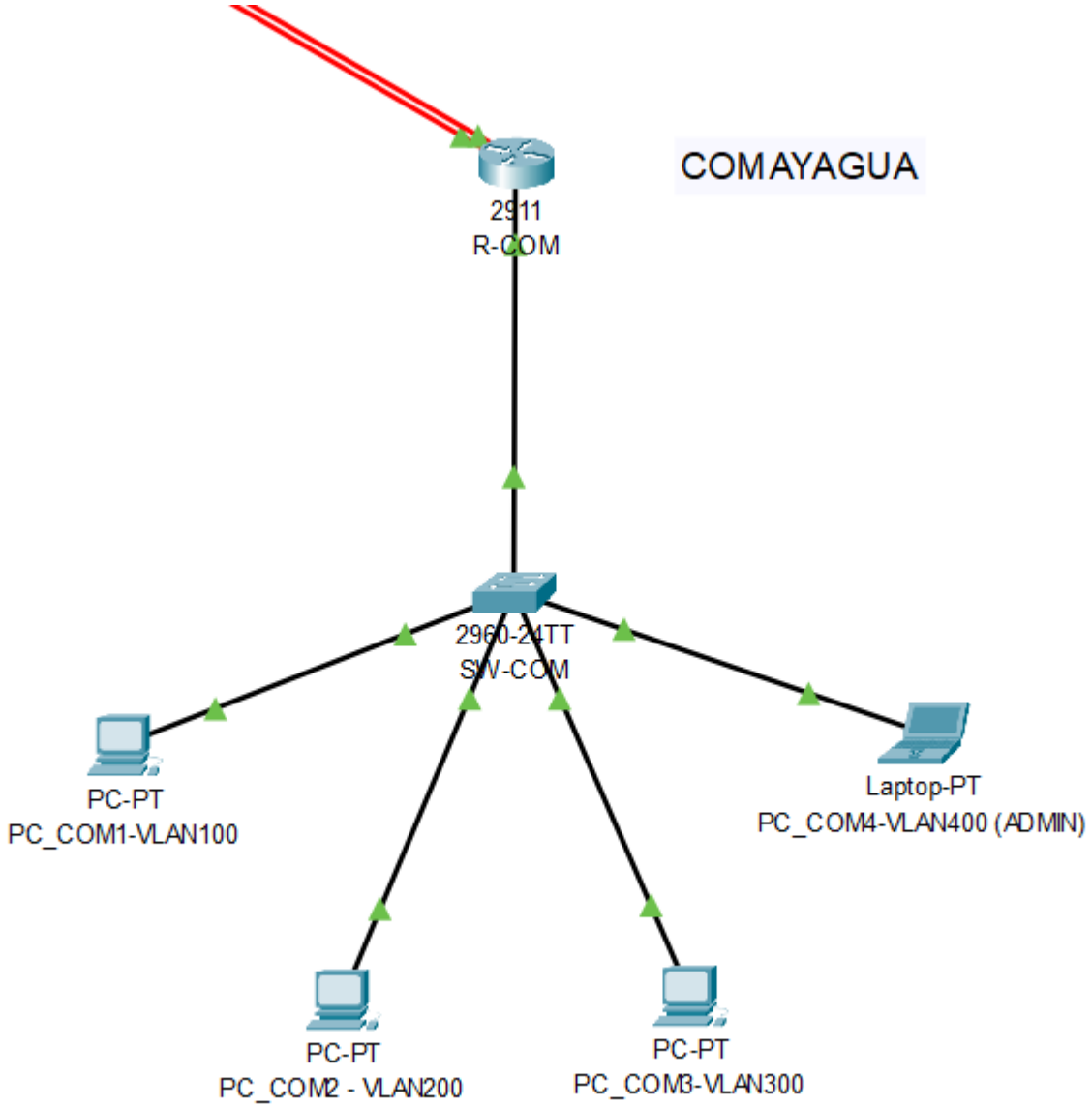
### 2.3.3 Topología Cluster Tegucigalpa (Main DataCenter)



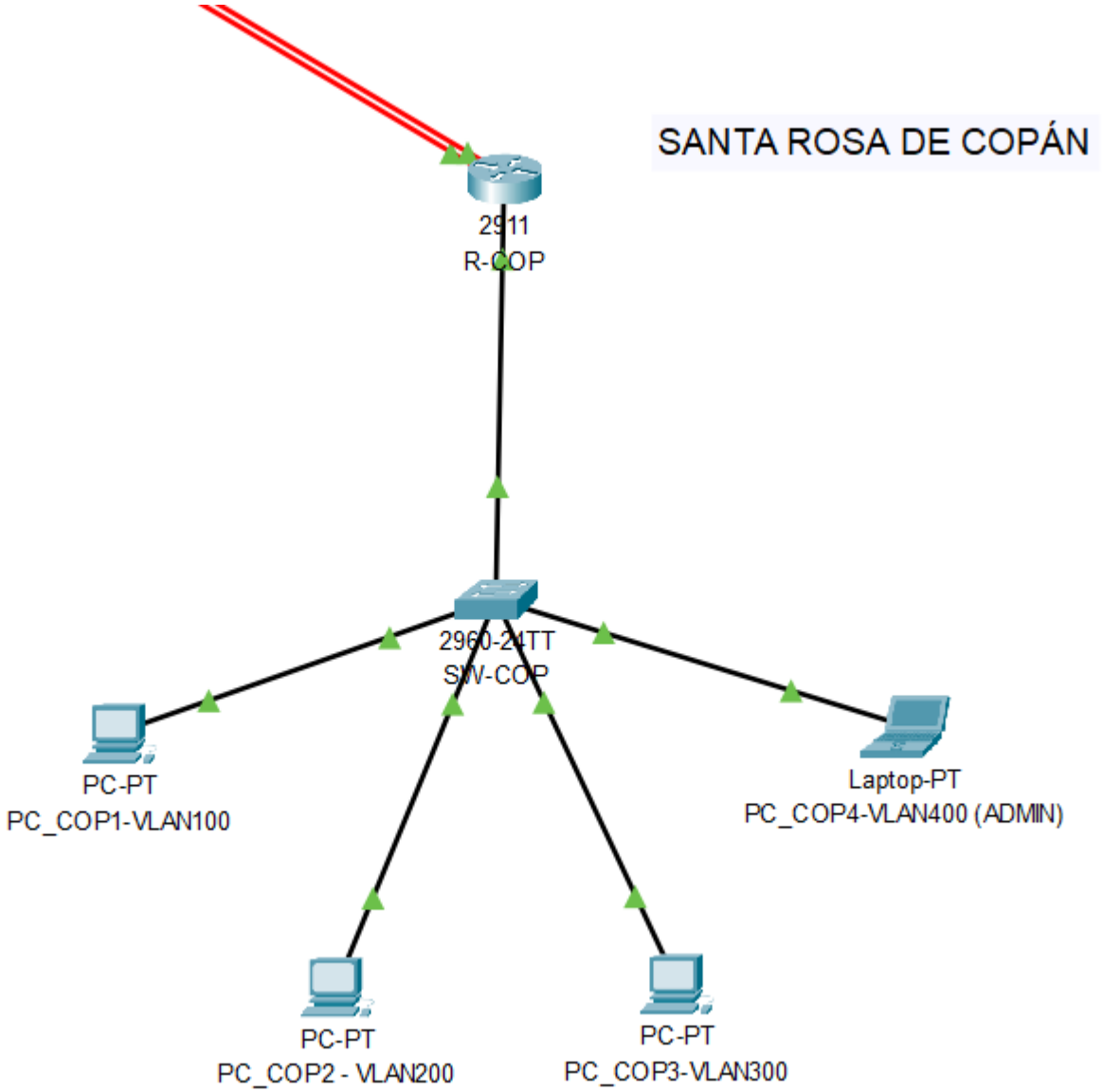
### 2.3.4 Topología Cluster San Pedro Sula (DataCenter Respaldo)



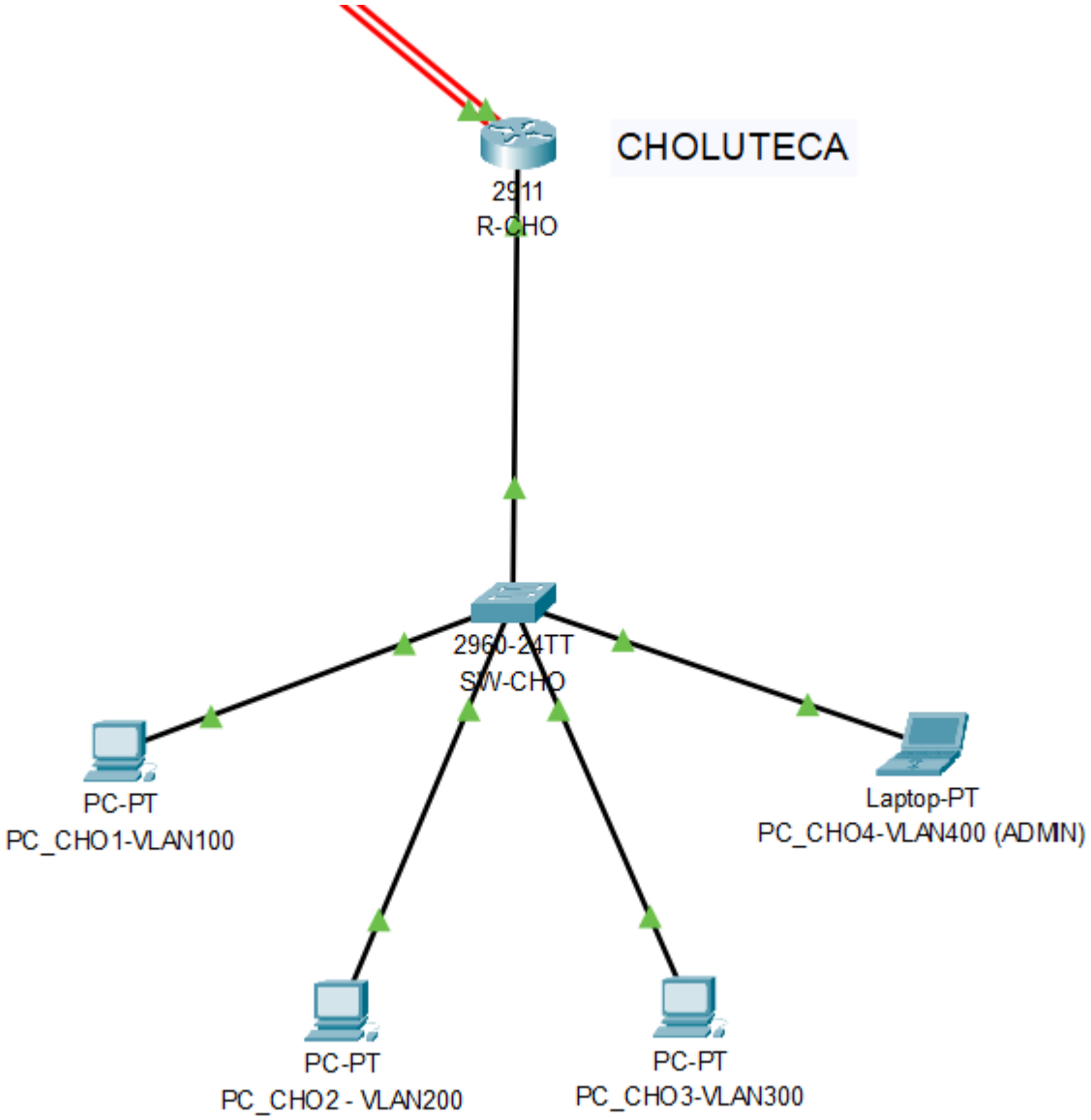
### 2.3.5 Topología Comayagua (Sucursal Static)



