Laboratorio 2 de Redes 1

2. Objetivo
En esta práctica se plantean los siguientes objetivos:
• Configurar un entorno de red de transporte para dos DCs, mediante VXLAN.
• Emplear GNS3-VM Alpha, así como Cumulus Linux para implementar la prueba de concepto de VXLAN
• Comprender mediante la práctica el concepto de Open Networking, VLXAN, Cumulus Linux y todos los elementos y protocolos que componen este entorno de redes moderno.

3. Materiales
La presente práctica requiere al menos los siguientes materiales:
• Una PC de 64-Bits, con 8GB de RAM
• Software GNS3-VM con imágenes de Cumulus Linux
• Acceso a Internet
• Acceso a manuales de GNS3-VM y Cumulus Linux

4. Procedimiento
No olvide incluir captura de pantallas (las que considere pertinentes) de todas las actividades realizadas durante la práctica.

Paso 1
• Inicialice GNS3-VM con Cumulus Linux
• Ubique la topología a emular según el Anexo A.

Paso 2
• Realice todos los pasos necesarios para lograr conectividad de extremo a extremo (Anexo B).

Paso 3
• Capture todas las pantallas que considere necesarias como evidencia de su trabajo.

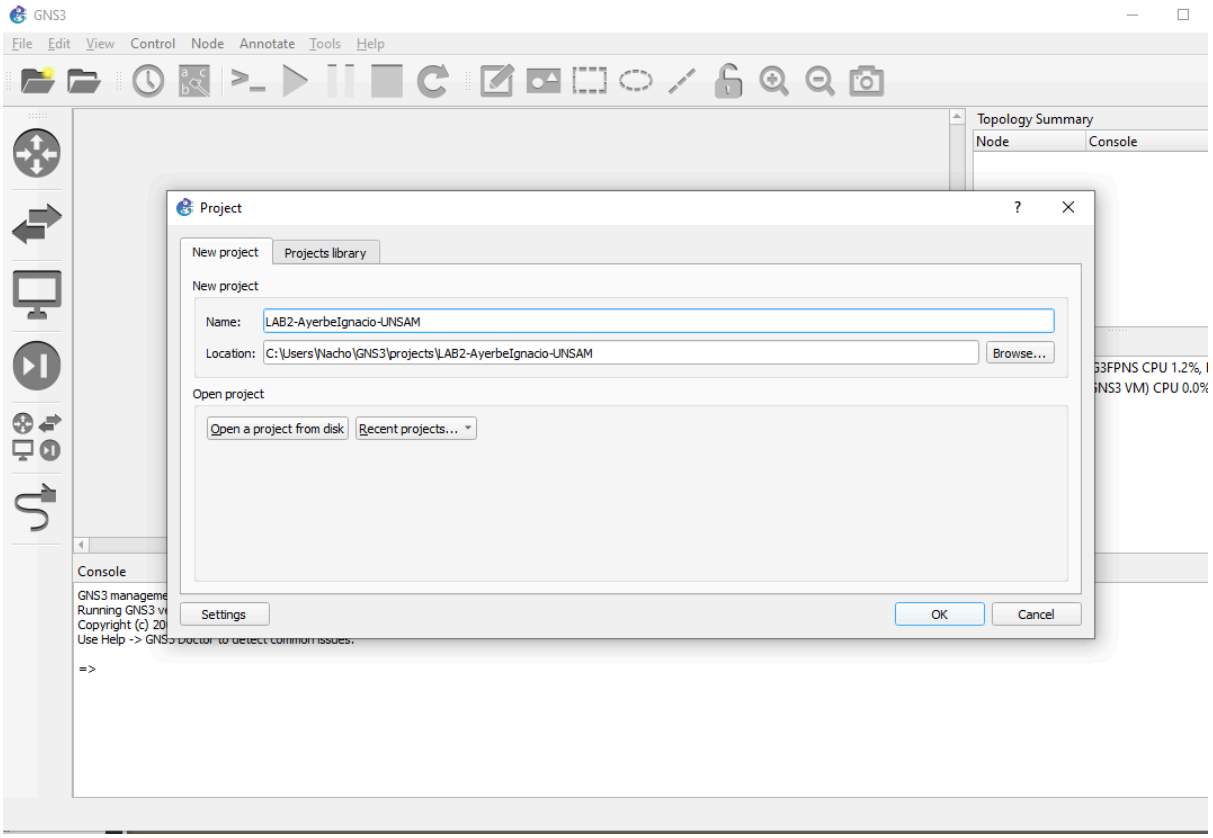
5. Cuestionario
Responda a las siguientes preguntas:
• Defina Qué es e indique la importancia de Cumulus Linux para Open Networking.
• ¿Qué es VXLAN y Cuál es su proceso de encapsulación – INNER y OUTER?
• ¿En qué se relaciona VXLAN con EVPN?
• ¿En qué se relaciona VXLAN con SDN?
• Realice un breve resumen sobre las Eras del Networking

6. Conclusiones y Recomendaciones

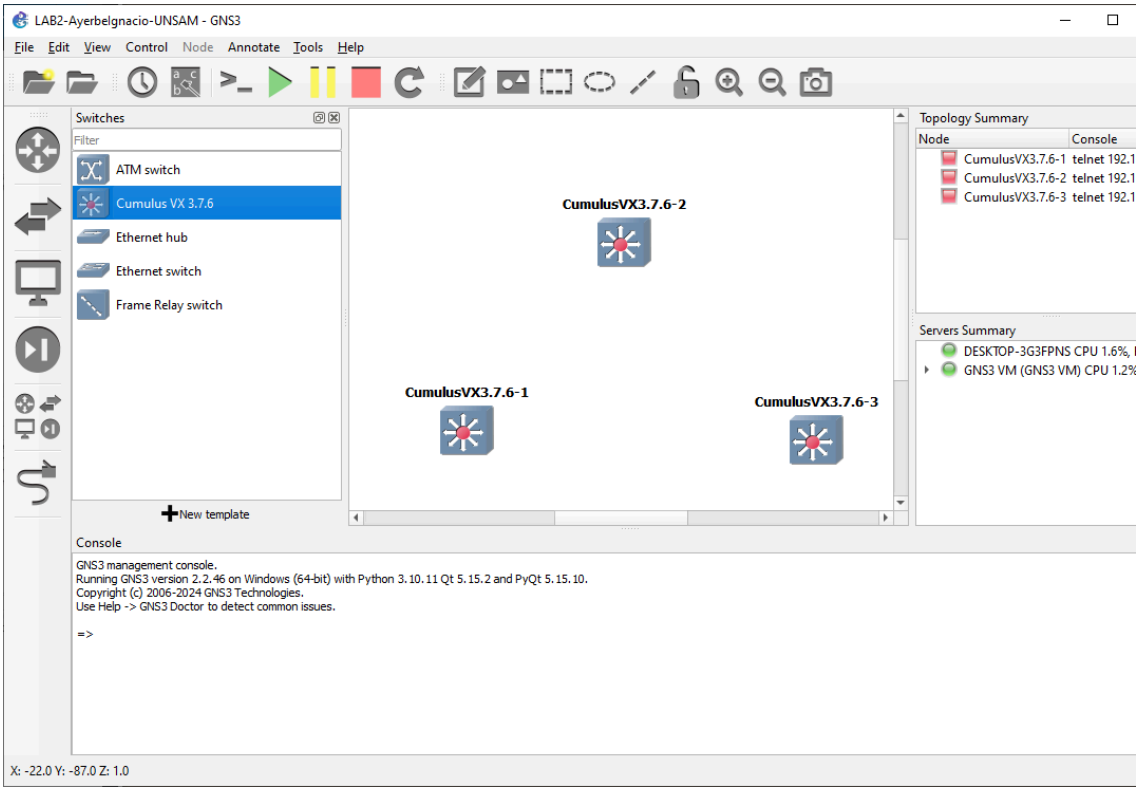
Exponer al menos tres conclusiones y tres recomendaciones

7. Bibliografía
Indicar la Bibliografía utilizada en formato APA

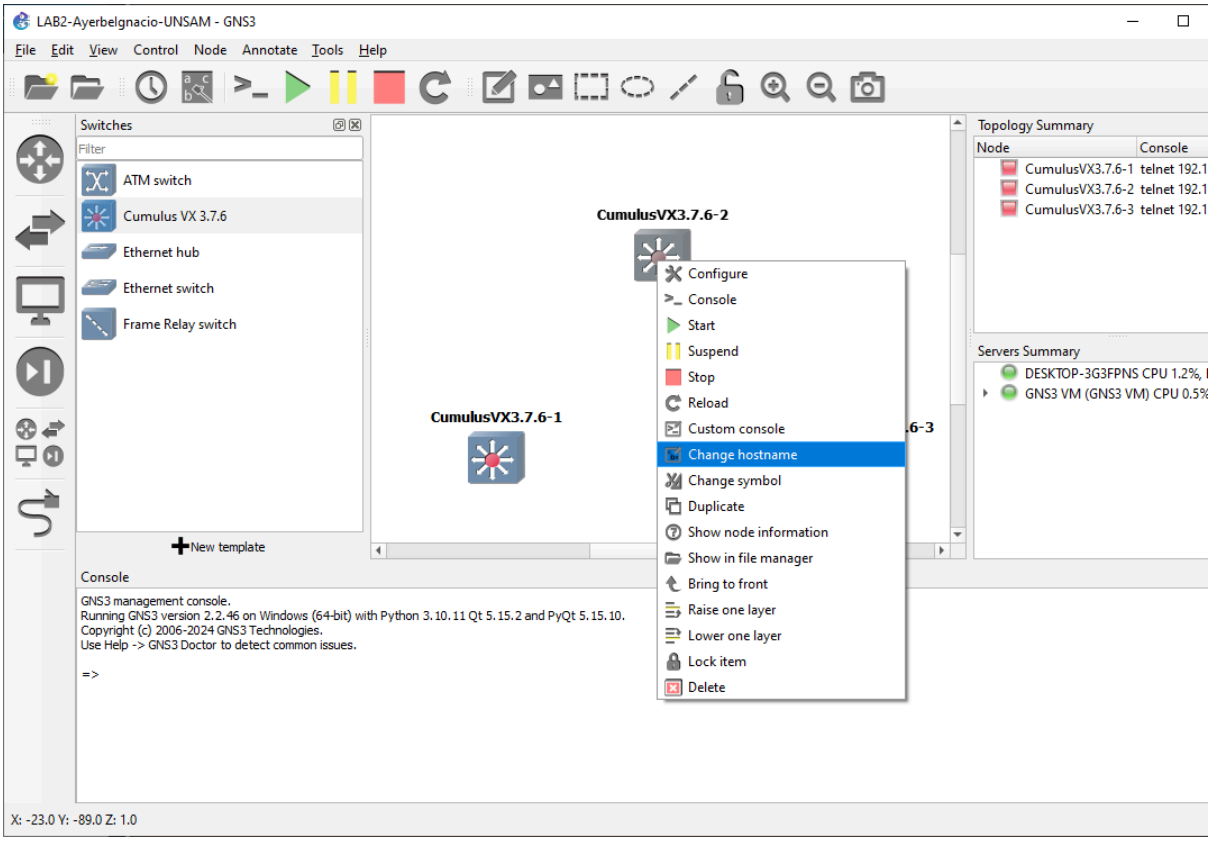
Iniciamos el programa GNS-3 y creamos un nuevo proyecto llamado “LAB2-AyerbeIgnacio-UNSAM”

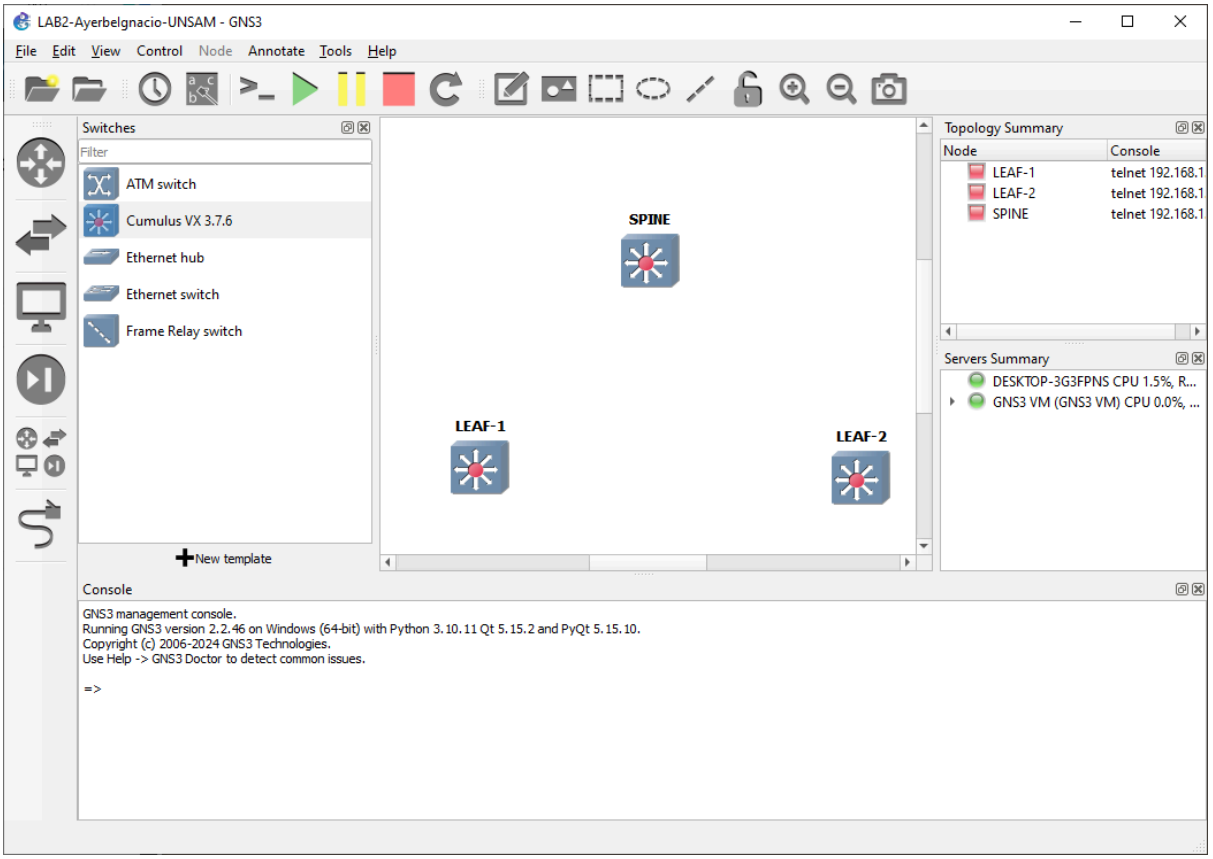


Colocamos 3 switches en el área de trabajo que representan la topología “SPINE-LEAF” de VXLAN