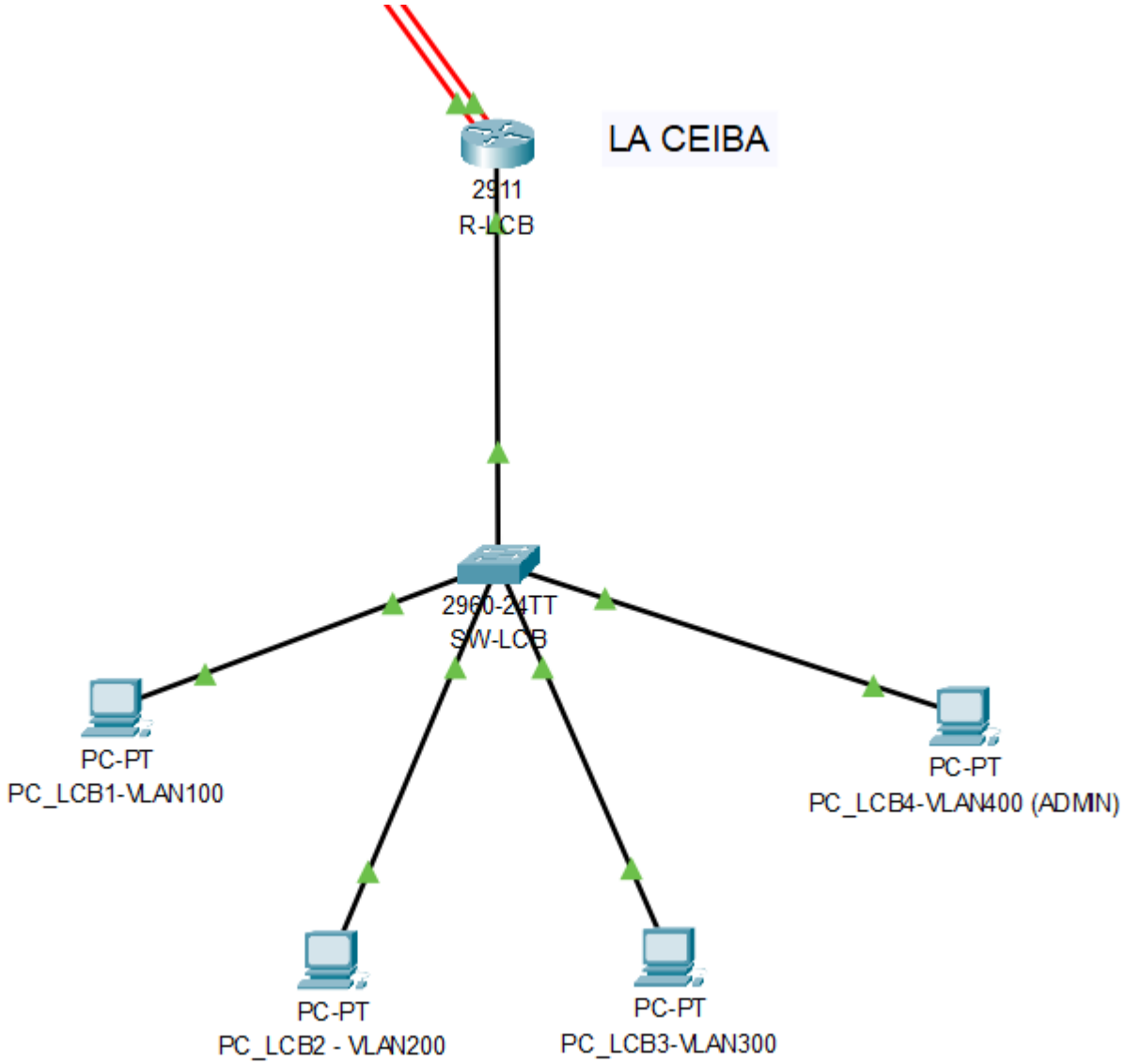
### 2.3.6 Topología Santa Rosa de Copán (Sucursal EIGRP)



### 2.3.7 Topología Choluteca (Sucursal EIGRP)



### 2.3.8 Topología La Ceiba (Sucursal EIGRP)



## 2.4 Componentes Principales

- **Datacenter Principal:** Tegucigalpa (TGU)
- **Datacenter Secundario:** San Pedro Sula (SPS)
- **Sucursales:** Comayagua, Choluteca, Copán, La Ceiba

## 2.5 Topología de Red

La red implementa un modelo jerárquico de tres capas:

- **Capa de Acceso:** Conectividad para dispositivos finales
- **Capa de Distribución:** Agregación de tráfico y políticas
- **Capa de Control/Core:** Enrutamiento principal y conectividad WAN]

## 2.6 Requisitos de Conectividad

**Patrones de Tráfico Identificados:**

- **Norte-Sur:** Acceso a recursos centralizados desde sucursales
- **Este-Oeste:** Comunicación interdepartamental sede principal
- **Backup:** Replicación hacia Data Center SPS

# 3. PLAN DE DIRECCIONAMIENTO & JUSTIFICACIÓN

El plan de direccionamiento de la red se diseñó siguiendo un esquema jerárquico que contempla las diferentes capas de acceso, distribución y core, aplicadas tanto en la sede principal como en los Data Centers y sucursales. La asignación de direcciones IPv4 se realizó mediante subredes /24 y /26 para segmentar departamentos y enlaces WAN, mientras que IPv6 se implementó con prefijos /64 de acuerdo con las mejores prácticas establecidas en los estándares internacionales (RFC 4291). De esta forma, se asegura una administración ordenada y escalable de la red.

Una de las principales razones para adoptar este esquema dual-stack (IPv4 e IPv6) es garantizar compatibilidad con las aplicaciones y servicios existentes, al mismo tiempo que se prepara la infraestructura para la transición al nuevo protocolo. IPv4 continúa siendo necesario para servicios y sistemas legados, mientras que IPv6 ofrece un espacio prácticamente ilimitado de direcciones y ventajas como la autoconfiguración y mayor seguridad en el manejo de identidades de red. La coexistencia de ambos protocolos permite mantener continuidad sin interrumpir operaciones.

Además, la segmentación de direcciones por VLANs asegura separación lógica entre áreas críticas de la empresa como logística, soporte técnico, desarrollo de software y administración. Esto no solo facilita la aplicación de políticas de seguridad y calidad de servicio, sino que también simplifica el diagnóstico y control del tráfico. En conclusión, el direccionamiento adoptado no solo responde a las necesidades actuales de conectividad, sino que también sienta las bases para la expansión futura de la organización, evitando problemas de escalabilidad y redundancia en la asignación de recursos.

# 4. DATACENTER TGU IPV4

| *Capa* | Subred | Máscara | Comentario | Gateway |
|---|---|---|---|---|
| *Acceso Switch 1* | 192.168.120.0 | 255.255.255.0 | VLAN o segmento para acceso 1 | 192.168.121.1 |
| *Acceso Switch 2* | 192.168.121.0 | 255.255.255.0 | VLAN o segmento para acceso 2 | 192.168.122.1 |
| *Distribución Switch 1* | 192.168.110.0 | 255.255.255.0 | Interconexión distribución 1 | 192.168.110.1 |
| *Distribución Switch 2* | 192.168.111.0 | 255.255.255.0 | Interconexión distribución 2 | 192.168.111.1 |
| *Router Sede Central* | 192.168.100.0 | 255.255.255.0 | Enlace y gestión con router sede central | 192.168.100.1 |

# 5. DATACENTER TGU IPV6

| *Capa* | Subred | Máscara | Comentario | Gateway |
|---|---|---|---|---|
| *Acceso Switch 1* | 2001:db8:4000:120:: | /64 | VLAN o segmento para acceso 1 | 2001:db8: 4000:120::1 |
| *Acceso Switch 2* | 2001:db8: 4000:121:: | /64 | VLAN o segmento para acceso 2 | 2001:db8: 4000:122::1 |
| *Distribución Switch 1* | 2001:db8: 4000:110:: | /64 | Interconexión distribución 1 | 2001:db8: 4000:110::1 |
| *Distribución Switch 2* | 2001:db8: 4000:111:: | /64 | Interconexión distribución 2 | 2001:db8: 4000:111::1 |
| *Router Sede Central* | 2001:db8: 4000:100:: | /64 | Enlace y gestión con router sede central | 2001:db8: 4000:100::1 |

# 6. DATACENTER SPS IPV4

| *Capa* | Subred | Máscara | Comentario | Gateway |
|---|---|---|---|---|
| *Acceso Switch 1* | 192.168.170.0 | 255.255.255.0 | VLAN o segmento para acceso 1 | 192.168.171.1 |
| *Acceso Switch 2* | 192.168.171.0 | 255.255.255.0 | VLAN o segmento para acceso 2 | 192.168.172.1 |
| *Distribución Switch 1* | 192.168.160.0 | 255.255.255.0 | Interconexión distribución 1 | 192.168.160.1 |
| *Distribución Switch 2* | 192.168.161.0 | 255.255.255.0 | Interconexión distribución 2 | 192.168.161.1 |
| *Router DataCenter SPS* | 192.168.150.0 | 255.255.255.0 | Enlace y gestión con router datacenter | 192.168.150.1 |

# 7. DATACENTER SPS IPV6

| *Capa* | Subred | Máscara | Comentario | Gateway |
|---|---|---|---|---|
| *Acceso Switch 1* | 2001:db8:4000:170:: | /64 | VLAN o segmento para acceso 1 | 2001:db8: 4000:170::1 |
| *Acceso Switch 2* | 2001:db8: 4000:171:: | /64 | VLAN o segmento para acceso 2 | 2001:db8: 4000:171::1 |
| *Distribución Switch 1* | 2001:db8: 4000:160:: | /64 | Interconexión distribución 1 | 2001:db8: 4000:160::1 |
| *Distribución Switch 2* | 2001:db8: 4000:161:: | /64 | Interconexión distribución 2 | 2001:db8: 4000:161::1 |
| *Router DataCenter SPS* | 2001:db8: 4000:150:: | /64 | Enlace y gestión con router datacenter | 2001:db8: 4000:150::1 |

# 8. SUCURSALES IPV4

| *Sucursal* | Capa | Subred | Máscara | Comentario | Gateway |
|---|---|---|---|---|---|
| *Comayagua* | Acceso | 192.168.1.0 | 255.255.255.0 | Solo acceso, enlace a sede | 192.168.1.1 |
| *Choluteca* | Acceso | 192.168.2.0 | 255.255.255.0 | Solo acceso, enlace a sede | 192.168.2.1 |
| *Copan* | Acceso | 192.168.4.0 | 255.255.255.0 | Solo acceso, enlace a sede | 192.168.4.1 |
| *La Ceiba* | Acceso | 192.168.5.0 | 255.255.255.0 | Solo acceso, enlace a sede | 192.168.5.1 |

# 9. SUCURSALES IPV6

| *Sucursal* | Capa | Subred | Máscara | Comentario | Gateway |
|---|---|---|---|---|---|
| *Comayagua* | Acceso | 2001:db8:3000:1:: | /64 | Solo acceso, enlace a sede | 2001:db8:3000:1::1 |
| *Choluteca* | Acceso | 2001:db8:3000:2:: | /64 | Solo acceso, enlace a sede | 2001:db8:3000:2::1 |
| *Copan* | Acceso | 2001:db8:3000:4:: | /64 | Solo acceso, enlace a sede | 2001:db8:3000:4::1 |
| *La Ceiba* | Acceso | 2001:db8:3000:5:: | /64 | Solo acceso, enlace a sede | 2001:db8:3000:5::1 |

# 10. WAN DE SEDE A SUCURSAL IPV4

| *Sucursal* | Enlace | Subred | Máscara | Comentario | IP Router Sede/DataCenter | IP Router Sucursal |
|---|---|---|---|---|---|---|
| *Comayagua* | Sucursal <-> Sede | 192.168.200.0 | 255.255.255.252 | Enlace punto a punto Comayagua-Sede | 192.168.200.1 | 192.168.200.2 |
| *Comayagua* | Sucursal <-> DataCenter | 192.168.200.4 | 255.255.255.252 | Enlace punto a punto Comayagua-DC | 192.168.200.5 | 192.168.200.6 |
| *Choluteca* | Sucursal <-> Sede | 192.168.201.0 | 255.255.255.252 | Enlace punto a punto Choluteca-Sede | 192.168.201.1 | 192.168.201.2 |
| *Choluteca* | Sucursal <-> DataCenter | 192.168.201.4 | 255.255.255.252 | Enlace punto a punto Choluteca-DC | 192.168.201.5 | 192.168.201.6 |
| *SPS* | Sucursal <-> Sede | 192.168.202.0 | 255.255.255.252 | Enlace punto a punto SPS-Sede | 192.168.202.1 | 192.168.202.2 |
| *Copan* | Sucursal <-> Sede | 192.168.203.0 | 255.255.255.252 | Enlace punto a punto Copan-Sede | 192.168.203.1 | 192.168.203.2 |
| *Copan* | Sucursal <-> DataCenter | 192.168.203.4 | 255.255.255.252 | Enlace punto a punto Copan-DC | 192.168.203.5 | 192.168.203.6 |
| *La Ceiba* | Sucursal <-> Sede | 192.168.204.0 | 255.255.255.252 | Enlace punto a punto La Ceiba-Sede | 192.168.204.1 | 192.168.204.2 |
| *La Ceiba* | Sucursal <-> DataCenter | 192.168.204.4 | 255.255.255.252 | Enlace punto a punto La Ceiba-DC | 192.168.204.5 | 192.168.204.6 |

# 11. WAN DE SEDE A SUCURSAL IPV6

| *Sucursal* | *Enlace* | *Subred IPv6* | *Prefijo* | *Comentario* | *IP Router Sede/DataCenter* | *IP Router Sucursal* |
|---|---|---|---|---|---|---|
| Comayagua | Sucursal <-> Sede | 2001:db8:200::/64 | /64 | Enlace punto a punto Comayagua-Sede | 2001:db8:200:1::1 | 2001:db8:200:1::2 |
| Comayagua | Sucursal <-> DC | 2001:db8:200:1::/64 | /64 | Enlace punto a punto Comayagua-DC | 2001:db8:200:2::1 | 2001:db8:200:2::2 |
| Choluteca | Sucursal <-> Sede | 2001:db8:201::/64 | /64 | Enlace punto a punto Choluteca-Sede | 2001:db8:201:1::1 | 2001:db8:201:1::2 |
| Choluteca | Sucursal <-> DC | 2001:db8:201:1::/64 | /64 | Enlace punto a punto Choluteca-DC | 2001:db8:201:2::1 | 2001:db8:201:2::2 |
| SPS | Sucursal <-> Sede | 2001:db8:202::/64 | /64 | Enlace punto a punto SPS-Sede | 2001:db8:202:1::1 | 2001:db8:202:1::2 |
| Copán | Sucursal <-> Sede | 2001:db8:203::/64 | /64 | Enlace punto a punto Copán-Sede | 2001:db8:203:1::1 | 2001:db8:203:1::2 |
| Copán | Sucursal <-> DC | 2001:db8:203:1::/64 | /64 | Enlace punto a punto Copán-DC | 2001:db8:203:2::1 | 2001:db8:203:2::2 |
| La Ceiba | Sucursal <-> Sede | 2001:db8:204::/64 | /64 | Enlace punto a punto La Ceiba-Sede | 2001:db8:204:1::1 | 2001:db8:204:1::2 |
| La Ceiba | Sucursal <-> DC | 2001:db8:204:1::/64 | /64 | Enlace punto a punto La Ceiba-DC | 2001:db8:204:2::1 | 2001:db8:204:2::2 |

# 12. Arquitectura de Redundancia Implementada

**Estructura Dual de Data Centers**

- Data Center Principal: Tegucigalpa (TGU) - Centro operativo primario
- Data Center Secundario: San Pedro Sula (SPS) - Centro de respaldo

**Redundancia de Conectividad por Sucursal**

*1. Conexiones Duales:*

Cada sucursal mantiene dos enlaces WAN independientes:

- Enlace Primario: Hacia Data Center TGU (ruta principal)
- Enlace Secundario: Hacia Data Center SPS (ruta de respaldo)

*2. Ejemplo de Implementación - Comayagua:*

- Enlace principal: 192.168.200.0/30 hacia TGU
- Enlace respaldo: 192.168.200.4/30 hacia SPS

*Mecanismos de Failover*

**Enrutamiento con Métricas Administrativas:**

```
# Ruta principal (distancia administrativa 10)
ip route 0.0.0.0 0.0.0.0 192.168.200.1 10
# Ruta de respaldo (distancia administrativa 20)
ip route 0.0.0.0 0.0.0.0 192.168.200.5 20
```

*Protocolos de Enrutamiento Dinámico:*

- OSPF: Entre TGU y SPS para intercambio de rutas
- EIGRP: Para sucursales con redistribución automática
- Redistribución: Los protocolos intercambian rutas para garantizar conectividad total

*Beneficios del Diseño*

a) **Alta Disponibilidad:** Conmutación automática ante falla del enlace primario Tiempo de convergencia optimizado mediante protocolos dinámicos
b) **Balanceamento de Carga:** Distribución inteligente del tráfico Utilización eficiente de recursos de red
c) **Continuidad del Negocio:** Operaciones ininterrumpidas ante fallas de infraestructura, Acceso garantizado a recursos críticos desde cualquier sucursal

*Implementación IPv6*

El mismo esquema de redundancia se replica para IPv6, asegurando continuidad en ambos protocolos y preparación para migración futura.

Esta arquitectura garantiza que si el Data Center principal en Tegucigalpa presenta fallas, todas las sucursales automáticamente redirigen su tráfico hacia el Data Center de respaldo en San Pedro Sula, manteniendo la conectividad empresarial sin intervención manual.

# 13. CONFIGURACIONES DISPOSITIVOS DATACENTER & RESPALDO (EIGRP, STATIC & OSPF)

## 13.1 Router DC

```
!==================================
! ROUTER CORE SPS (R-SPS-RESPALDO) -
CONFIGURACIÓN IPv4 + IPv6 COMPLETA
!==================================

enable
configure terminal
hostname R-SPS-RESPALDO
ipv6 unicast-routing
banner motd # GRUPO ARRIETA SPS-
RESPALDO - SOLO ACCESO AUTORIZADO #

ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025

crypto key generate rsa general-keys modulus
1024
ip ssh version 2
service ssh

line vty 0 15
 login local
 transport input ssh
line con 0
 login local
 logging synchronous
 exec-timeout 0 0
exit

! ================================
! CONFIGURACIÓN NAT PARA ACCESO A
INTERNET
! ================================
interface GigabitEthernet0/2
 description ENLACE-INTERNET-SPS-ISP
 ip address 10.0.2.1 255.255.255.252
 ipv6 address 2001:db8:internet:2::1/64
 ip nat outside
 ipv6 enable
 no shutdown
exit

ip nat inside source list 1 interface
GigabitEthernet0/2 overload
access-list 1 permit 192.168.150.0 0.0.0.255
access-list 1 permit 10.0.0.0 0.255.255.255

! Rutas por defecto
ip route 0.0.0.0 0.0.0.0 10.0.2.2
ipv6 route ::/0 2001:db8:internet:2::2

! ================================
! INTERFACES HACIA SWITCHES DIST
! ================================
! Interface hacia DIST1
interface GigabitEthernet0/0
 description ENLACE-HACIA-DIST1-Gi0/1
 no switchport
 ip address 192.168.199.1 255.255.255.252
 ipv6 address 2001:db8:4000:199::1/64
 ip nat inside
 ipv6 enable
 no shutdown
exit

! Interface hacia DIST2
interface GigabitEthernet0/1
 description ENLACE-HACIA-DIST2-Gi0/1
 no switchport
 ip address 192.168.199.5 255.255.255.252
 ipv6 address 2001:db8:4000:199:1::1/64
 ip nat inside
 ipv6 enable
 no shutdown
exit

! ================================
! INTERFACES WAN HACIA SITIOS (IPv4 +
IPv6)
! ================================
interface Serial0/2/0
 description ENLACE-DC-TGU-OSPF
 ip address 192.168.202.2 255.255.255.252
 ipv6 address 2001:db8:202:1::2/64
 ip nat inside
 ipv6 enable
 no shutdown
exit

interface Serial0/1/1
 description ENLACE-DC-LA-CEIBA-EIGRP-
RESPALDO
 ip address 192.168.204.5 255.255.255.252
 ipv6 address 2001:db8:204:2::1/64
 ip nat inside
 ipv6 enable
 clock rate 2000000
 no shutdown
```

```
exit

interface Serial0/1/0
 description ENLACE-DC-CHOLUTECA-
EIGRP-RESPALDO
 ip address 192.168.201.5 255.255.255.252
 ipv6 address 2001:db8:201:2::1/64
 ip nat inside
 ipv6 enable
 clock rate 2000000
 no shutdown
exit

interface Serial0/0/1
 description ENLACE-DC-COPAN-EIGRP-
RESPALDO
 ip address 192.168.203.5 255.255.255.252
 ipv6 address 2001:db8:203:2::1/64
 ip nat inside
 ipv6 enable
 clock rate 2000000
 no shutdown
exit

interface Serial0/0/0
 description ENLACE-DC-COMAYAGUA-
STATIC-RESPALDO
 ip address 192.168.200.5 255.255.255.252
 ipv6 address 2001:db8:200:2::1/64
 ip nat inside
 ipv6 enable
 clock rate 2000000
 no shutdown
exit

! ================================
! RUTAS IPv4 HACIA LAS VLANs VIA DIST
SWITCHES
! ================================
ip route 192.168.150.0 255.255.255.192
192.168.199.2
ip route 192.168.150.64 255.255.255.192
192.168.199.2
ip route 192.168.150.128 255.255.255.192
192.168.199.6
ip route 192.168.150.192 255.255.255.192
192.168.199.6

! ================================
! RUTAS IPv6 HACIA LAS VLANs VIA DIST
SWITCHES
! ================================
ipv6 route 2001:db8:4100:150::/64
2001:db8:4000:199::2
ipv6 route 2001:db8:4200:150::/64
2001:db8:4000:199::2
ipv6 route 2001:db8:4300:150::/64
2001:db8:4000:199:1::2
ipv6 route 2001:db8:4400:150::/64
2001:db8:4000:199:1::2

! ================================
! PROTOCOLOS DE ENRUTAMIENTO IPv4
! ================================
router ospf 1
 router-id 2.2.2.2
 network 192.168.199.0 0.0.0.7 area 0
 network 192.168.202.0 0.0.0.3 area 0
 redistribute eigrp 100 subnets metric 20
 redistribute static subnets metric 10
 default-information originate
exit

router eigrp 100
 network 192.168.201.4 0.0.0.3
 network 192.168.203.4 0.0.0.3
 network 192.168.204.4 0.0.0.3
 redistribute ospf 1 metric 1544 20000 255 1 1500
 redistribute static metric 1544 20000 255 1 1500
 no auto-summary
exit

! ================================
! PROTOCOLOS DE ENRUTAMIENTO IPv6
! ================================
ipv6 router ospf 1
 router-id 2.2.2.2
 redistribute eigrp 100 metric 20
 redistribute static metric 10
 default-information originate
exit

ipv6 router eigrp 100
 eigrp router-id 2.2.2.2
 redistribute ospf 1 metric 1544 20000 255 1 1500
 redistribute static metric 1544 20000 255 1 1500
 no shutdown
exit

! Aplicar protocolos IPv6 a interfaces
interface Serial0/2/0
 ipv6 ospf 1 area 0
exit

interface GigabitEthernet0/0
 ipv6 ospf 1 area 0
exit
```

```
interface GigabitEthernet0/1
 ipv6 ospf 1 area 0
exit

interface Serial0/1/1
 ipv6 eigrp 100
exit

interface Serial0/1/0
 ipv6 eigrp 100
exit

interface Serial0/0/1
 ipv6 eigrp 100
exit
```

```
! Rutas estáticas de respaldo
ip route 192.168.1.0 255.255.255.0 192.168.200.6
100
ipv6 route 2001:DB8:3100:1::/64
2001:DB8:200:2::2 100
ipv6 route 2001:DB8:3200:1::/64
2001:DB8:200:2::2 100
ipv6 route 2001:DB8:3300:1::/64
2001:DB8:200:2::2 100
ipv6 route 2001:DB8:3400:1::/64
2001:DB8:200:2::2 100

end
copy running-config startup-config
```