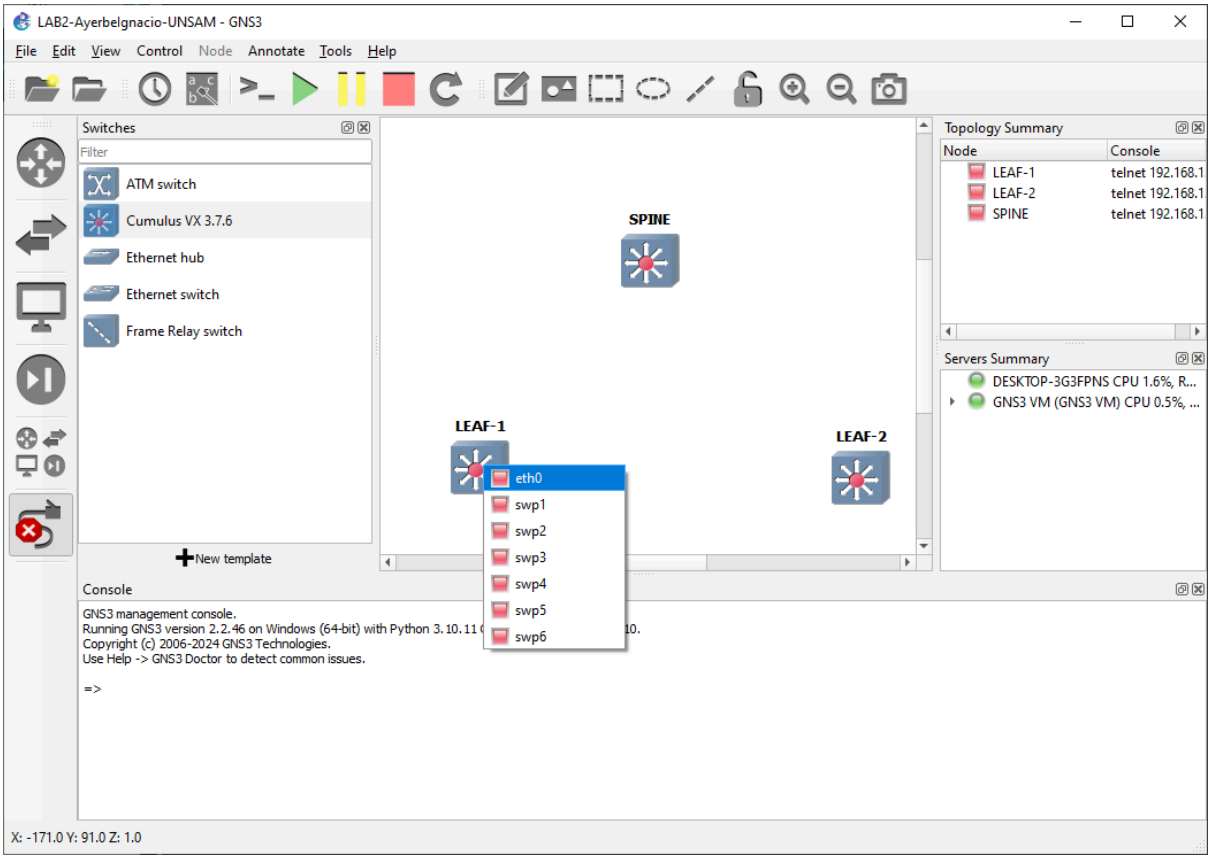


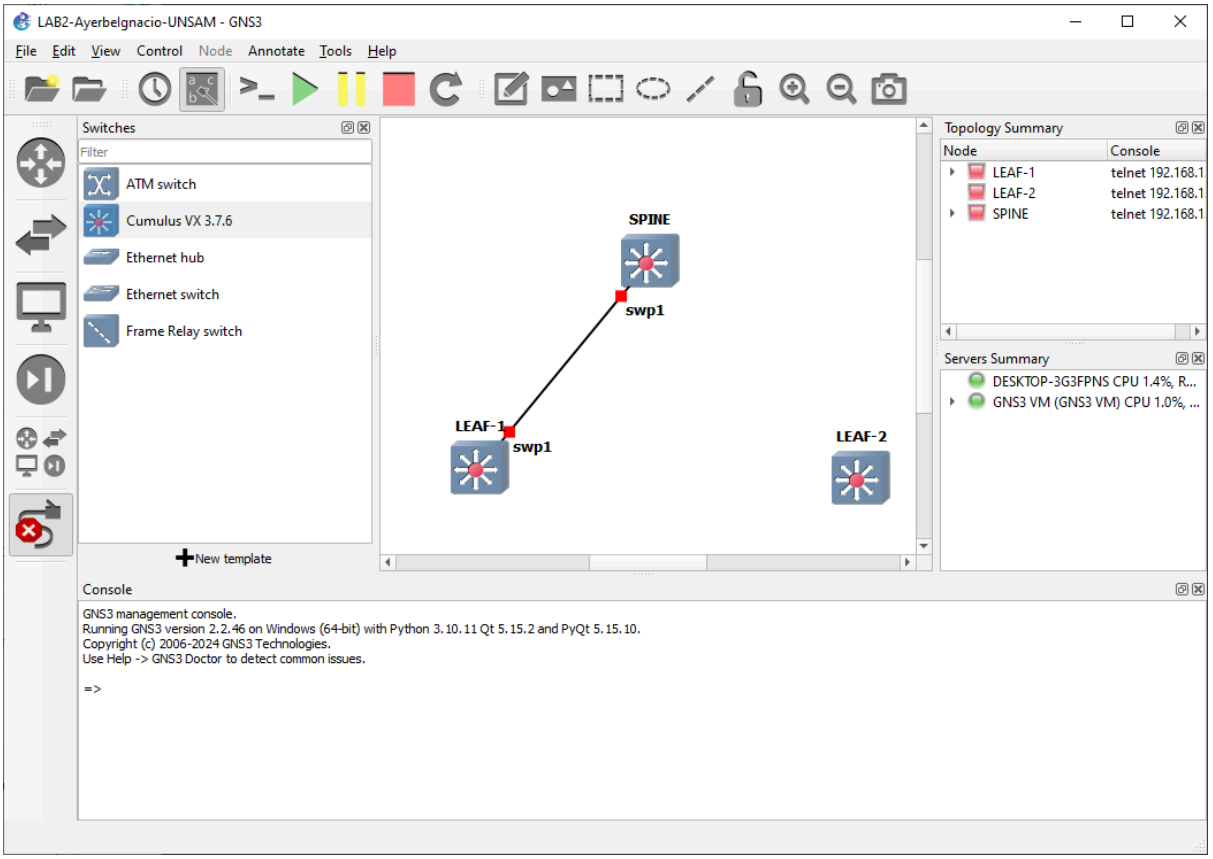
El equipo del medio será el SPINE y los dos siguientes sram los LEAVES, para ello cambiamos el nombre de los dispositivos