## 13.2 Switch Distribución DC

```
!==================================
! SWITCH DIST1 (Layer 3)
!==================================

enable
configure terminal
hostname DIST1
ipv6 unicast-routing
banner motd # GRUPO ARRIETA SPS DIST1 -
SOLO ACCESO AUTORIZADO #
ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025

! Habilitar enrutamiento IP
ip routing

crypto key generate rsa general-keys modulus
1024
ip ssh version 2
service ssh

! Acceso remoto
line vty 0 15
 login local
 transport input ssh
line con 0
 login local
 logging synchronous
 exec-timeout 0 0
exit

! ================================
! VLANs
! ================================
vlan 100
 name LOGISTICA
vlan 200
 name SOPORTE_TECNICO
vlan 300
 name DESARROLLO_DE_SOFTWARE
vlan 400
 name ADMINISTRACION

! ================================
! INTERFACES VLAN CON HSRP IPv4 + IPv6
! ================================
interface vlan 100
 description LOGISTICA-GATEWAY
 ip address 192.168.150.2 255.255.255.192
 ipv6 address 2001:db8:4100:150::2/64
 standby version 2
 standby 1 ip 192.168.150.1
 standby 1 priority 110
 standby 1 preempt
 standby 1 track GigabitEthernet0/1 10
 ipv6 enable
 no shutdown

interface vlan 200
 description SOPORTE_TECNICO-GATEWAY
 ip address 192.168.150.66 255.255.255.192
 ipv6 address 2001:db8:4200:150::2/64
 standby version 2
 standby 2 ip 192.168.150.65
 standby 2 priority 110
 standby 2 preempt
 standby 2 track GigabitEthernet0/1 10
 ipv6 enable
 no shutdown

interface vlan 300
 description DESARROLLO_SOFTWARE-
GATEWAY
 ip address 192.168.150.130 255.255.255.192
```

```
 ipv6 address 2001:db8:4300:150::2/64
 standby version 2
 standby 3 ip 192.168.150.129
 standby 3 priority 90
 standby 3 preempt
 standby 3 track GigabitEthernet0/1 10
 ipv6 enable
 no shutdown

interface vlan 400
 description ADMINISTRACION-GATEWAY
 ip address 192.168.150.194 255.255.255.192
 ipv6 address 2001:db8:4400:150::2/64
 standby version 2
 standby 4 ip 192.168.150.193
 standby 4 priority 90
 standby 4 preempt
 standby 4 track GigabitEthernet0/1 10
 ipv6 enable
 no shutdown

! ================================
! INTERFACE HACIA ROUTER CORE
! ================================
interface GigabitEthernet0/1
 description ENLACE-HACIA-ROUTER-CORE-
Gi0/0
 no switchport
 ip address 192.168.199.2 255.255.255.252
 ipv6 address 2001:db8:4000:199::2/64
 ipv6 enable
 no shutdown
exit

! ================================
! ENLACES TRUNK HACIA ACCESS
SWITCHES
! ================================
interface FastEthernet0/3
 description TRUNK_HACIA_ACCESS1
 switchport trunk encapsulation dot1q

 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 spanning-tree portfast trunk
 no shutdown
exit

interface FastEthernet0/5
 description TRUNK_HACIA_ACCESS2
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 spanning-tree portfast trunk
 no shutdown
exit

! ================================
! ENLACE HACIA DIST2 (INTERSWITCH
LINK)
! ================================
interface FastEthernet0/24
 description ISL-HACIA-DIST2
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 no shutdown
exit

! ================================
! SPANNING TREE CONFIGURATION
! ================================
spanning-tree vlan 100 root primary
spanning-tree vlan 200 root primary
spanning-tree vlan 300 root secondary
spanning-tree vlan 400 root secondary
spanning-tree mode rapid-pvst

! ================================
! RUTAS ESTÁTICAS IPv4 + IPv6
! ================================
ip route 0.0.0.0 0.0.0.0 192.168.199.1
ipv6 route ::/0 2001:db8:4000:199::1

end
copy running-config startup-config
```

## 13.3 Switch Acceso DC

```
!==================================
! SWITCH ACCESS1 (LOGÍSTICA + SOPORTE) - CONFIGURACIÓN IPv4 + IPv6
!==================================

enable
configure terminal
hostname ACCESS1
ipv6 unicast-routing
banner motd # SWITCH ACCESS1 - SOLO ACCESO AUTORIZADO #
ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025

crypto key generate rsa general-keys modulus 1024
ip ssh version 2
service ssh

! Acceso remoto
line vty 0 15
 login local
 transport input ssh
line con 0
 login local
 logging synchronous
 exec-timeout 0 0
exit

! ================================
! VLANs
! ================================
vlan 100
 name LOGISTICA
vlan 200
 name SOPORTE_TECNICO
vlan 300
 name DESARROLLO_DE_SOFTWARE
vlan 400
 name ADMINISTRACION

! ================================
! PUERTOS DE USUARIOS CON PORT SECURITY
! ================================
interface FastEthernet0/2
 description PC_LOGISTICA_001
 switchport mode access
 switchport access vlan 100
 switchport port-security
 switchport port-security maximum 1
 switchport port-security mac-address sticky
 switchport port-security violation shutdown
 spanning-tree portfast
 spanning-tree bpduguard enable
 no shutdown
exit

interface FastEthernet0/3
 description PC_LOGISTICA_002
 switchport mode access
 switchport access vlan 100
 switchport port-security
 switchport port-security maximum 1
 switchport port-security mac-address sticky
 switchport port-security violation shutdown
 spanning-tree portfast
 spanning-tree bpduguard enable
 no shutdown
exit

interface FastEthernet0/4
 description PC_SOPORTE_001
 switchport mode access
 switchport access vlan 200
 switchport port-security
 switchport port-security maximum 1
 switchport port-security mac-address sticky
 switchport port-security violation shutdown
 spanning-tree portfast
 spanning-tree bpduguard enable
 no shutdown
exit

interface FastEthernet0/6
 description PC_SOPORTE_002
 switchport mode access
 switchport access vlan 200
 switchport port-security
 switchport port-security maximum 1
 switchport port-security mac-address sticky
 switchport port-security violation shutdown
 spanning-tree portfast
 spanning-tree bpduguard enable
 no shutdown
exit

! ================================
! UPLINKS HACIA DIST SWITCHES (REDUNDANCIA)
! ================================
interface FastEthernet0/1
 description TRUNK_HACIA_DIST1
 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 no shutdown
```

```
exit

interface FastEthernet0/5
 description TRUNK_HACIA_DIST2
 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 no shutdown
exit

! ================================
! SPANNING TREE CONFIGURATION
! ================================
spanning-tree mode rapid-pvst
spanning-tree portfast default

end
copy running-config startup-config
```

# 14. CONFIGURACIONES DISPOSITIVOS SUCURSALES STATIC

## 14.1 Router STATIC

```
!==================================
! ROUTER COMAYAGUA (R-COMAYAGUA)
!==================================
En
Conf t
hostname R-COMAYAGUA
Ipv6 unicast-routing
banner motd # GRUPO ARRIETA
COMAYAGUA - SOLO ACCESO
AUTORIZADO #

Ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025
crypto key generate rsa general-keys modulus
1024

! ACL que permite solo SSH desde VLAN 400
access-list 10 permit 192.168.1.192 0.0.0.63
access-list 10 deny any

ip ssh version 2

! LÍNEAS VTY CON RESTRICCIÓN ACL
line vty 0 15
 login local
 transport input ssh telnet
 access-class 10 in
 privilege level 15
 exit

line con 0
 login local
 exit


interface Serial0/0/0
 description WAN-COMAYAGUA-TGU
 ip address 192.168.200.2 255.255.255.252
 ipv6 address 2001:db8:200:1::2/64
 no shutdown
 exit

interface Serial0/0/1
description WAN-COMAYAGUA-
DCRESPALDO
 ip address 192.168.200.6 255.255.255.252
 ipv6 address 2001:db8:200:2::2/64
 no shutdown
 exit

interface GigabitEthernet0/0
 description ENLACE-SWITCH-LOCAL
 no shutdown
 exit

interface GigabitEthernet0/0.100
 description VLAN100-LOGISTICA
 encapsulation dot1q 100
 ip address 192.168.1.1 255.255.255.192
 ipv6 address 2001:db8:3100:1::1/64
 no shutdown
 exit

interface GigabitEthernet0/0.200
 description VLAN200-SOPORTE_TECNICO
 encapsulation dot1q 200
 ip address 192.168.1.65 255.255.255.192
 ipv6 address 2001:db8:3200:1::1/64
 no shutdown
 exit

interface GigabitEthernet0/0.300
 description VLAN300-
DESARROLLO_DE_SOFTWARE
 encapsulation dot1q 300
 ip address 192.168.1.129 255.255.255.192
 ipv6 address 2001:db8:3300:1::1/64
 no shutdown
 exit

interface GigabitEthernet0/0.400
 description VLAN400-ADMINISTRACION
 encapsulation dot1q 400
 ip address 192.168.1.193 255.255.255.192
 ipv6 address 2001:db8:3400:1::1/64
 no shutdown
 exit

! ENRUTAMIENTO ESTÁTICO IPv4
! Ruta por defecto principal hacia TGU
ip route 0.0.0.0 0.0.0.0 192.168.200.1 10

! Ruta por defecto de respaldo hacia SPS
ip route 0.0.0.0 0.0.0.0 192.168.200.5 20

! Rutas específicas hacia otras sucursales vía TGU
ip route 192.168.2.0 255.255.255.0 192.168.200.1
10
```

```
ip route 192.168.3.0 255.255.255.0 192.168.200.1
0
ip route 192.168.4.0 255.255.255.0 192.168.200.1
10
ip route 192.168.5.0 255.255.255.0 192.168.200.1
10

! Rutas específicas hacia otras sucursales vía SPS
DATACENTER
ip route 192.168.2.0 255.255.255.0 192.168.200.5
20

ip route 192.168.150.0 255.255.255.0
192.168.200.5

! ENRUTAMIENTO ESTÁTICO IPv6
! Ruta por defecto principal hacia TGU
ipv6 route ::/0 2001:db8:200:1::1 20

! Ruta por defecto de respaldo hacia SPS
ipv6 route ::/0 2001:db8:200:2::1 10

! Rutas específicas hacia otras sucursales
ipv6 route 2001:db8:3100:2::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3100:3::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3100:4::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3100:5::/64
2001:db8:200:1::1 10

ipv6 route 2001:db8:3200:2::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3200:3::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3200:4::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3200:5::/64
2001:db8:200:1::1 10

ipv6 route 2001:db8:3300:2::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3300:3::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3300:4::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3300:5::/64
2001:db8:200:1::1 10

ipv6 route 2001:db8:3400:2::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3400:3::/64
2001:db8:200:1::1 10
ip route 192.168.3.0 255.255.255.0 192.168.200.5
20
ip route 192.168.4.0 255.255.255.0 192.168.200.5
20
ip route 192.168.5.0 255.255.255.0 192.168.200.5
20

! Rutas hacia datacenters
ip route 192.168.100.0 255.255.255.0
192.168.200.1
ipv6 route 2001:db8:3400:4::/64
2001:db8:200:1::1 10
ipv6 route 2001:db8:3400:5::/64
2001:db8:200:1::1 10

ipv6 route 2001:db8:3100:2::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3100:3::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3100:4::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3100:5::/64
2001:db8:200:2::1 20

ipv6 route 2001:db8:3200:2::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3200:3::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3200:4::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3200:5::/64
2001:db8:200:2::1 20

ipv6 route 2001:db8:3300:2::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3300:3::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3300:4::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3300:5::/64
2001:db8:200:2::1 20

ipv6 route 2001:db8:3400:2::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3400:3::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3400:4::/64
2001:db8:200:2::1 20
ipv6 route 2001:db8:3400:5::/64
2001:db8:200:2::1 20
end
copy running-config startup-config
```

## 14.2 Switch STATIC

```
!==================================
! SWITCH COMAYAGUA (SW-COM)
!==================================
en
conf t
hostname SW-COM
banner motd # GRUPO ARRIETA
COMAYAGUA SWITCH - SOLO ACCESO
AUTORIZADO #
ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025

! Acceso remoto y consola
line vty 0 15
 login local
 transport input ssh
line con 0
 login local
exit

! Configuración de VLANs
vlan 100
 name LOGISTICA
exit
vlan 200
 name SOPORTE_TECNICO
exit
vlan 300
 name DESARROLLO_DE_SOFTWARE
exit
vlan 400
 name ADMINISTRACION
exit

! Configuración de trunk al router
interface GigabitEthernet0/1
 description ENLACE-ROUTER-COMAYAGUA
 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 no shutdown
exit

! Puertos de acceso VLAN 100 (FINANZAS)
interface FastEthernet0/1
 description LOGISTICA-VLAN100
 switchport mode access
 switchport access vlan 100
 no shutdown
exit

! Puertos de acceso VLAN 200 (SERVICIO AL
CLIENTE)
interface FastEthernet0/2
 description SOPORTE_TECNICO-VLAN200
 switchport mode access
 switchport access vlan 200
exit

! Puertos de acceso VLAN 300 (SISTEMAS)
interface FastEthernet0/3
 description DESARROLLO_DE_SOFTWARE-
VLAN300
 switchport mode access
 switchport access vlan 300
 no shutdown
exit

! Puertos de acceso VLAN 400
(ADMINISTRACION)
interface FastEthernet0/4
 description ADMINISTRACION-VLAN400
 switchport mode access
 switchport access vlan 400
 no shutdown
exit

! Gateway por defecto
ip default-gateway 192.168.1.193

end
copy running-config startup-config
```