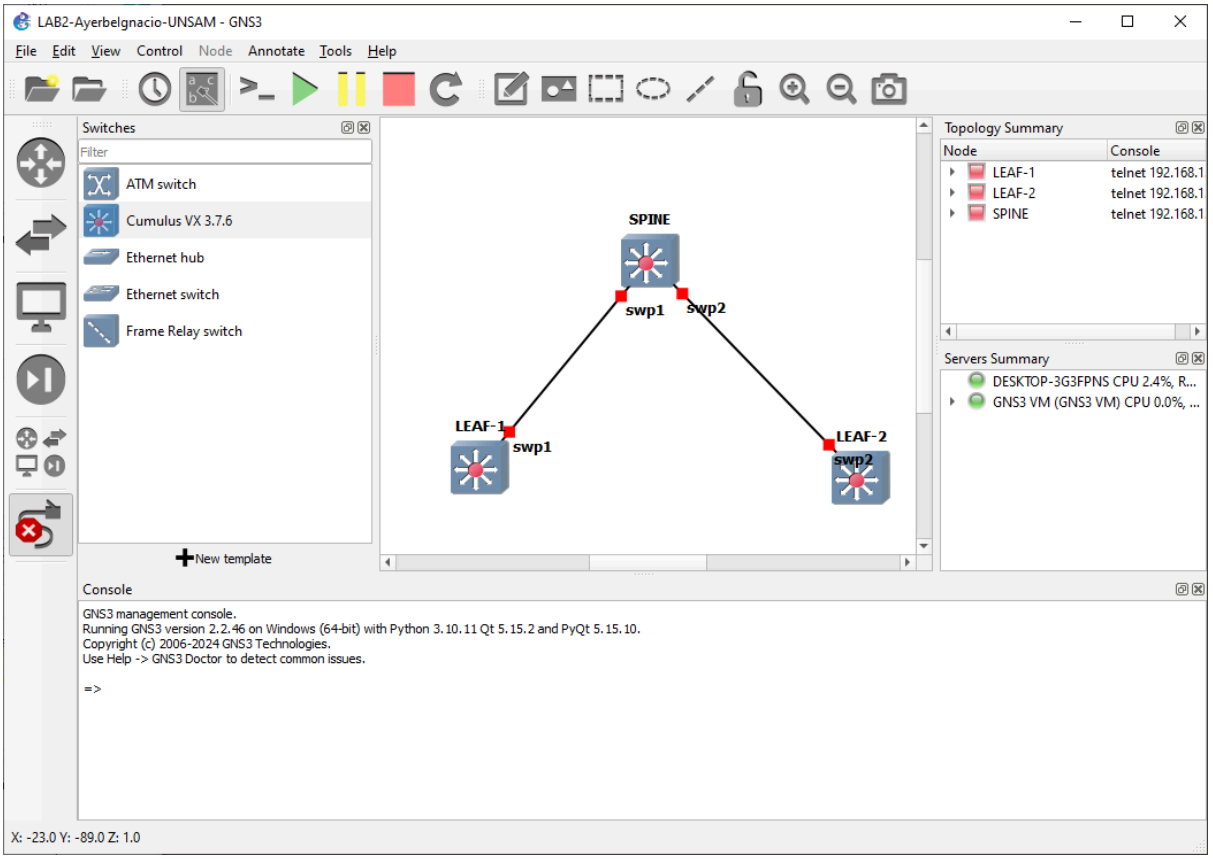




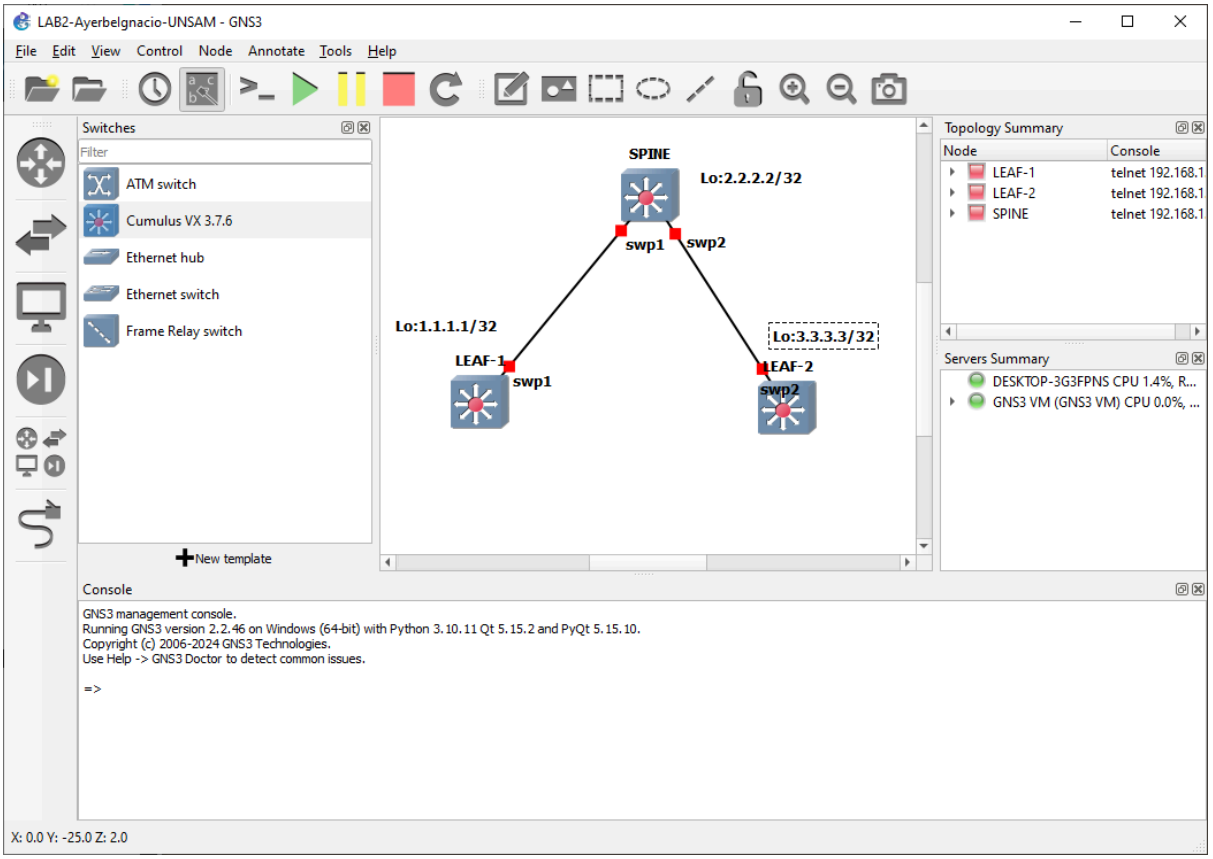
Luego conectamos los dispositivos de los extremos hacia el SPINE. En este caso concectamos el LEAF-1 con el SPINE en swp1 y el LEAF-2 en swp2.


LAB2-Ayerbelgnacio-UNSAM - GNS3
File Edit View Control Node Annotate Tools Help
Switches
Filter
ATM switch
Cumulus VX 3.7.6
Ethernet hub
Ethernet switch
Frame Relay switch
New template
SPINE
LEAF-1
LEAF-2
eth0
swp1
swp2
swp3
swp4
swp5
swp6
Topology Summary
Node
Console
LEAF-1 telnet 192.168.1
LEAF-2 telnet 192.168.1
SPINE telnet 192.168.1
Servers Summary
DESKTOP-3G3FPNS CPU 1.6%, R...
GNS3 VM (GNS3 VM) CPU 0.5%, ...
Console
GNS3 management console.
Running GNS3 version 2.2.46 on Windows (64-bit) with Python 3.10.11
Copyright (c) 2006-2024 GNS3 Technologies.
Use Help -> GNS3 Doctor to detect common issues.
=>
X: -171.0 Y: 91.0 Z: 1.0

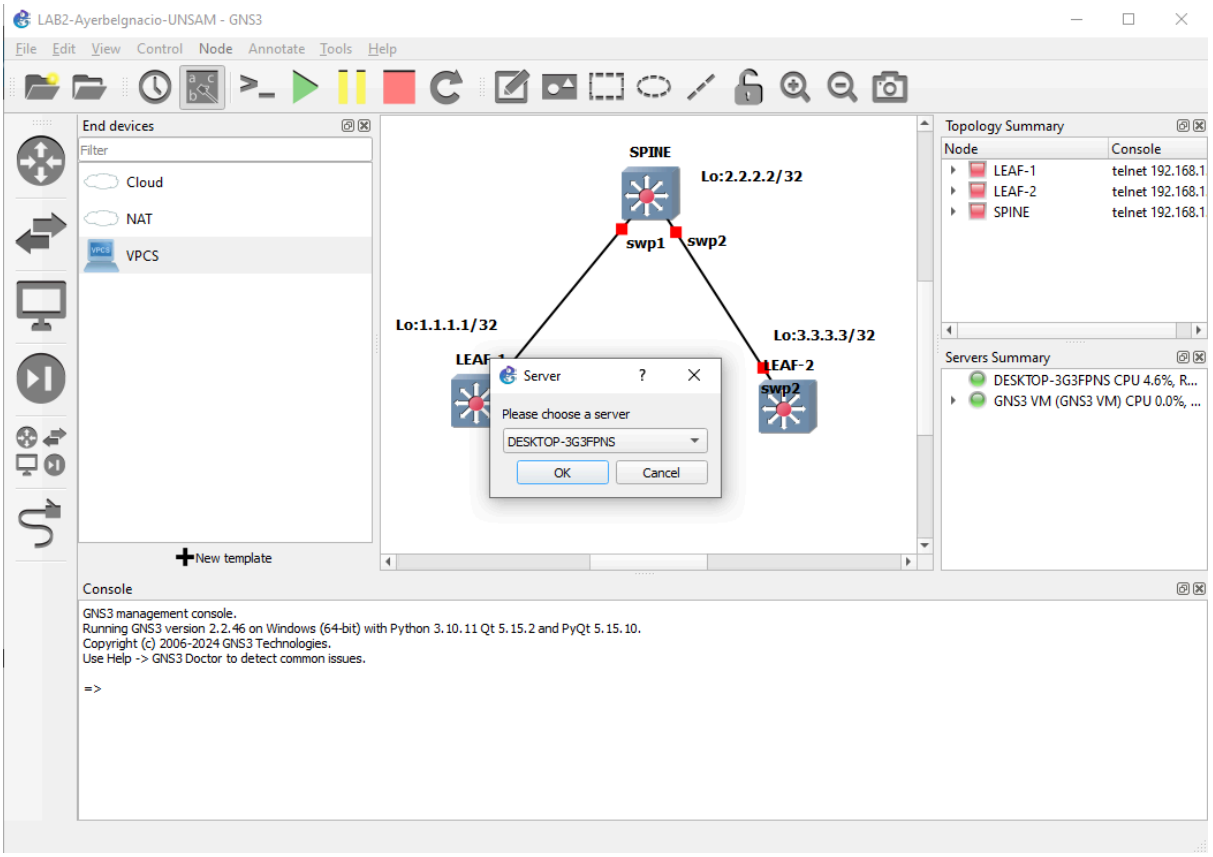

LAB2-Ayerbelgnacio-UNSAM - GNS3
File Edit View Control Node Annotate Tools Help
Switches
Filter
ATM switch
Cumulus VX 3.7.6
Ethernet hub
Ethernet switch
Frame Relay switch
New template
SPINE
swp1
LEAF-1
swp1
LEAF-2
Topology Summary
Node
Console
LEAF-1 telnet 192.168.1
LEAF-2 telnet 192.168.1
SPINE telnet 192.168.1
Servers Summary
DESKTOP-3G3FPNS CPU 1.4%, R...
GNS3 VM (GNS3 VM) CPU 1.0%, ...
Console
GNS3 management console.
Running GNS3 version 2.2.46 on Windows (64-bit) with Python 3.10.11 Qt 5.15.2 and PyQt 5.15.10.
Copyright (c) 2006-2024 GNS3 Technologies.
Use Help -> GNS3 Doctor to detect common issues.
=>

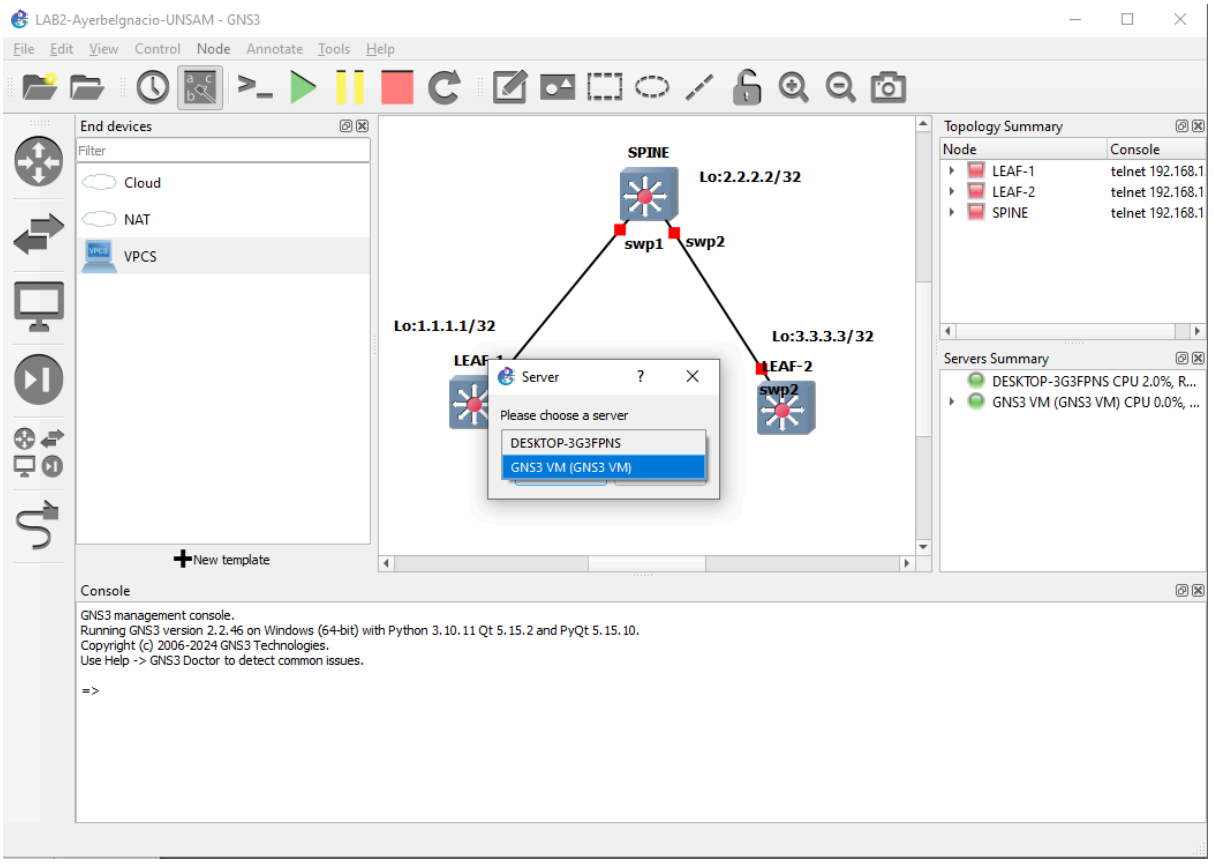


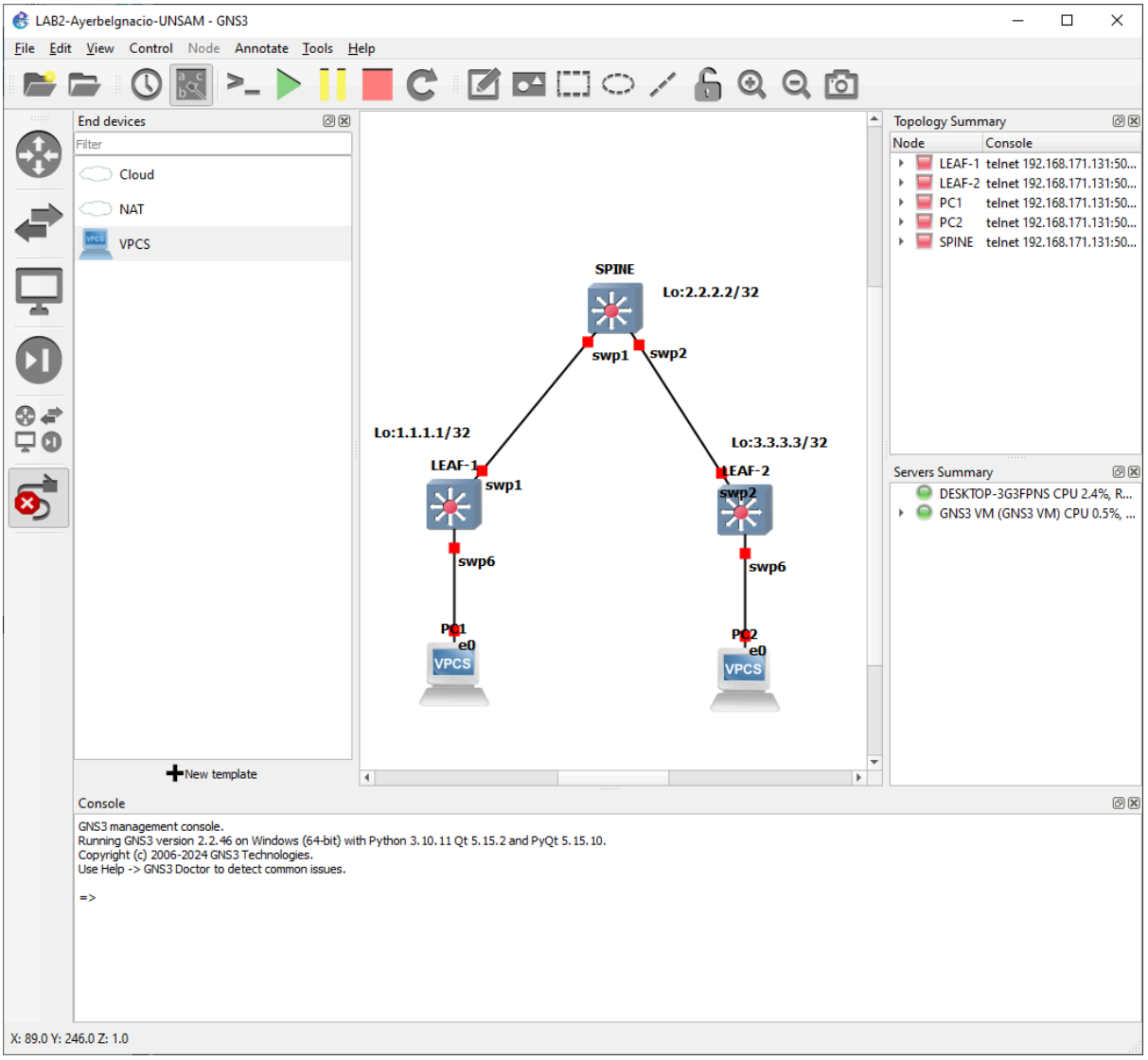
Agregamos los datos de la infraestructura (IP, interfaces de loopback)


LAB2-Ayerbelgnacio-UNSAM - GNS3
File Edit View Control Node Annotate Tools Help
Switches
Filter
ATM switch
Cumulus VX 3.7.6
Ethernet hub
Ethernet switch
Frame Relay switch
New template
SPINE
Lo:2.2.2.2/32
swp1
swp2
Lo:1.1.1.1/32
LEAF-1
swp1
Lo:3.3.3.3/32
LEAF-2
swp2
Topology Summary
Node
Console
LEAF-1
telnet 192.168.1
LEAF-2
telnet 192.168.1
SPINE
telnet 192.168.1
Servers Summary
DESKTOP-3G3FPNS CPU 1.4%, R...
GNS3 VM (GNS3 VM) CPU 0.0%, ...
Console
GNS3 management console.
Running GNS3 version 2.2.46 on Windows (64-bit) with Python 3.10.11 Qt 5.15.2 and PyQt 5.15.10.
Copyright (c) 2006-2024 GNS3 Technologies.
Use Help -> GNS3 Doctor to detect common issues.
=>
X: 0.0 Y: -25.0 Z: 2.0

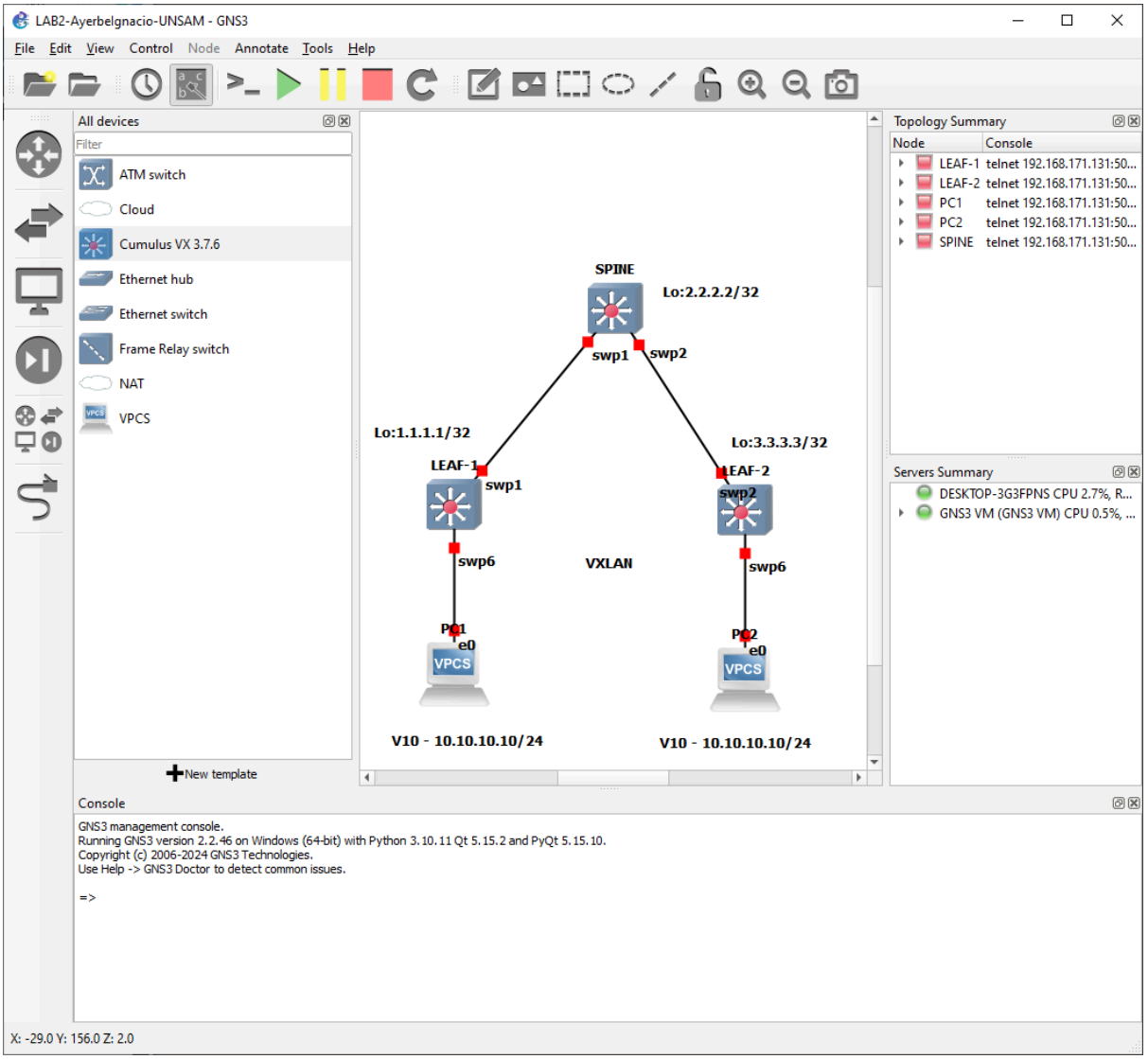
Ahora agregamos una PC (host) para cada LEAF, escogiendo el server VM.






LAB2-Ayerbelgnacio-UNSAM - GNS3
File Edit View Control Node Annotate Tools Help
End devices
Filter
Cloud
NAT
VPCS
New template
Topology Summary
Node Console
LEAF-1 telnet 192.168.171.131:50...
LEAF-2 telnet 192.168.171.131:50...
PC1 telnet 192.168.171.131:50...
PC2 telnet 192.168.171.131:50...
SPINE telnet 192.168.171.131:50...
Servers Summary
DESKTOP-3G3FPNS CPU 2.4%, R...
GNS3 VM (GNS3 VM) CPU 0.5%, ...
SPINE
Lo:2.2.2.2/32
swp1
swp2
Lo:1.1.1.1/32
Lo:3.3.3.3/32
LEAF-1
swp1
LEAF-2
swp2
swp6
swp6
PC1
e0
VPCS
PC2
e0
VPCS
Console
GNS3 management console.
Running GNS3 version 2.2.46 on Windows (64-bit) with Python 3.10.11 Qt 5.15.2 and PyQt 5.15.10.
Copyright (c) 2006-2024 GNS3 Technologies.
Use Help -> GNS3 Doctor to detect common issues.
=>
X: 89.0 Y: 246.0 Z: 1.0

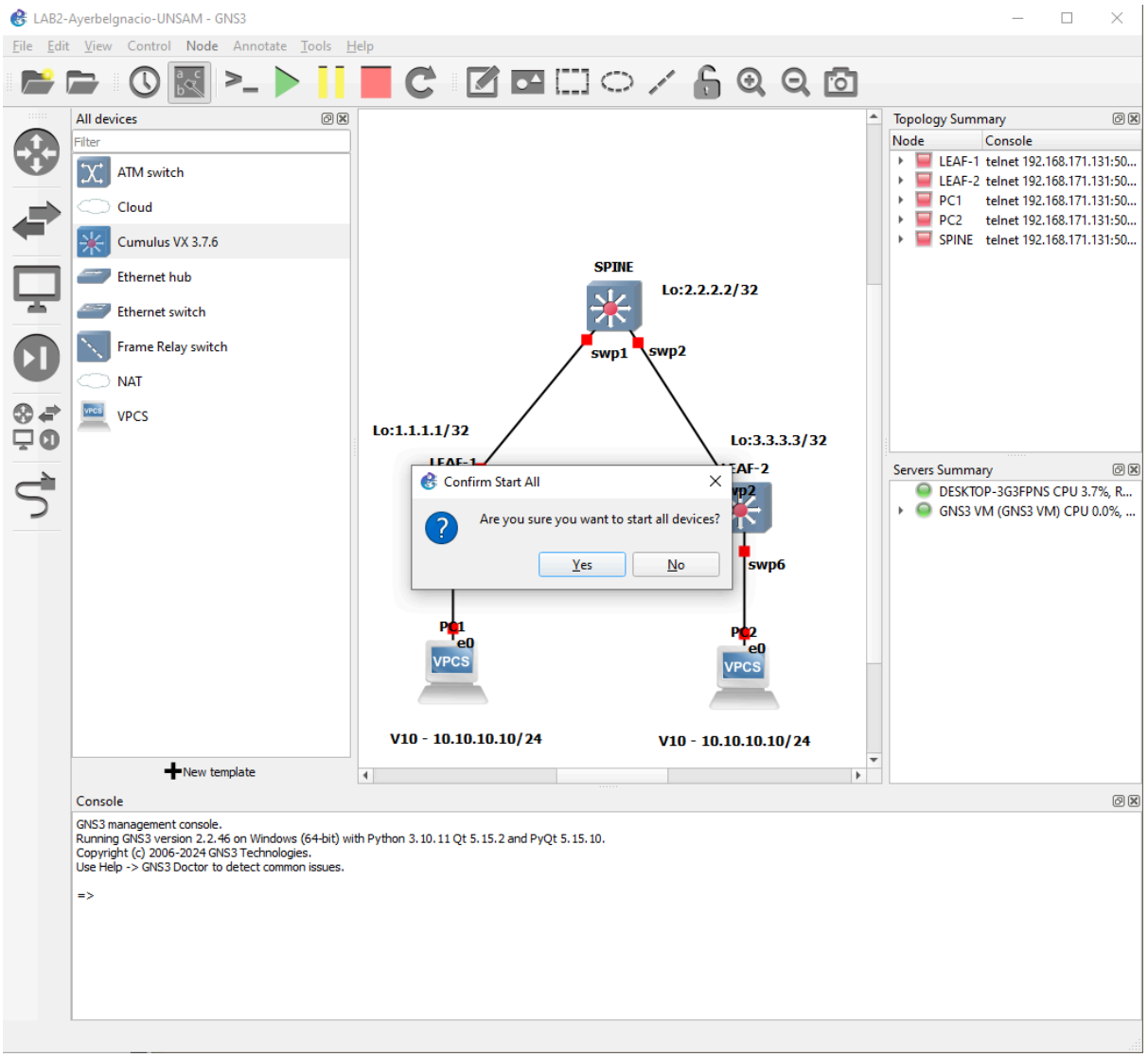
Agregamos la información de la VLAN que pertenece y la dirección IP.