# 15. CONFIGURACIONES DISPOSITIVOS SUCURSALES EIGRP

## 15.1 Router EIGRP

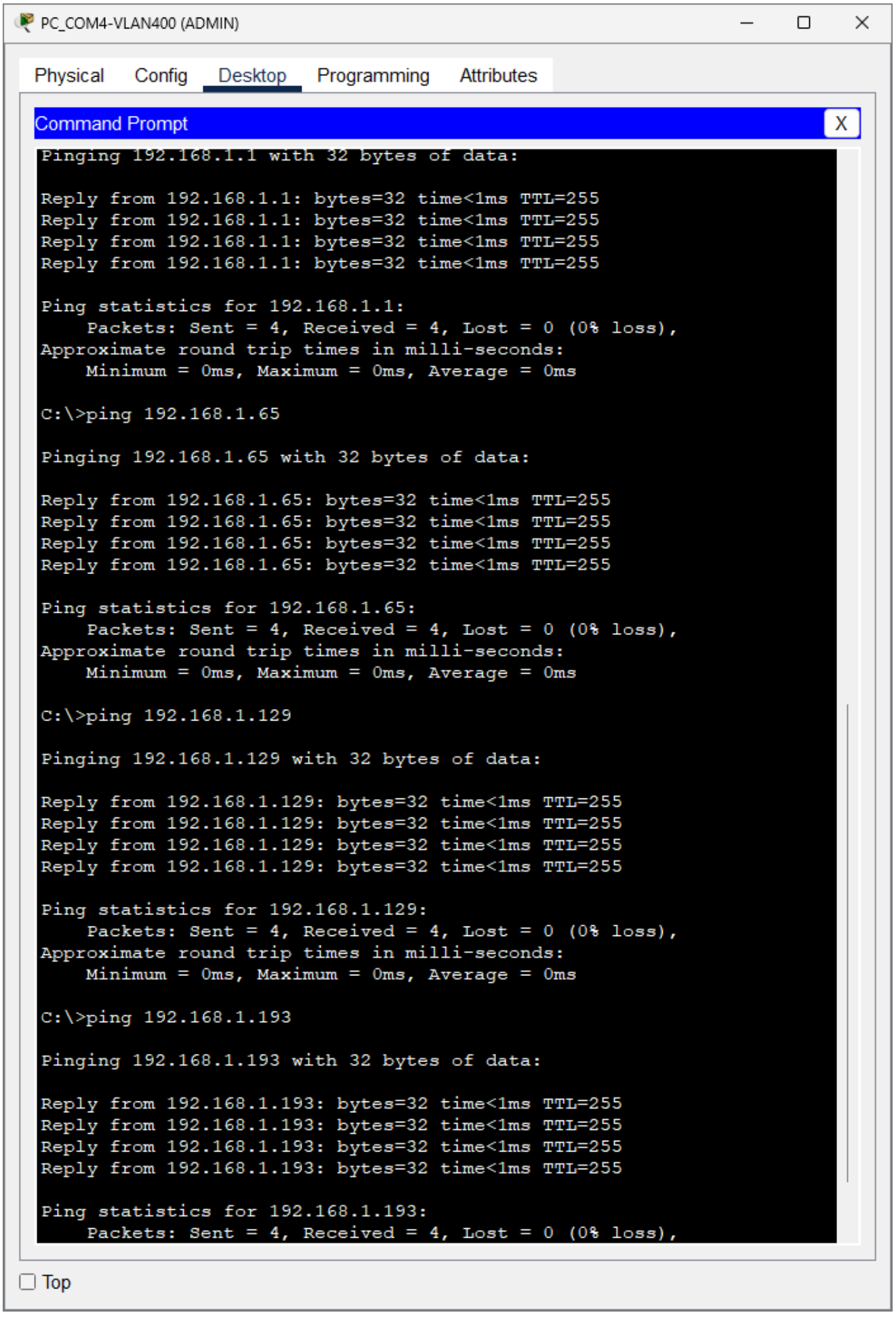
```
!==================================
! ROUTER LA CEIBA (R-LA-CEIBA)
!==================================
En
Conf t
hostname R-LA-CEIBA
ipv6 unicast-routing
banner motd # GRUPO ARRIETA LA CEIBA -
SOLO ACCESO AUTORIZADO #

ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025
crypto key generate rsa general-keys modulus
1024

! ACL que permite solo SSH desde VLAN 400
access-list 10 permit 192.168.5.192 0.0.0.63
access-list 10 deny any

! LÍNEAS VTY CON RESTRICCIÓN ACL
line vty 0 15
 login local
 transport input ssh
 access-class 10 in
 privilege level 15
 exit

line con 0
 login local
 exit

interface Serial0/0/0
description ENLACE-LA-CEIBA-TGU
ip address 192.168.204.2 255.255.255.252
ipv6 address 2001:db8:204:1::2/64
no shutdown
exit

interface Serial0/0/1
description WAN-LA-CEIBA-DCRESPALDO
ip address 192.168.204.6 255.255.255.252
ipv6 address 2001:db8:204:2::2/64
no shutdown
exit

interface GigabitEthernet0/0
description ENLACE-SWITCH-LOCAL
no shutdown
exit

interface GigabitEthernet0/0.100
description VLAN100-LOGISTICA
encapsulation dot1q 100
ip address 192.168.5.1 255.255.255.192
ipv6 address 2001:db8:3100:5::1/64
no shutdown
exit

interface GigabitEthernet0/0.200
description VLAN200-SOPORTE_TECNICO
encapsulation dot1q 200
ip address 192.168.5.65 255.255.255.192
ipv6 address 2001:db8:3200:5::1/64
no shutdown
exit

interface GigabitEthernet0/0.300
description VLAN300-
DESARROLLO_DE_SOFTWARE
encapsulation dot1q 300
ip address 192.168.5.129 255.255.255.192
ipv6 address 2001:db8:3300:5::1/64
no shutdown
exit

interface GigabitEthernet0/0.400
description VLAN400-ADMINISTRACION
encapsulation dot1q 400
ip address 192.168.5.193 255.255.255.192
ipv6 address 2001:db8:3400:5::1/64
no shutdown
exit

! Configuración EIGRP IPv4
router eigrp 100
network 192.168.204.0 0.0.0.3
network 192.168.204.4 0.0.0.3
network 192.168.5.0 0.0.0.255
no auto-summary
exit

! Configuración EIGRPv6 para IPv6
ipv6 router eigrp 100
eigrp router-id 6.6.6.6
no shutdown
exit

! Aplicar EIGRP a interfaces
interface Serial0/0/0
```

```
ipv6 eigrp 100
exit

interface Serial0/0/1
ipv6 eigrp 100
exit

interface GigabitEthernet0/0.100
ipv6 eigrp 100
exit

interface GigabitEthernet0/0.200
ipv6 eigrp 100
exit

interface GigabitEthernet0/0.300
ipv6 eigrp 100
exit

interface GigabitEthernet0/0.400
ipv6 eigrp 100
exit

end
copy running-config startup-config
```

## 15.2 Switch EIGRP

```
!==================================
! SWITCH LA CEIBA (SW-LCB)
!==================================
en
conf t
ipv6 unicast-routing
hostname SW-LCB
banner motd # GRUPO ARRIETA LA CEIBA
SWITCH - SOLO ACCESO AUTORIZADO #
ip domain-name arrieta.hn
username admin privilege 15 secret Arrieta2025

! Acceso remoto y consola
line vty 0 15
 login local
 transport input all
line con 0
 login local
exit

! Configuración de VLANs
vlan 100
 name LOGISTICA
exit
vlan 200
 name SOPORTE_TECNICO
exit
vlan 300
 name DESARROLLO_DE_SOFTWARE
exit
vlan 400
 name ADMINISTRACION
exit

! Configuración de trunk al router
interface GigabitEthernet0/1
 description ENLACE-ROUTER-LA-CEIBA
 switchport mode trunk
 switchport trunk allowed vlan 100,200,300,400
 no shutdown
exit

! Puertos de acceso VLAN 100
interface FastEthernet0/1
 description LOGISTICA-VLAN100
 switchport mode access
 switchport access vlan 100
 no shutdown
exit

! Puertos de acceso VLAN 200
interface FastEthernet0/2
 description SOPORTE_TECNICO-VLAN200
 switchport mode access
 switchport access vlan 200
 no shutdown
exit

! Puertos de acceso VLAN 300
interface FastEthernet0/3
 description DESARROLLO_DE_SOFTWARE-
VLAN300
 switchport mode access
 switchport access vlan 300
 no shutdown
exit

! Puertos de acceso VLAN 400
interface FastEthernet0/4
 description ADMINISTRACION-VLAN400
 switchport mode access
 switchport access vlan 400
 no shutdown
exit

! Gateway por defectos
ip default-gateway 192.168.5.193

end
copy running-config startup-config
```

# 16. PRUEBAS DE PINGS ENTRE SUCURSALES & VLANS IPv4



PC_COM4-VLAN400 (ADMIN)

Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 192.168.2.1 with 32 bytes of data:

Reply from 192.168.2.1: bytes=32 time=4ms TTL=253
Reply from 192.168.2.1: bytes=32 time=19ms TTL=253
Reply from 192.168.2.1: bytes=32 time=3ms TTL=253
Reply from 192.168.2.1: bytes=32 time=20ms TTL=253

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 20ms, Average = 11ms

C:\>ping 192.168.2.65

Pinging 192.168.2.65 with 32 bytes of data:

Reply from 192.168.2.65: bytes=32 time=38ms TTL=253
Reply from 192.168.2.65: bytes=32 time=2ms TTL=253
Reply from 192.168.2.65: bytes=32 time=2ms TTL=253
Reply from 192.168.2.65: bytes=32 time=27ms TTL=253

Ping statistics for 192.168.2.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 38ms, Average = 17ms

C:\>ping 192.168.2.129

Pinging 192.168.2.129 with 32 bytes of data:

Reply from 192.168.2.129: bytes=32 time=30ms TTL=253
Reply from 192.168.2.129: bytes=32 time=13ms TTL=253
Reply from 192.168.2.129: bytes=32 time=18ms TTL=253
Reply from 192.168.2.129: bytes=32 time=24ms TTL=253

Ping statistics for 192.168.2.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 13ms, Maximum = 30ms, Average = 21ms

C:\>ping 192.168.2.193

Pinging 192.168.2.193 with 32 bytes of data:

Reply from 192.168.2.193: bytes=32 time=35ms TTL=253
Reply from 192.168.2.193: bytes=32 time=10ms TTL=253
Reply from 192.168.2.193: bytes=32 time=2ms TTL=253
Reply from 192.168.2.193: bytes=32 time=18ms TTL=253

Ping statistics for 192.168.2.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC_COM4-VLAN400 (ADMIN)

Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 192.168.4.1 with 32 bytes of data:

Reply from 192.168.4.1: bytes=32 time=30ms TTL=253
Reply from 192.168.4.1: bytes=32 time=23ms TTL=253
Reply from 192.168.4.1: bytes=32 time=2ms TTL=253
Reply from 192.168.4.1: bytes=32 time=21ms TTL=253

Ping statistics for 192.168.4.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 30ms, Average = 19ms

C:\>ping 192.168.4.65

Pinging 192.168.4.65 with 32 bytes of data:

Reply from 192.168.4.65: bytes=32 time=26ms TTL=253
Reply from 192.168.4.65: bytes=32 time=2ms TTL=253
Reply from 192.168.4.65: bytes=32 time=21ms TTL=253
Reply from 192.168.4.65: bytes=32 time=21ms TTL=253

Ping statistics for 192.168.4.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 26ms, Average = 17ms

C:\>ping 192.168.4.129

Pinging 192.168.4.129 with 32 bytes of data:

Reply from 192.168.4.129: bytes=32 time=34ms TTL=253
Reply from 192.168.4.129: bytes=32 time=10ms TTL=253
Reply from 192.168.4.129: bytes=32 time=2ms TTL=253
Reply from 192.168.4.129: bytes=32 time=2ms TTL=253

Ping statistics for 192.168.4.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 34ms, Average = 12ms

C:\>ping 192.168.4.193

Pinging 192.168.4.193 with 32 bytes of data:

Reply from 192.168.4.193: bytes=32 time=43ms TTL=253
Reply from 192.168.4.193: bytes=32 time=14ms TTL=253
Reply from 192.168.4.193: bytes=32 time=18ms TTL=253
Reply from 192.168.4.193: bytes=32 time=19ms TTL=253

Ping statistics for 192.168.4.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC_COM4-VLAN400 (ADMIN)

Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 192.168.5.1 with 32 bytes of data:

Reply from 192.168.5.1: bytes=32 time=22ms TTL=253
Reply from 192.168.5.1: bytes=32 time=23ms TTL=253
Reply from 192.168.5.1: bytes=32 time=24ms TTL=253
Reply from 192.168.5.1: bytes=32 time=29ms TTL=253

Ping statistics for 192.168.5.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 22ms, Maximum = 29ms, Average = 24ms

C:\>ping 192.168.5.65

Pinging 192.168.5.65 with 32 bytes of data:

Reply from 192.168.5.65: bytes=32 time=32ms TTL=253
Reply from 192.168.5.65: bytes=32 time=14ms TTL=253
Reply from 192.168.5.65: bytes=32 time=41ms TTL=253
Reply from 192.168.5.65: bytes=32 time=5ms TTL=253

Ping statistics for 192.168.5.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 5ms, Maximum = 41ms, Average = 23ms

C:\>ping 192.168.5.129

Pinging 192.168.5.129 with 32 bytes of data:

Reply from 192.168.5.129: bytes=32 time=28ms TTL=253
Reply from 192.168.5.129: bytes=32 time=13ms TTL=253
Reply from 192.168.5.129: bytes=32 time=39ms TTL=253
Reply from 192.168.5.129: bytes=32 time=24ms TTL=253

Ping statistics for 192.168.5.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 13ms, Maximum = 39ms, Average = 26ms

C:\>ping 192.168.5.193

Pinging 192.168.5.193 with 32 bytes of data:

Reply from 192.168.5.193: bytes=32 time=25ms TTL=253
Reply from 192.168.5.193: bytes=32 time=2ms TTL=253
Reply from 192.168.5.193: bytes=32 time=30ms TTL=253
Reply from 192.168.5.193: bytes=32 time=2ms TTL=253

Ping statistics for 192.168.5.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC-TGU1

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>
ping 192.168.100.1

Pinging 192.168.100.1 with 32 bytes of data:

Reply from 192.168.100.1: bytes=32 time<1ms TTL=255
Reply from 192.168.100.1: bytes=32 time<1ms TTL=255
Reply from 192.168.100.1: bytes=32 time<1ms TTL=255
Reply from 192.168.100.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.100.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.100.65

Pinging 192.168.100.65 with 32 bytes of data:

Reply from 192.168.100.65: bytes=32 time<1ms TTL=255
Reply from 192.168.100.65: bytes=32 time<1ms TTL=255
Reply from 192.168.100.65: bytes=32 time<1ms TTL=255
Reply from 192.168.100.65: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.100.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.100.129

Pinging 192.168.100.129 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 192.168.100.129: bytes=32 time=1ms TTL=255
Reply from 192.168.100.129: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.100.129:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.100.193

Pinging 192.168.100.193 with 32 bytes of data:

Request timed out.
Reply from 192.168.100.193: bytes=32 time<1ms TTL=255
Reply from 192.168.100.193: bytes=32 time<1ms TTL=255
Reply from 192.168.100.193: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.100.193:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Top

PC-SPS4

Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 192.168.150.1 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 192.168.150.1: bytes=32 time<1ms TTL=255
Reply from 192.168.150.1: bytes=32 time=2ms TTL=255

Ping statistics for 192.168.150.1:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\>ping 192.168.150.65

Pinging 192.168.150.65 with 32 bytes of data:

Request timed out.
Reply from 192.168.150.65: bytes=32 time<1ms TTL=255
Reply from 192.168.150.65: bytes=32 time<1ms TTL=255
Reply from 192.168.150.65: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.150.65:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.150.129

Pinging 192.168.150.129 with 32 bytes of data:

Reply from 192.168.150.129: bytes=32 time<1ms TTL=255
Reply from 192.168.150.129: bytes=32 time<1ms TTL=255
Reply from 192.168.150.129: bytes=32 time=15ms TTL=255
Reply from 192.168.150.129: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.150.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 15ms, Average = 3ms

C:\>ping 192.168.150.193

Pinging 192.168.150.193 with 32 bytes of data:

Reply from 192.168.150.193: bytes=32 time<1ms TTL=255
Reply from 192.168.150.193: bytes=32 time<1ms TTL=255
Reply from 192.168.150.193: bytes=32 time<1ms TTL=255
Reply from 192.168.150.193: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.150.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

# 17. PRUEBAS DE PINGS ENTRE SUCURSALES & VLANS IPv6

PC_COM4-VLAN400 (ADMIN)

Physical | Config | Desktop | Programming | Attributes

Command Prompt

```
Pinging 2001:DB8:3100:1::1 with 32 bytes of data:

Reply from 2001:DB8:3100:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3100:1::1: bytes=32 time=6ms TTL=255
Reply from 2001:DB8:3100:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3100:1::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:3100:1::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 6ms, Average = 1ms

C:\>ping 2001:DB8:3200:1::1

Pinging 2001:DB8:3200:1::1 with 32 bytes of data:

Reply from 2001:DB8:3200:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3200:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3200:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3200:1::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:3200:1::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:DB8:3300:1::1

Pinging 2001:DB8:3300:1::1 with 32 bytes of data:

Reply from 2001:DB8:3300:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3300:1::1: bytes=32 time=3ms TTL=255
Reply from 2001:DB8:3300:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3300:1::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:3300:1::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms

C:\>ping 2001:DB8:3400:1::1

Pinging 2001:DB8:3400:1::1 with 32 bytes of data:

Reply from 2001:DB8:3400:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3400:1::1: bytes=32 time=1ms TTL=255
Reply from 2001:DB8:3400:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:3400:1::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:3400:1::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

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PC_COM4-VLAN400 (ADMIN)

Physical | Config | Desktop | Programming | Attributes

Command Prompt

```
Pinging 2001:DB8:3100:2::1 with 32 bytes of data:

Reply from 2001:DB8:3100:2::1: bytes=32 time=2ms TTL=253
Reply from 2001:DB8:3100:2::1: bytes=32 time=17ms TTL=253
Reply from 2001:DB8:3100:2::1: bytes=32 time=22ms TTL=253
Reply from 2001:DB8:3100:2::1: bytes=32 time=2ms TTL=253

Ping statistics for 2001:DB8:3100:2::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 22ms, Average = 10ms

C:\>ping 2001:DB8:3200:2::1

Pinging 2001:DB8:3200:2::1 with 32 bytes of data:

Reply from 2001:DB8:3200:2::1: bytes=32 time=17ms TTL=253
Reply from 2001:DB8:3200:2::1: bytes=32 time=27ms TTL=253
Reply from 2001:DB8:3200:2::1: bytes=32 time=22ms TTL=253
Reply from 2001:DB8:3200:2::1: bytes=32 time=2ms TTL=253

Ping statistics for 2001:DB8:3200:2::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 27ms, Average = 17ms

C:\>ping 2001:DB8:3300:2::1

Pinging 2001:DB8:3300:2::1 with 32 bytes of data:

Reply from 2001:DB8:3300:2::1: bytes=32 time=19ms TTL=253
Reply from 2001:DB8:3300:2::1: bytes=32 time=8ms TTL=253
Reply from 2001:DB8:3300:2::1: bytes=32 time=10ms TTL=253
Reply from 2001:DB8:3300:2::1: bytes=32 time=7ms TTL=253

Ping statistics for 2001:DB8:3300:2::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 19ms, Average = 11ms

C:\>ping 2001:DB8:3400:2::1

Pinging 2001:DB8:3400:2::1 with 32 bytes of data:

Reply from 2001:DB8:3400:2::1: bytes=32 time=66ms TTL=253
Reply from 2001:DB8:3400:2::1: bytes=32 time=16ms TTL=253
Reply from 2001:DB8:3400:2::1: bytes=32 time=2ms TTL=253
Reply from 2001:DB8:3400:2::1: bytes=32 time=14ms TTL=253

Ping statistics for 2001:DB8:3400:2::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

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PC_COM4-VLAN400 (ADMIN)

Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 2001:DB8:3100:4::1 with 32 bytes of data:

Reply from 2001:DB8:3100:4::1: bytes=32 time=28ms TTL=253
Reply from 2001:DB8:3100:4::1: bytes=32 time=2ms TTL=253
Reply from 2001:DB8:3100:4::1: bytes=32 time=2ms TTL=253
Reply from 2001:DB8:3100:4::1: bytes=32 time=2ms TTL=253

Ping statistics for 2001:DB8:3100:4::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 28ms, Average = 8ms

C:\>ping 2001:DB8:3200:4::1

Pinging 2001:DB8:3200:4::1 with 32 bytes of data:

Reply from 2001:DB8:3200:4::1: bytes=32 time=27ms TTL=253
Reply from 2001:DB8:3200:4::1: bytes=32 time=14ms TTL=253
Reply from 2001:DB8:3200:4::1: bytes=32 time=2ms TTL=253
Reply from 2001:DB8:3200:4::1: bytes=32 time=8ms TTL=253

Ping statistics for 2001:DB8:3200:4::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 27ms, Average = 12ms

C:\>ping 2001:DB8:3300:4::1

Pinging 2001:DB8:3300:4::1 with 32 bytes of data:

Reply from 2001:DB8:3300:4::1: bytes=32 time=23ms TTL=253
Reply from 2001:DB8:3300:4::1: bytes=32 time=34ms TTL=253
Reply from 2001:DB8:3300:4::1: bytes=32 time=33ms TTL=253
Reply from 2001:DB8:3300:4::1: bytes=32 time=2ms TTL=253

Ping statistics for 2001:DB8:3300:4::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 34ms, Average = 23ms

C:\>ping 2001:DB8:3400:4::1

Pinging 2001:DB8:3400:4::1 with 32 bytes of data:

Reply from 2001:DB8:3400:4::1: bytes=32 time=4ms TTL=253
Reply from 2001:DB8:3400:4::1: bytes=32 time=4ms TTL=253
Reply from 2001:DB8:3400:4::1: bytes=32 time=8ms TTL=253
Reply from 2001:DB8:3400:4::1: bytes=32 time=23ms TTL=253

Ping statistics for 2001:DB8:3400:4::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

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PC_COM4-VLAN400 (ADMIN)

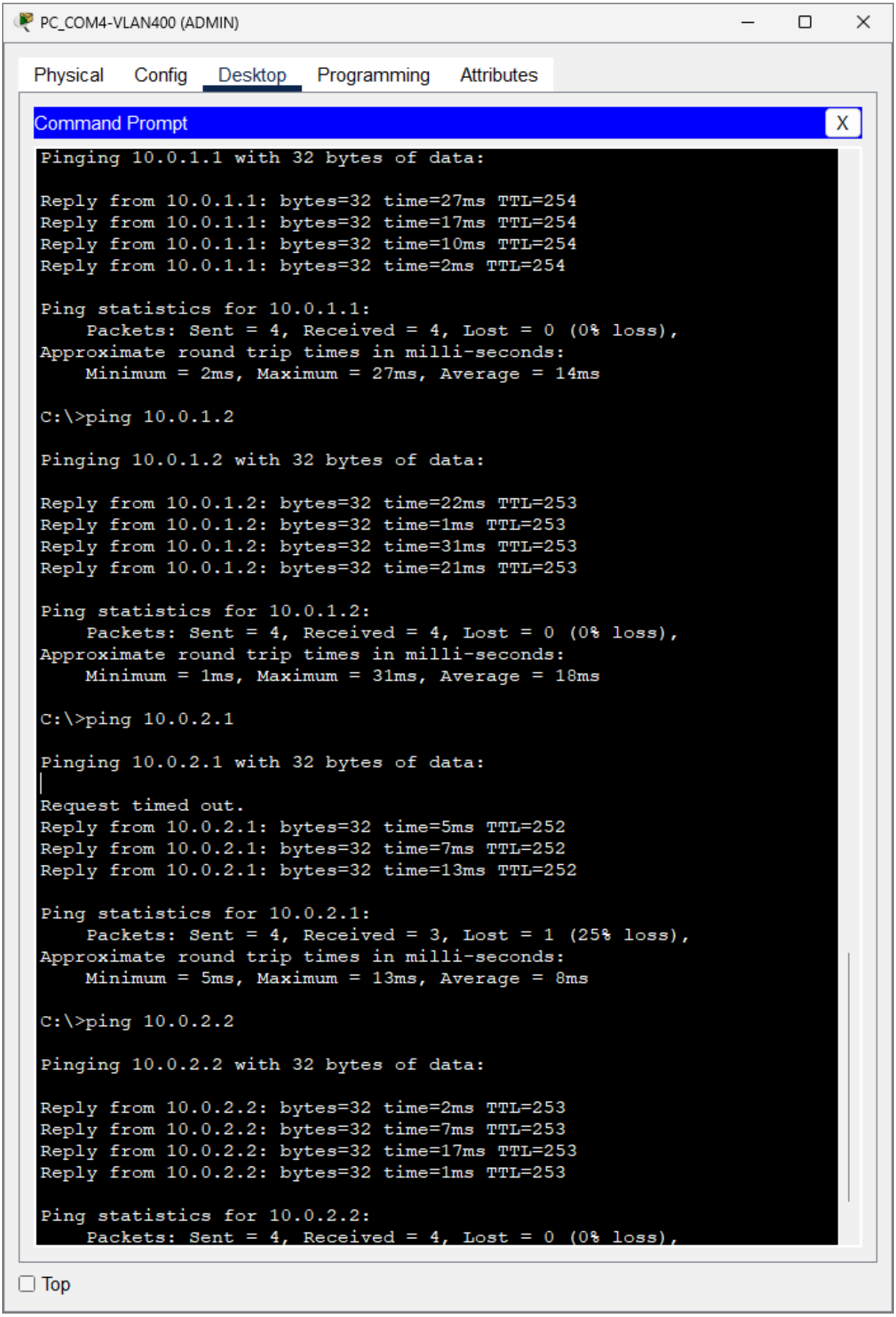
Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 2001:DB8:3100:5::1 with 32 bytes of data:

Reply from 2001:DB8:3100:5::1: bytes=32 time=17ms TTL=253
Reply from 2001:DB8:3100:5::1: bytes=32 time=29ms TTL=253
Reply from 2001:DB8:3100:5::1: bytes=32 time=2ms TTL=253
Reply from 2001:DB8:3100:5::1: bytes=32 time=2ms TTL=253

Ping statistics for 2001:DB8:3100:5::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 29ms, Average = 12ms

C:\>ping 2001:DB8:3200:5::1

Pinging 2001:DB8:3200:5::1 with 32 bytes of data:

Reply from 2001:DB8:3200:5::1: bytes=32 time=26ms TTL=253
Reply from 2001:DB8:3200:5::1: bytes=32 time=8ms TTL=253
Reply from 2001:DB8:3200:5::1: bytes=32 time=18ms TTL=253
Reply from 2001:DB8:3200:5::1: bytes=32 time=11ms TTL=253

Ping statistics for 2001:DB8:3200:5::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 8ms, Maximum = 26ms, Average = 15ms

C:\>ping 2001:DB8:3300:5::1

Pinging 2001:DB8:3300:5::1 with 32 bytes of data:

Reply from 2001:DB8:3300:5::1: bytes=32 time=52ms TTL=253
Reply from 2001:DB8:3300:5::1: bytes=32 time=9ms TTL=253
Reply from 2001:DB8:3300:5::1: bytes=32 time=25ms TTL=253
Reply from 2001:DB8:3300:5::1: bytes=32 time=2ms TTL=253

Ping statistics for 2001:DB8:3300:5::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 52ms, Average = 22ms

C:\>ping 2001:DB8:3400:5::1

Pinging 2001:DB8:3400:5::1 with 32 bytes of data:

Reply from 2001:DB8:3400:5::1: bytes=32 time=28ms TTL=253
Reply from 2001:DB8:3400:5::1: bytes=32 time=20ms TTL=253
Reply from 2001:DB8:3400:5::1: bytes=32 time=3ms TTL=253
Reply from 2001:DB8:3400:5::1: bytes=32 time=10ms TTL=253

Ping statistics for 2001:DB8:3400:5::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

# 18. PRUEBAS DE PINGS NAT e INTERNET



PC_COM4-VLAN400 (ADMIN)

Physical Config Desktop Programming Attributes

Command Prompt X

```
Pinging 8.8.8.8 with 32 bytes of data:

Reply from 8.8.8.8: bytes=32 time=2ms TTL=125
Reply from 8.8.8.8: bytes=32 time=13ms TTL=125
Reply from 8.8.8.8: bytes=32 time=15ms TTL=125
Reply from 8.8.8.8: bytes=32 time=4ms TTL=125

Ping statistics for 8.8.8.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 15ms, Average = 8ms

C:\>ping 8.8.8.9

Pinging 8.8.8.9 with 32 bytes of data:

Request timed out.
Reply from 8.8.8.9: bytes=32 time=7ms TTL=125
Reply from 8.8.8.9: bytes=32 time=6ms TTL=125
Reply from 8.8.8.9: bytes=32 time=7ms TTL=125

Ping statistics for 8.8.8.9:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 7ms, Average = 6ms

C:\>ping 8.8.8.10

Pinging 8.8.8.10 with 32 bytes of data:

Request timed out.
Reply from 8.8.8.10: bytes=32 time=7ms TTL=125
Reply from 8.8.8.10: bytes=32 time=13ms TTL=125
Reply from 8.8.8.10: bytes=32 time=4ms TTL=125

Ping statistics for 8.8.8.10:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 13ms, Average = 8ms

C:\>ping 8.8.8.11

Pinging 8.8.8.11 with 32 bytes of data:

Request timed out.
Reply from 8.8.8.11: bytes=32 time=19ms TTL=125
Reply from 8.8.8.11: bytes=32 time=2ms TTL=125
Reply from 8.8.8.11: bytes=32 time=16ms TTL=125

Ping statistics for 8.8.8.11:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
```

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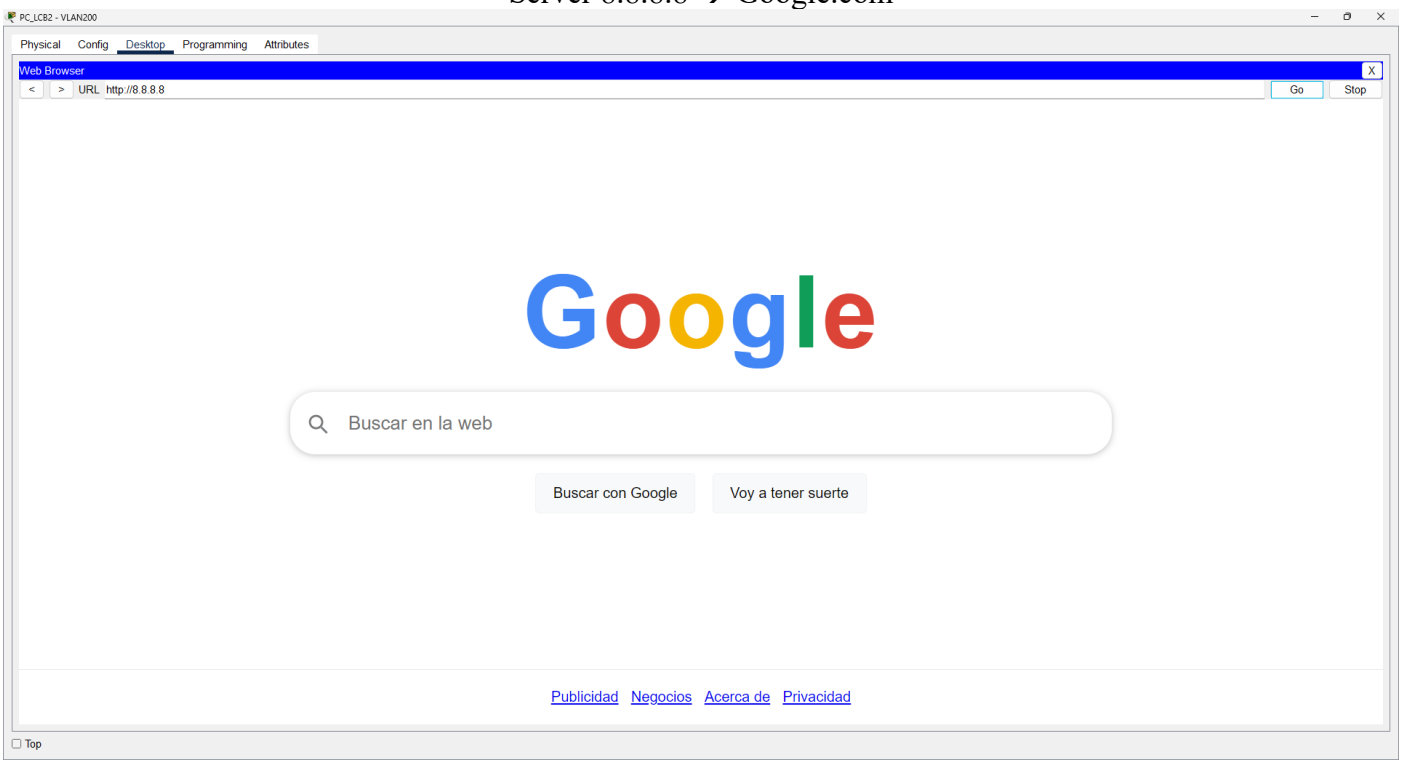
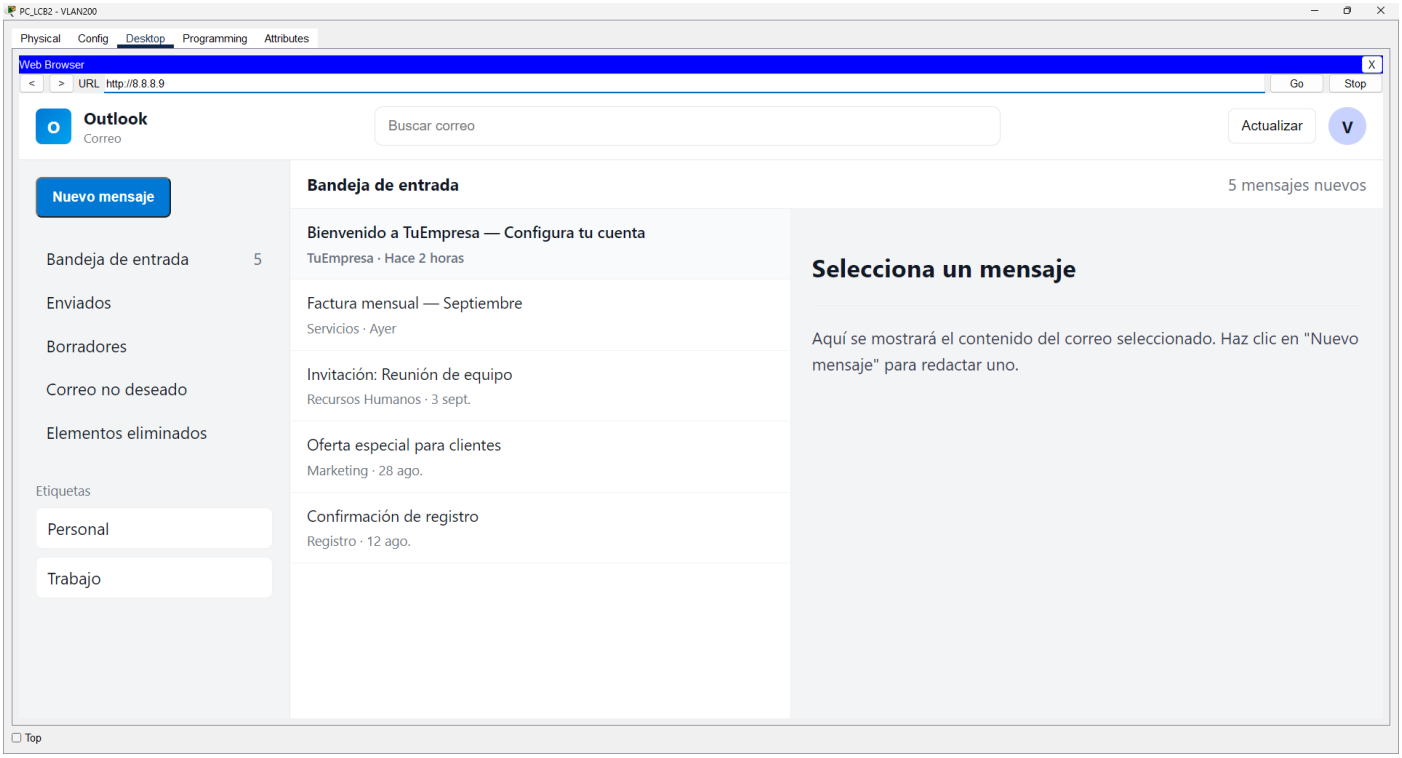
Server 8.8.8.8 → Google.com