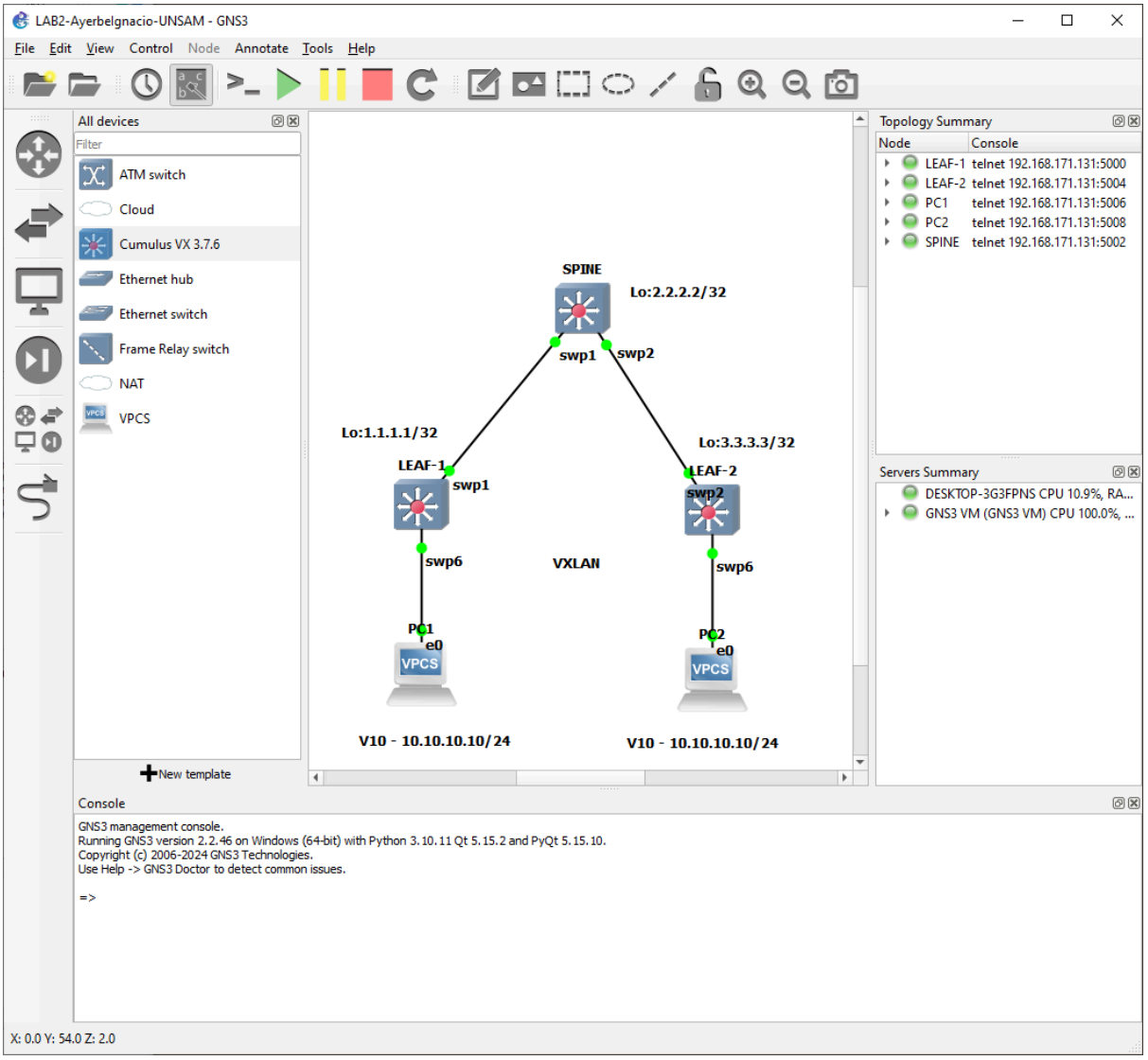


Hasta ahora tenemos 3 Switches, que 2 se conectan al SPINE y a su vez esos 2 switches tiene un host cada uno conectado. Tenemos todo el diagrama hecho pero nos falta conectar los elementos entre sí, con sus direcciones IP y VLANs.

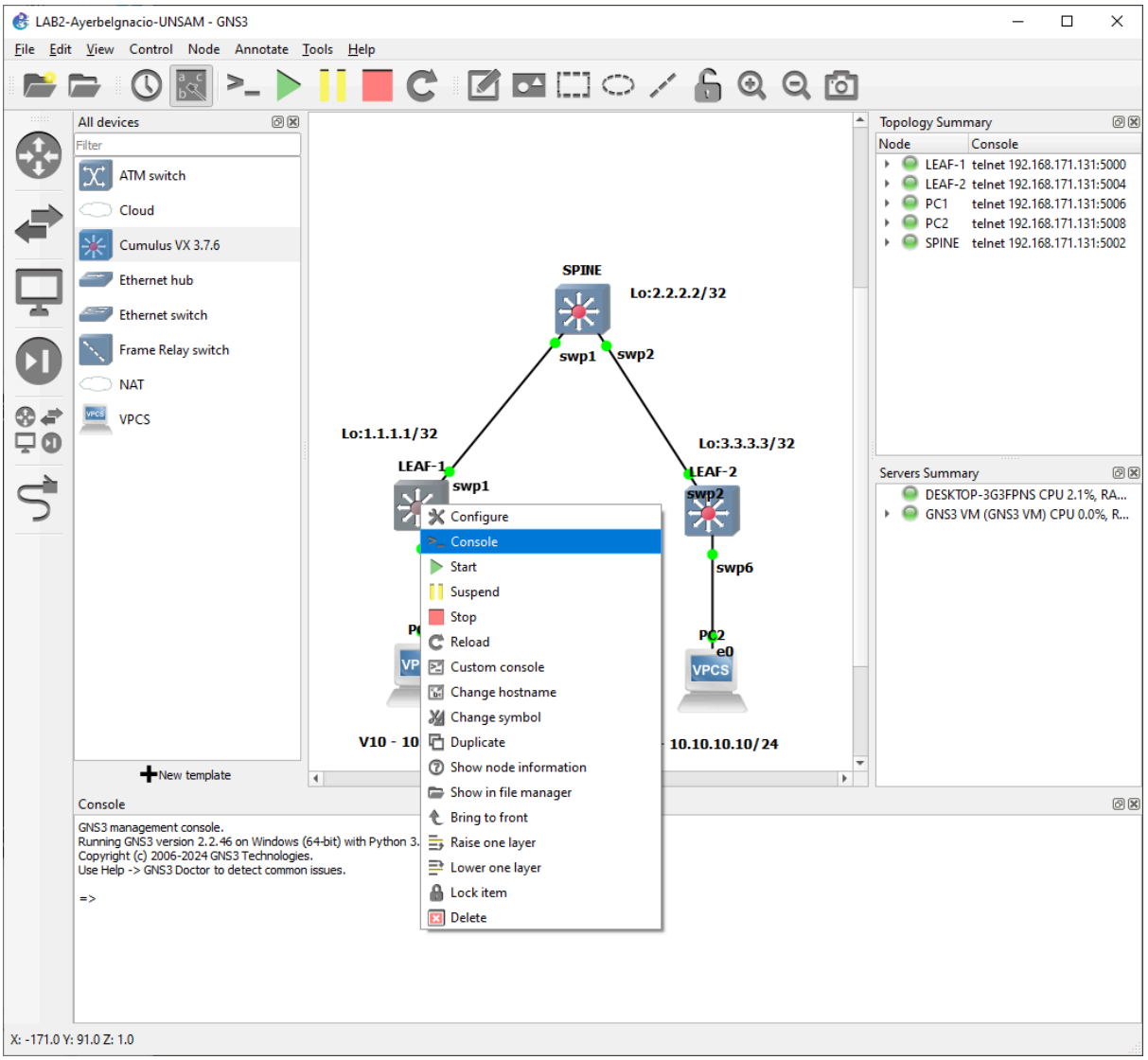
ANEXO B

Ahora encendemos los equipos con el botón Play

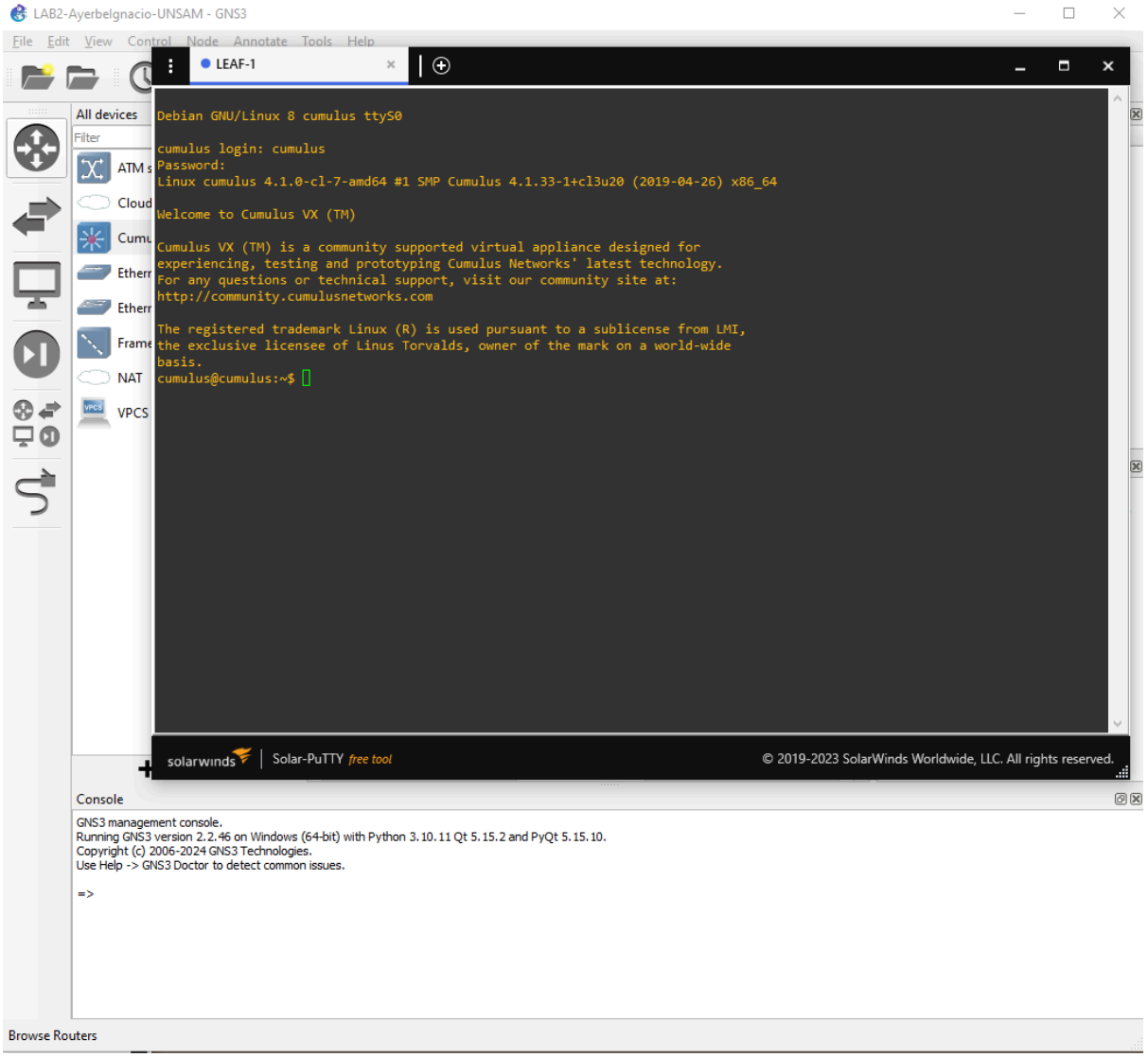



LAB2-Ayerbelgnacio-UNSAM - GNS3
File Edit View Control Node Annotate Tools Help
All devices
Filter
ATM switch
Cloud
Cumulus VX 3.7.6
Ethernet hub
Ethernet switch
Frame Relay switch
NAT
VPCS
New template
SPINE
Lo:2.2.2.2/32
swp1
swp2
Lo:1.1.1.1/32
Lo:3.3.3.3/32
LEAF-1
swp1
LEAF-2
swp2
swp6
VXLAN
swp6
PC1
e0
VPCS
PC2
e0
VPCS
V10 - 10.10.10.10/24
V10 - 10.10.10.10/24
Topology Summary
Node
Console
LEAF-1 telnet 192.168.171.131:5000
LEAF-2 telnet 192.168.171.131:5004
PC1 telnet 192.168.171.131:5006
PC2 telnet 192.168.171.131:5008
SPINE telnet 192.168.171.131:5002
Servers Summary
DESKTOP-3G3FPNS CPU 10.9%, RA...
GNS3 VM (GNS3 VM) CPU 100.0%, ...
Console
GNS3 management console.
Running GNS3 version 2.2.46 on Windows (64-bit) with Python 3.10.11 Qt 5.15.2 and PyQt 5.15.10.
Copyright (c) 2006-2024 GNS3 Technologies.
Use Help -> GNS3 Doctor to detect common issues.
=>
X: 0.0 Y: 54.0 Z: 2.0

Ahora procedemos a configurar las interfaces físicas y Loopbacks de cada equipo:
Empezamos por LEAF-1, doy click derecho y selecciono la consola.



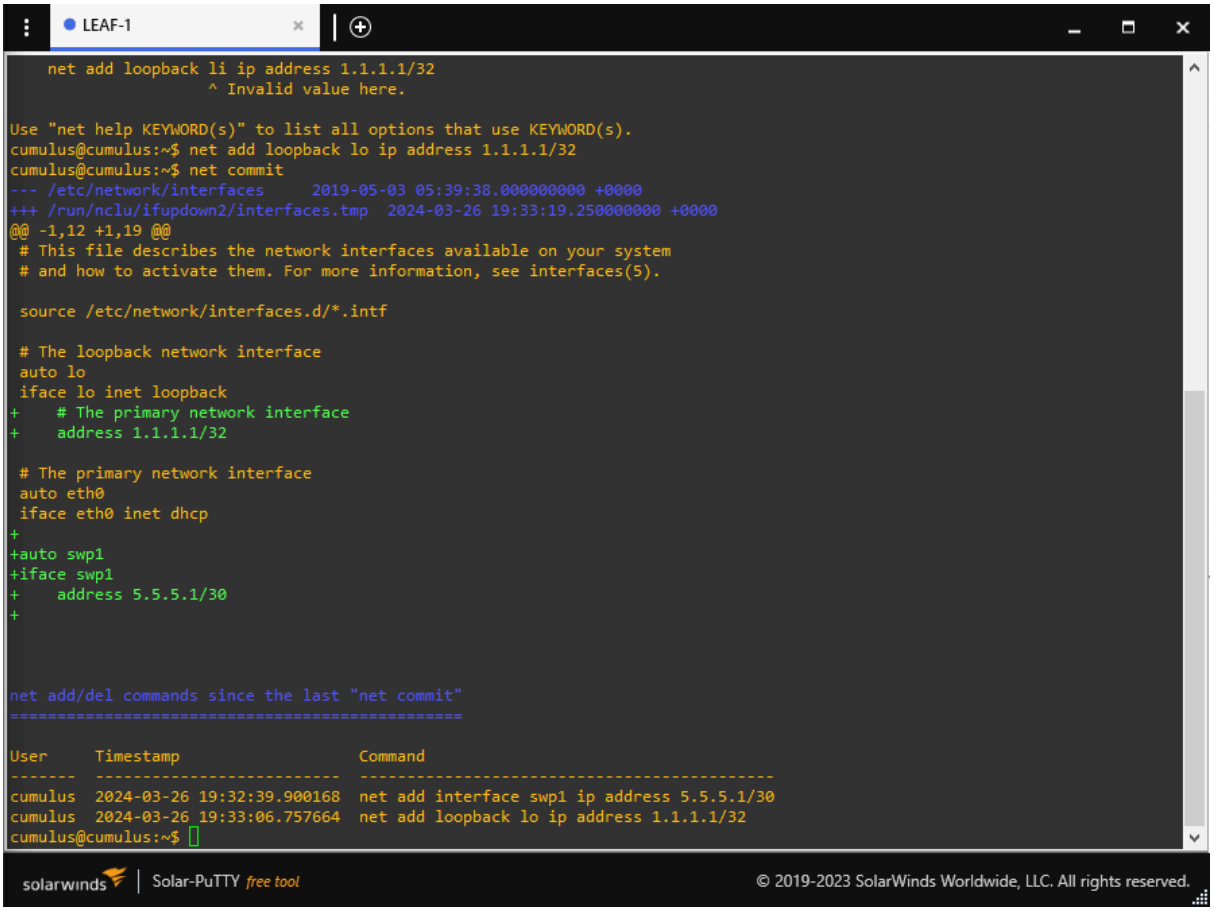
Ingresamos Usuario (cumulus) y contraseña (CumulusLinux!)