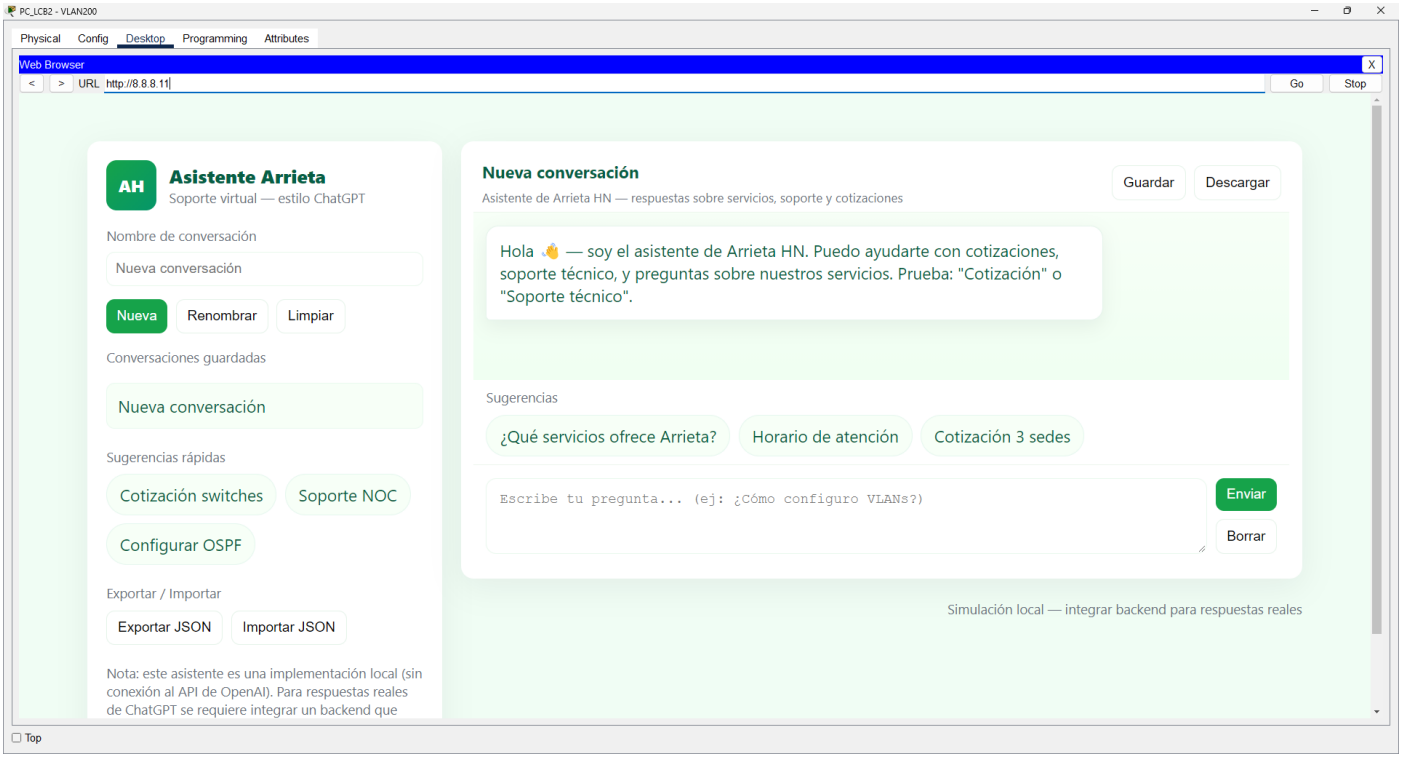



Server 8.8.8.9 → E-Mail

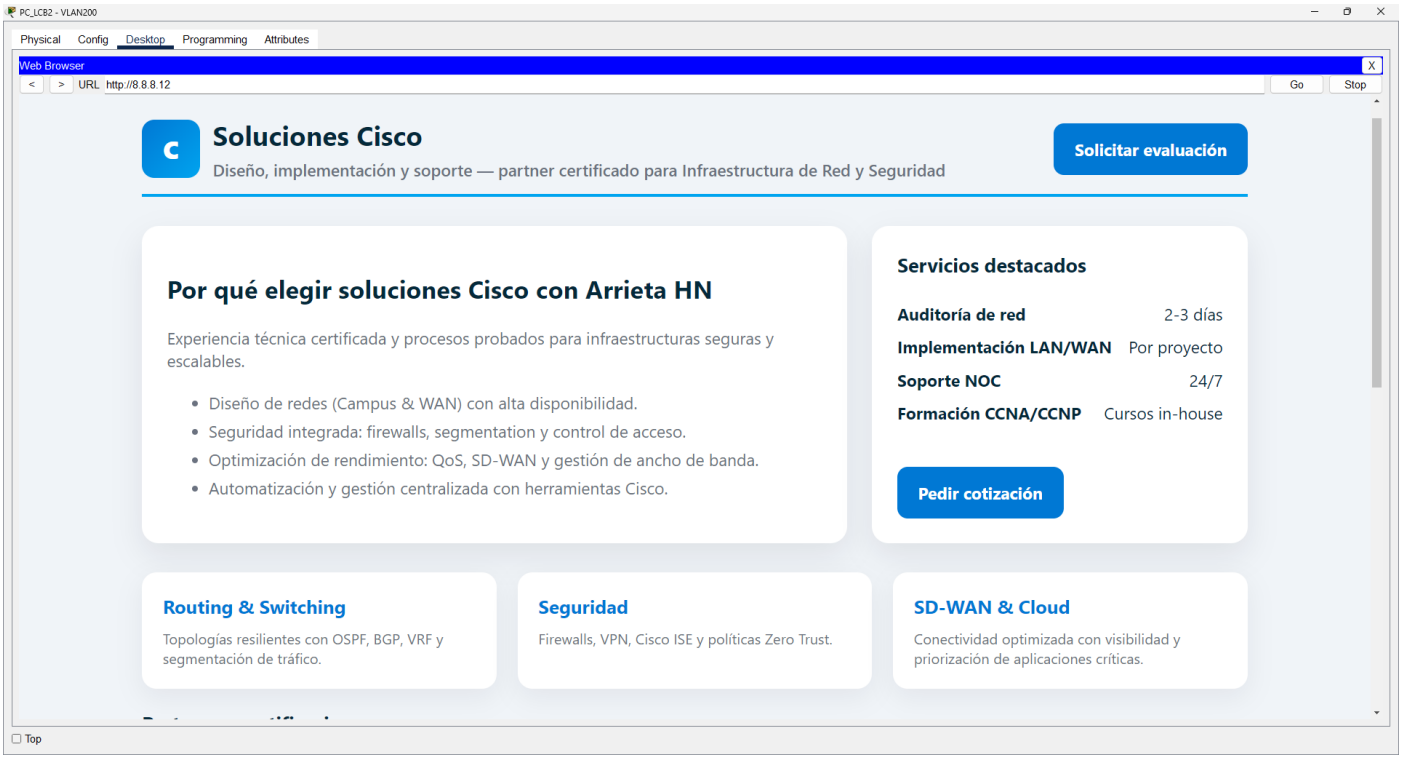


Server 8.8.8.10 → Arrieta.hn

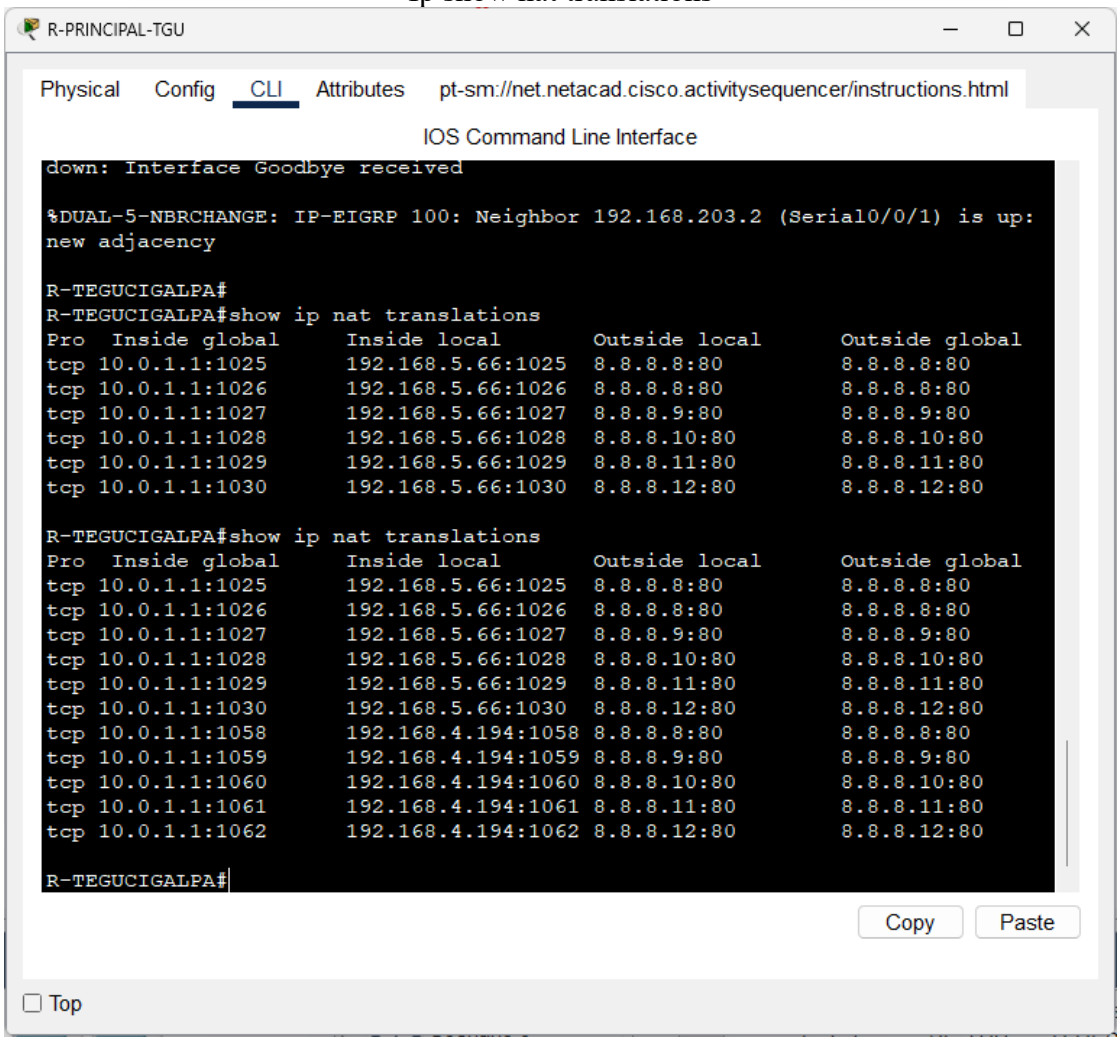

Server 8.8.8.11 → Arrieta-Chatbot.hn



Server 8.8.8.11 → Cisco.com




Ip show nat translations



# 19. CONCLUSIONES

La implementación de la red empresarial de Grupo Arrieta cumplió satisfactoriamente los objetivos técnicos establecidos, logrando conectividad segura entre seis ubicaciones corporativas mediante una arquitectura jerárquica Core-Distribución-Acceso. La infraestructura implementada garantiza escalabilidad, redundancia y separación lógica de funciones, posicionando a la organización con una base tecnológica sólida para su crecimiento.

La segmentación mediante VLANs departamentales (Finanzas, Servicio al Cliente, Sistemas y Administración) se estableció correctamente en todas las sucursales, mejorando la seguridad y facilitando la administración granular de políticas de red. La implementación dual de protocolos de enrutamiento (OSPF para enlaces principales entre datacenters, EIGRP para sucursales, y enrutamiento estático para Comayagua) proporciona redundancia efectiva con redistribución correcta entre protocolos.

El diseño dual-stack (IPv4/IPv6) garantiza compatibilidad actual y preparación para migración futura, cumpliendo con estándares modernos de networking. Los múltiples niveles de redundancia implementados, incluyendo rutas primarias y secundarias, datacenter de respaldo funcional y acceso independiente a Internet, aseguran alta disponibilidad del servicio.

Las medidas de seguridad fundamentales se implementaron correctamente, incluyendo Port Security en switches de acceso, restricción de acceso SSH desde VLAN administrativa, autenticación local con usuarios privilegiados y banners de seguridad en todos los dispositivos.

# 20. RECOMENDACIONES

**Monitoreo y Gestión:** Implementar una solución de monitoreo SNMP para supervisión proactiva, establecer logging centralizado mediante Syslog, y mantener documentación actualizada incluyendo diagramas de red y procedimientos operativos estándar. Crear inventario completo de dispositivos y establecer umbrales de alerta para recursos críticos.

**Seguridad:** Implementar servidor RADIUS/TACACS+ para autenticación centralizada, configurar políticas de rotación de contraseñas cada 90 días, y establecer firewalls en puntos críticos. Considerar la implementación de VPN para acceso remoto seguro, autenticación multifactor para accesos críticos, y listas de acceso más restrictivas por VLAN.

**Rendimiento y Escalabilidad:** Configurar Quality of Service (QoS) para priorizar tráfico crítico de negocio, implementar rate limiting en interfaces de acceso, y planificar upgrades de ancho de banda basados en crecimiento proyectado. Evaluar la implementación de agregación de enlaces en conexiones críticas y considerar migración a tecnologías de mayor velocidad.