Configuramos las interfaces físicas:

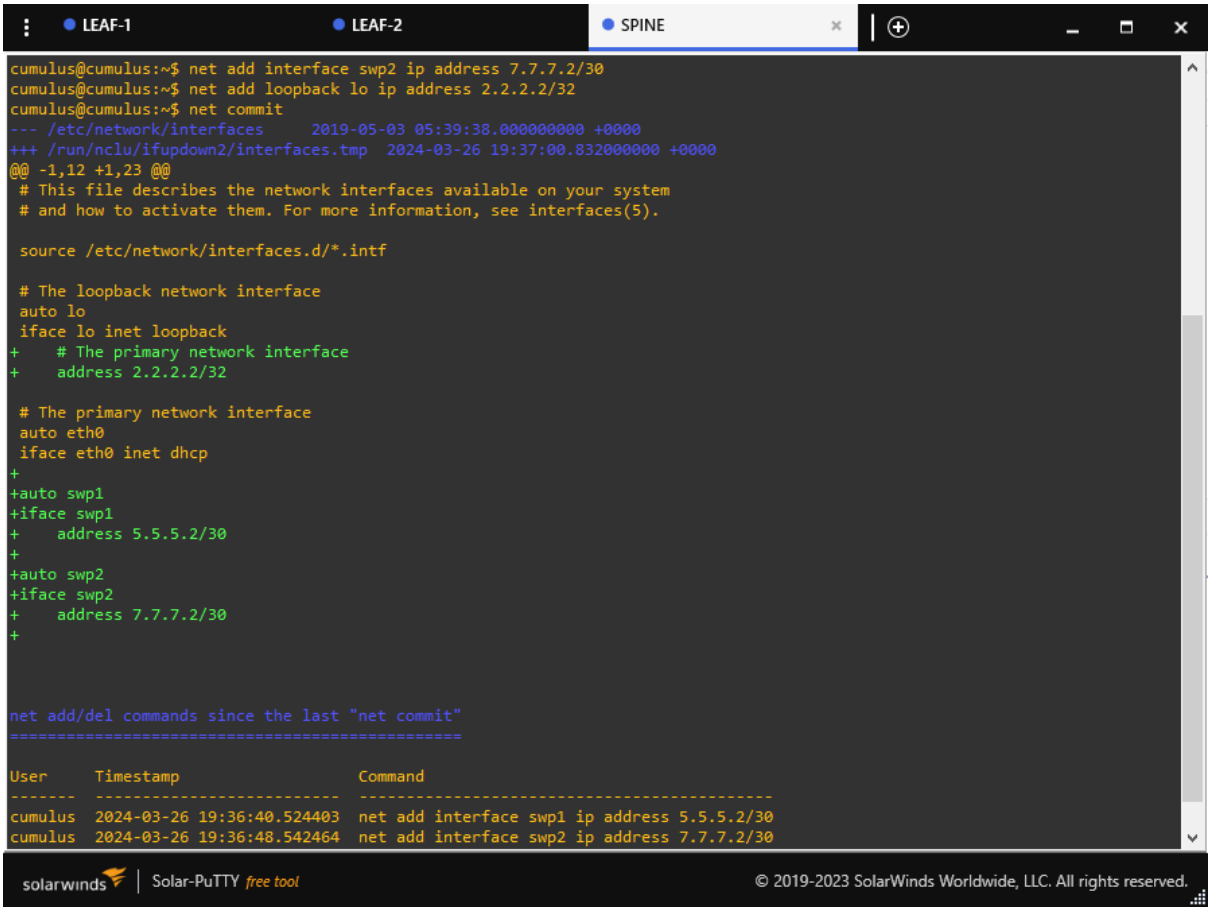
- swp1: 5.5.5.1/30
- Loopback: 1.1.1.1/32

A lo ultimo de cada configuración de cada dispositivo hacemos un net commit, para poder guardar los cambios hechos.



En LEAF-2 configuramos:

- swp2: 7.7.7.1/30
- Loopback 3.3.3.3/32


LEAF-1
LEAF-2
SPINE
cumulus@cumulus:~$ net add interface swp2 ip address 7.7.7.2/30
cumulus@cumulus:~$ net add loopback lo ip address 2.2.2.2/32
cumulus@cumulus:~$ net commit
--- /etc/network/interfaces 2019-05-03 05:39:38.000000000 +0000
+++ /run/nclu/ifupdown2/interfaces.tmp 2024-03-26 19:37:00.832000000 +0000
@@ -1,12 +1,23 @@
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).
source /etc/network/interfaces.d/*.intf
The loopback network interface
auto lo
iface lo inet loopback
+ # The primary network interface
+ address 2.2.2.2/32
# The primary network interface
auto eth0
iface eth0 inet dhcp
+
+auto swp1
+iface swp1
+ address 5.5.5.2/30
+
+auto swp2
+iface swp2
+ address 7.7.7.2/30
+
net add/del commands since the last "net commit"
User Timestamp Command
cumulus 2024-03-26 19:36:40.524403 net add interface swp1 ip address 5.5.5.2/30
cumulus 2024-03-26 19:36:48.542464 net add interface swp2 ip address 7.7.7.2/30
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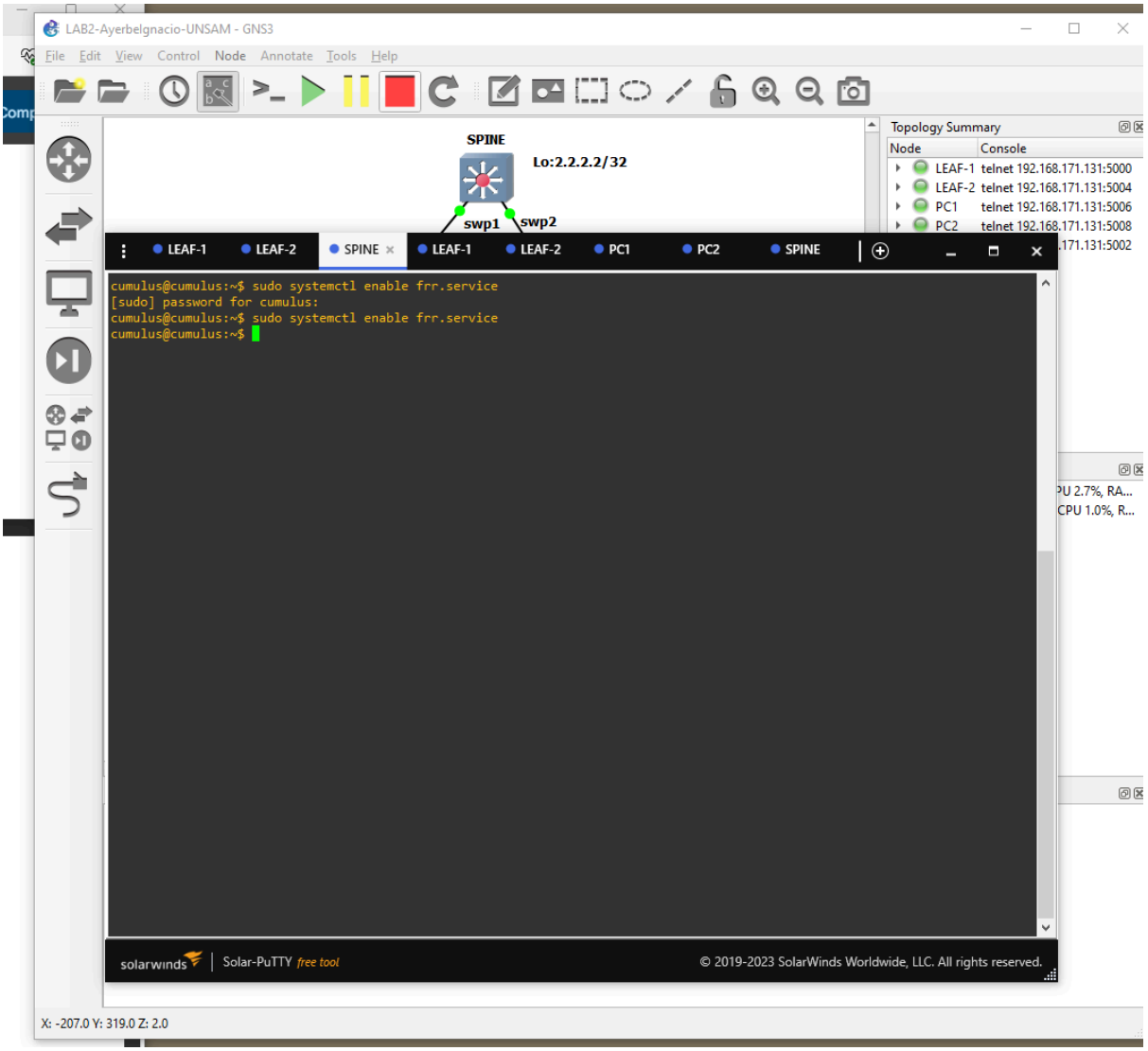
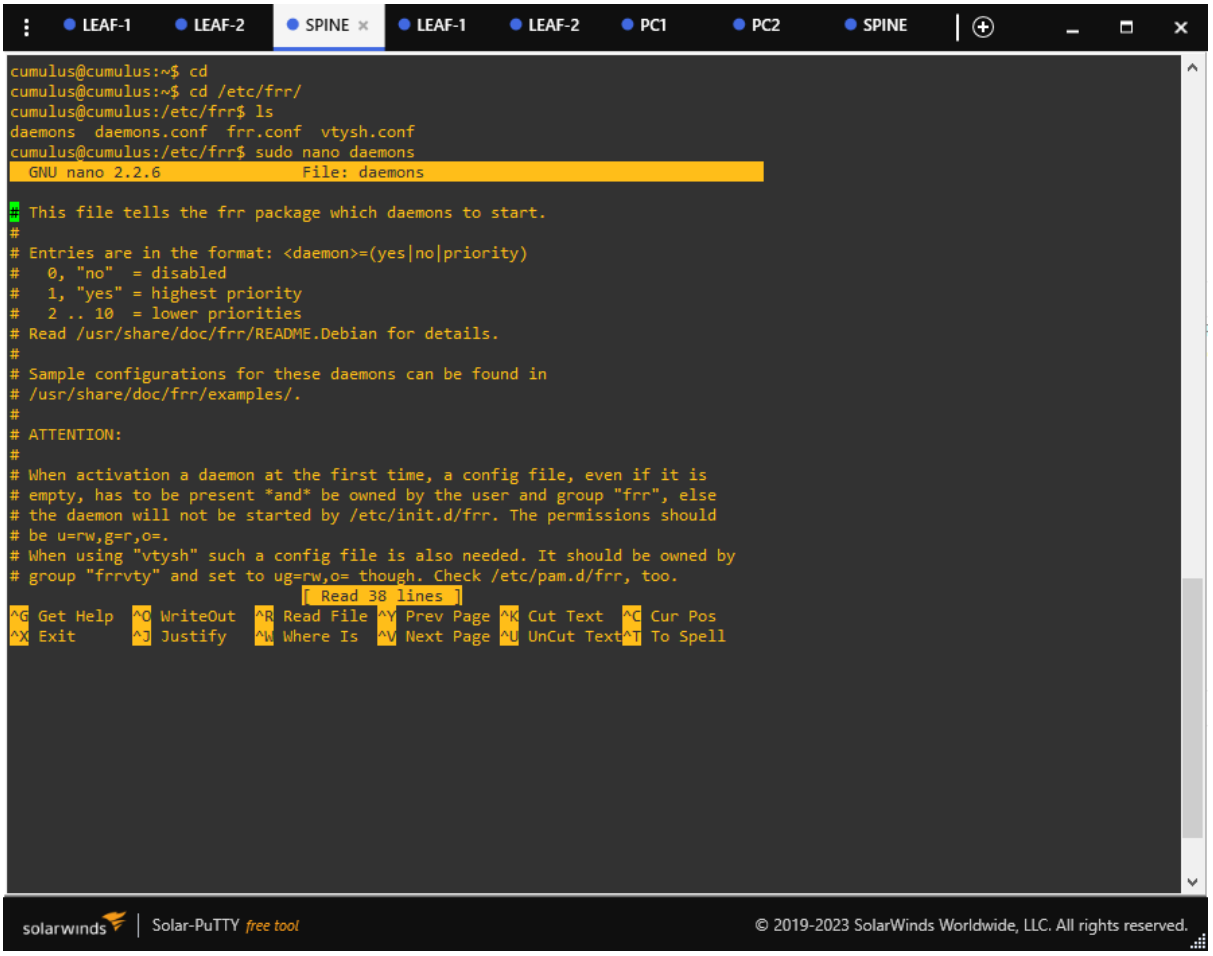
Y por último en SPINE, configuramos:

- • net add interface swp1 ip address 5.5.5.2/30
- • net add interface swp2 ip address 7.7.7.2/30
- • net add loopback lo ip address 2.2.2.2/32



Configuracion de OSPF, para que OSPF funcione correctamente, es necesario que ciertos servicios esten corriendo en Cumulus Linux, entre ellos FRR:
Para eso ejecutamos:

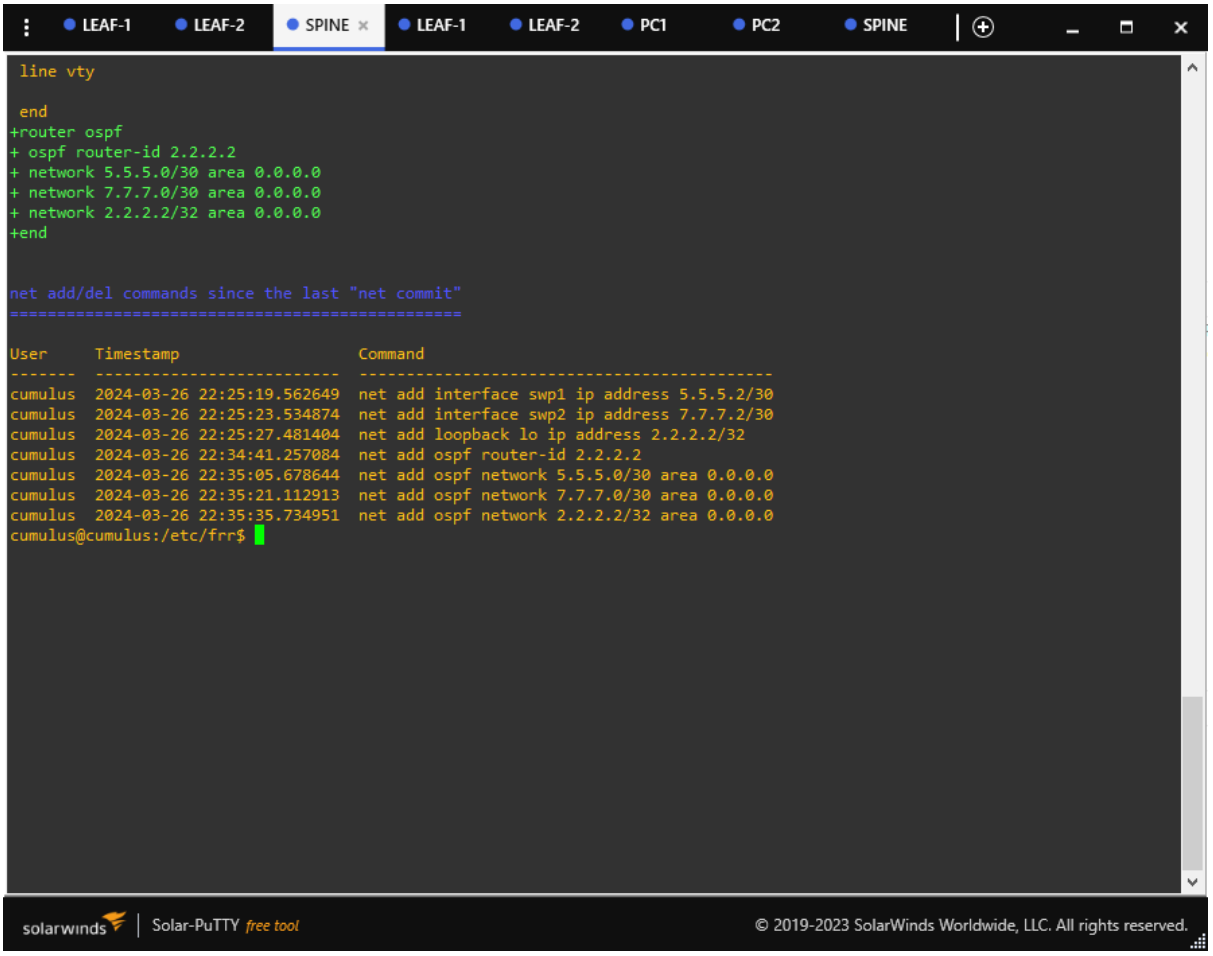
- sudo systemctl enable frr.service (nos va a pedir la password ya que accedemos al root)
- cd /etc/frr (direccionamiento a carpeta)
- ls (para listar)
- sudo nano daemon (para editar el archivo ‘daemon)



Cuando abre el archivo, habilitamos las casillas de ‘zebra’ y ‘ospfd’.

por ultimo reseteamos el servicio:

Configuramos el OSPF en SPINE:


LEAF-1
LEAF-2
SPINE
LEAF-1
LEAF-2
PC1
PC2
SPINE
line vty
end
+router ospf
+ ospf router-id 2.2.2.2
+ network 5.5.5.0/30 area 0.0.0.0
+ network 7.7.7.0/30 area 0.0.0.0
+ network 2.2.2.2/32 area 0.0.0.0
+end
net add/del commands since the last "net commit"
User Timestamp Command
cumulus 2024-03-26 22:25:19.562649 net add interface swp1 ip address 5.5.5.2/30
cumulus 2024-03-26 22:25:23.534874 net add interface swp2 ip address 7.7.7.2/30
cumulus 2024-03-26 22:25:27.481404 net add loopback lo ip address 2.2.2.2/32
cumulus 2024-03-26 22:34:41.257084 net add ospf router-id 2.2.2.2
cumulus 2024-03-26 22:35:05.678644 net add ospf network 5.5.5.0/30 area 0.0.0.0
cumulus 2024-03-26 22:35:21.112913 net add ospf network 7.7.7.0/30 area 0.0.0.0
cumulus 2024-03-26 22:35:35.734951 net add ospf network 2.2.2.2/32 area 0.0.0.0
cumulus@cumulus:/etc/frr$
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En LEAF-1:


LEAF-1
LEAF-2
SPINE
LEAF-1
LEAF-2
PC1
PC2
SPINE
cumulus@cumulus:~$ net add ospf router-id 1.1.1.1
cumulus@cumulus:~$ net add ospf network 5.5.5.0/30 area 0.0.0.0
cumulus@cumulus:~$ net add ospf network 1.1.1.1/32 area 0.0.0.0
cumulus@cumulus:~$ net commit
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LEAF-1
LEAF-2
SPINE
LEAF-1
LEAF-2
PC1
PC2
SPINE
bgpd=no
-ospfd=no
+ospfd=yes
ospf6d=no
ripd=no
ripngd=no
isisd=no
pimd=no
ldpd=no
nhrpd=no
eigrpd=no
babeld=no
sharpd=no
--- /run/nclu/frr/frr.conf.scratchpad.baseline 2024-03-26 22:36:52.392000000 +0000
+++ /run/nclu/frr/frr.conf.scratchpad 2024-03-26 22:37:33.816000000 +0000
@@ -1,9 +1,14 @@
frr version 4.0+cl3u11
frr defaults datacenter
hostname cumulus
username cumulus nopassword
service integrated-vtysh-config
log syslog informational
line vty
end
+router ospf
+ ospf router-id 1.1.1.1
+ network 5.5.5.0/30 area 0.0.0.0
+ network 1.1.1.1/32 area 0.0.0.0
+end
net add/del commands since the last "net commit"
User Timestamp Command
cumulus 2024-03-26 22:36:52.393800 net add ospf router-id 1.1.1.1
cumulus 2024-03-26 22:37:18.869888 net add ospf network 5.5.5.0/30 area 0.0.0.0
cumulus 2024-03-26 22:37:33.816161 net add ospf network 1.1.1.1/32 area 0.0.0.0
cumulus@cumulus:~$
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Y en LEAF-2:


LEAF-1
LEAF-2
SPINE
LEAF-1
LEAF-2
PC1
PC2
SPINE
cumulus@cumulus:~$ net add ospf router-id 3.3.3.3
'router ospf' configuration already has 'ospf router-id 3.3.3.3'
cumulus@cumulus:~$ net add ospf network 7.7.7.0/30 area 0.0.0.0
cumulus@cumulus:~$ net add ospf network 3.3.3.3/32 area 0.0.0.0
cumulus@cumulus:~$ net commit
solarwinds
Solar-PuTTY free tool
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LEAF-1
LEAF-2
SPINE
LEAF-1
LEAF-2
PC1
PC2
SPINE
isisd=no
pimd=no
ldpd=no
nhrpd=no
eigrpd=no
babeld=no
sharpd=no
--- /run/nclu/frr/frr.conf.scratchpad.baseline 2024-03-26 22:38:55.572000000 +0000
+++ /run/nclu/frr/frr.conf.scratchpad 2024-03-26 22:40:23.961000000 +0000
@@ -1,9 +1,16 @@
frr version 4.0+cl3u11
frr defaults datacenter
hostname cumulus
username cumulus nopassword
service integrated-vtysh-config
log syslog informational
line vty
end
+router ospf
+ ospf router-id 1.1.1.1
+ ospf router-id 3.3.3.3
+ network 5.5.5.0/30 area 0.0.0.0
+ network 7.7.7.0/30 area 0.0.0.0
+ network 3.3.3.3/32 area 0.0.0.0
+end
net add/del commands since the last "net commit"
User Timestamp Command
cumulus 2024-03-26 22:38:55.574277 net add ospf router-id 1.1.1.1
cumulus 2024-03-26 22:39:05.722470 net add ospf router-id 3.3.3.3
cumulus 2024-03-26 22:39:11.456608 net add ospf router-id 3.3.3.3
cumulus 2024-03-26 22:39:32.109992 net add ospf network 5.5.5.0/30 area 0.0.0.0
cumulus 2024-03-26 22:39:44.058378 net add ospf router-id 3.3.3.3
cumulus 2024-03-26 22:40:12.648155 net add ospf network 7.7.7.0/30 area 0.0.0.0
cumulus 2024-03-26 22:40:23.961986 net add ospf network 3.3.3.3/32 area 0.0.0.0
cumulus@cumulus:~$
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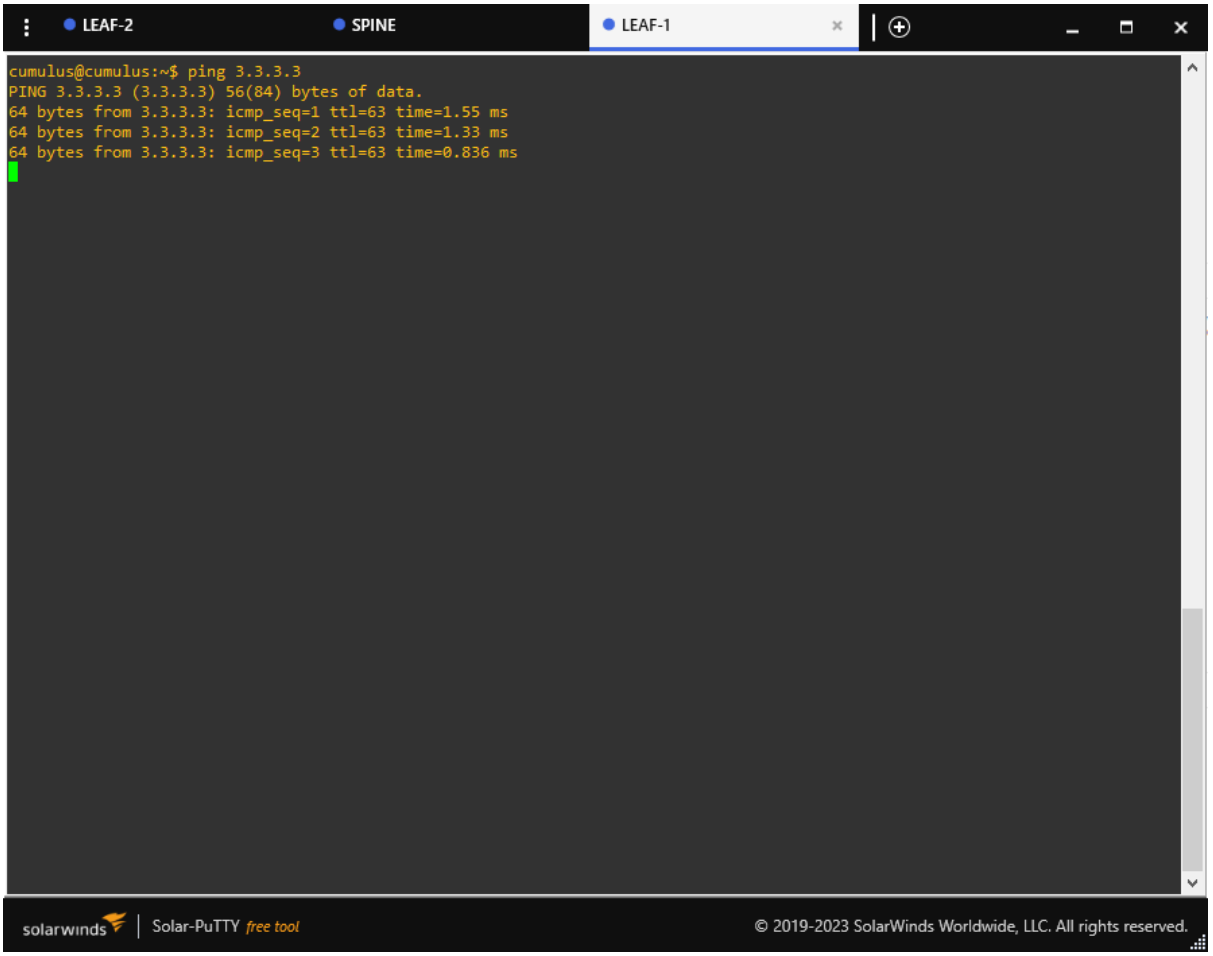
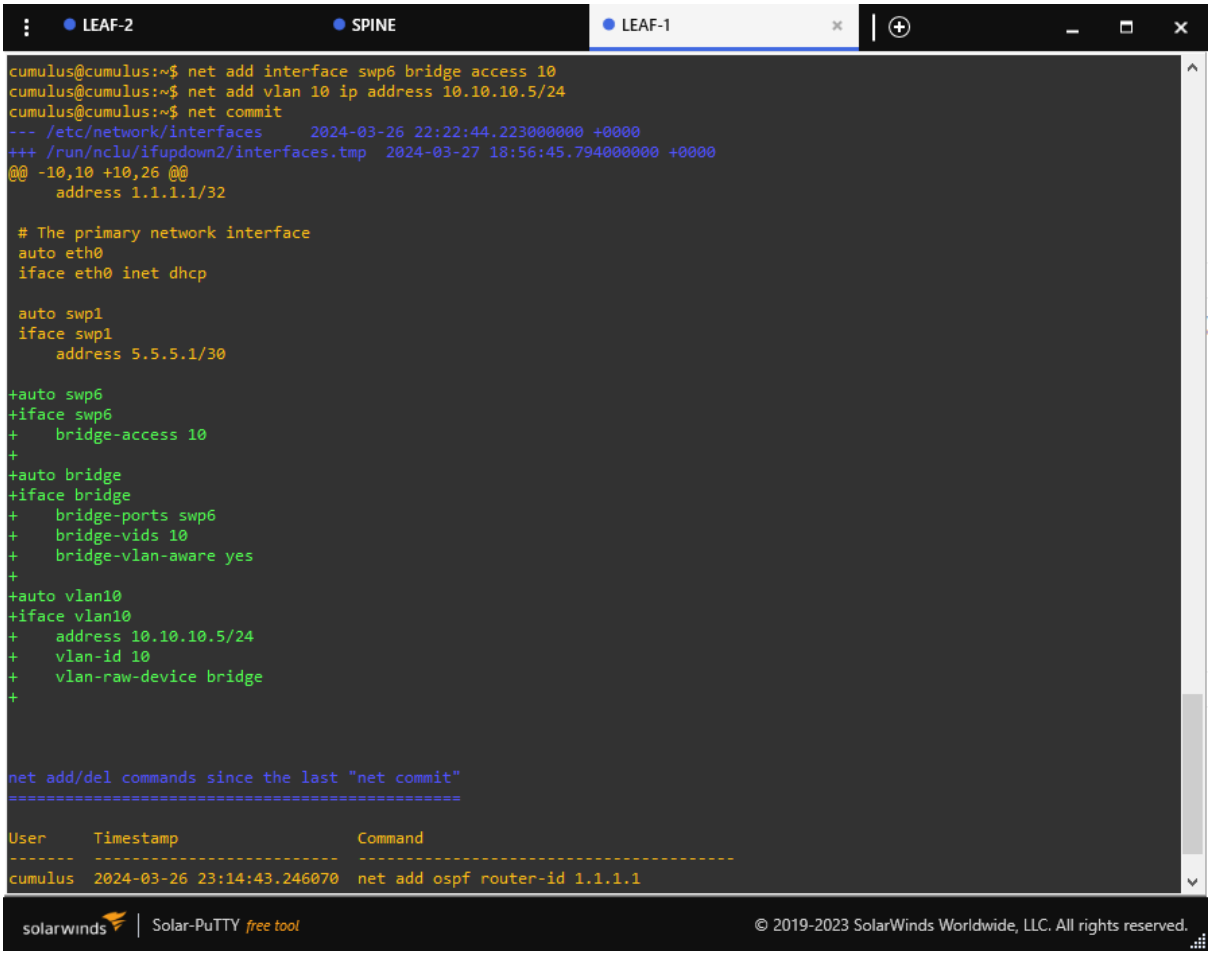
Ping to LEAF-2, desde LEAF-1, para comprobar que OSPF este funcionando.



Compruebo la tabla de enrutamiento haciendo: - sudo vtysh y -show ip route

Configurando VLANs:
LEAF-1



LEAF-2:


LEAF-2
SPINE
LEAF-1
cumulus@cumulus:~$ clear
cumulus@cumulus:~$ net add interface swp6 bridge access 10
cumulus@cumulus:~$ net add vlan 10 ip address 10.10.10.7/24
cumulus@cumulus:~$ net commit
--- /etc/network/interfaces 2024-03-26 22:24:35.501000000 +0000
+++ /run/nclu/ifupdown2/interfaces.tmp 2024-03-27 18:58:00.090000000 +0000
@@ -14,10 +14,26 @@
iface eth0 inet dhcp
auto swp1
iface swp1
address 7.7.7.1/30
auto swp2
iface swp2
address 7.7.7.1/30
+auto swp6
+iface swp6
+ bridge-access 10
+
+auto bridge
+iface bridge
+ bridge-ports swp6
+ bridge-vids 10
+ bridge-vlan-aware yes
+
+auto vlan10
+iface vlan10
+ address 10.10.10.7/24
+ vlan-id 10
+ vlan-raw-device bridge
+
net add/del commands since the last "net commit"
User Timestamp Command
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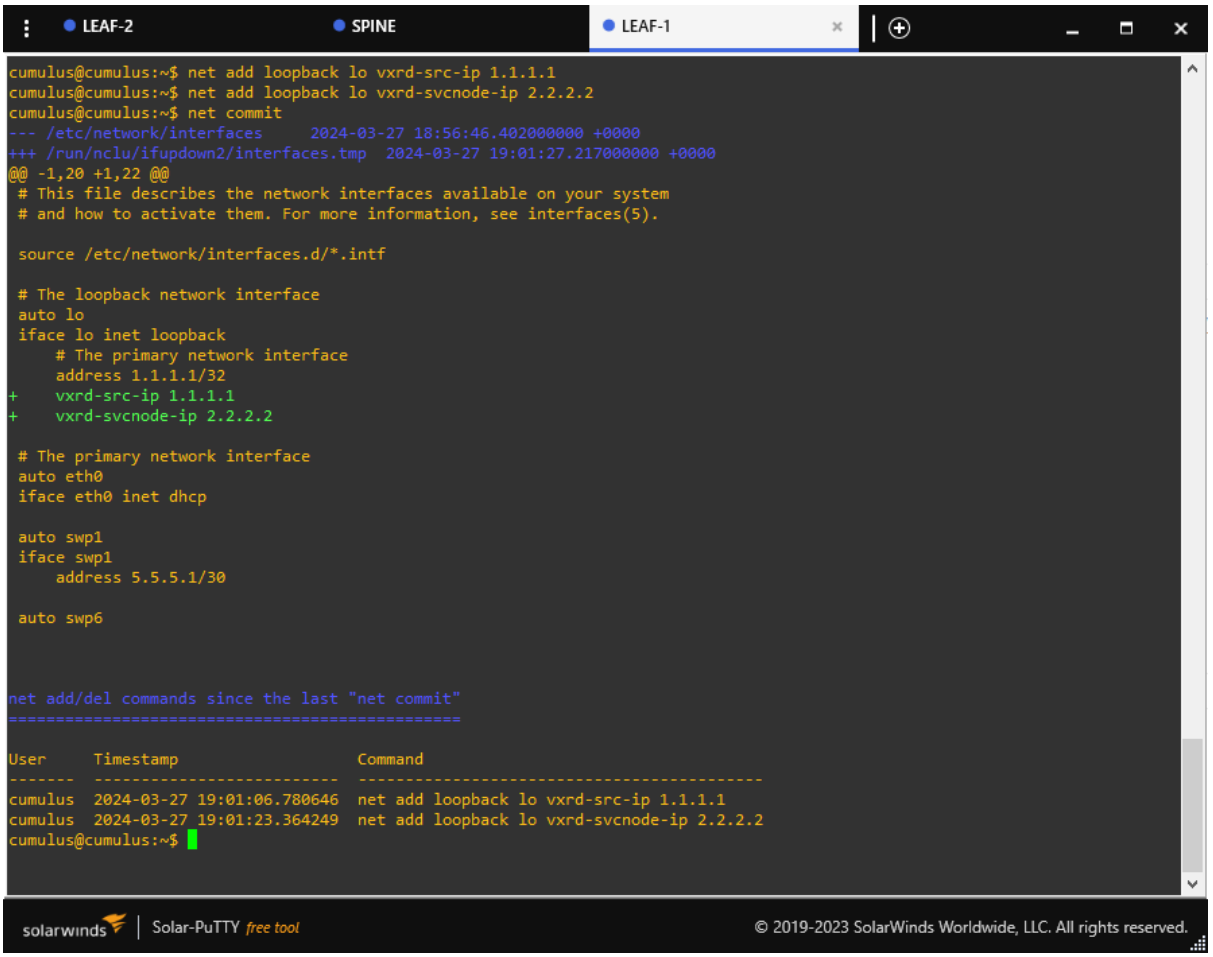
Para que VXLAN LNV (técnica para implementar VLAN sin controlador central) funcione, vxrd tiene que estar corriendo en todos los equipos, hacemos:

- sudo systemct1 start vxrd.service
- sudo systemct1 status vxrd.service

Configuración de Service Node Functionality en SPINE:

En LEAF-1:


LEAF-2
SPINE
LEAF-1
cumulus@cumulus:~$ net add loopback lo vxrd-src-ip 1.1.1.1
cumulus@cumulus:~$ net add loopback lo vxrd-svcnode-ip 2.2.2.2
cumulus@cumulus:~$ net commit
--- /etc/network/interfaces 2024-03-27 18:56:46.402000000 +0000
+++ /run/nclu/ifupdown2/interfaces.tmp 2024-03-27 19:01:27.217000000 +0000
@@ -1,20 +1,22 @@
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).
source /etc/network/interfaces.d/*.intf
The loopback network interface
auto lo
iface lo inet loopback
The primary network interface
address 1.1.1.1/32
+ vxrd-src-ip 1.1.1.1
+ vxrd-svcnode-ip 2.2.2.2
# The primary network interface
auto eth0
iface eth0 inet dhcp
auto swp1
iface swp1
address 5.5.5.1/30
auto swp6
net add/del commands since the last "net commit"
User Timestamp Command
cumulus 2024-03-27 19:01:06.780646 net add loopback lo vxrd-src-ip 1.1.1.1
cumulus 2024-03-27 19:01:23.364249 net add loopback lo vxrd-svcnode-ip 2.2.2.2
cumulus@cumulus:~$
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En LEAF-2:


LEAF-2
SPINE
LEAF-1
cumulus@cumulus:~$ net add loopback lo vxrd-src-ip 3.3.3.3
cumulus@cumulus:~$ net add loopback lo vxrd-svcnode-ip 2.2.2.2
cumulus@cumulus:~$ net commit
--- /etc/network/interfaces 2024-03-27 18:58:00.452000000 +0000
+++ /run/nclu/ifupdown2/interfaces.tmp 2024-03-27 19:02:21.088000000 +0000
@@ -1,20 +1,22 @@
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).
source /etc/network/interfaces.d/*.intf
The loopback network interface
auto lo
iface lo inet loopback
The primary network interface
address 3.3.3.3/32
+ vxrd-src-ip 3.3.3.3
+ vxrd-svcnode-ip 2.2.2.2
# The primary network interface
auto eth0
iface eth0 inet dhcp
auto swp1
iface swp1
address 7.7.7.1/30
auto swp2
net add/del commands since the last "net commit"
User Timestamp Command
cumulus 2024-03-27 19:02:02.700543 net add loopback lo vxrd-src-ip 3.3.3.3
cumulus 2024-03-27 19:02:17.756380 net add loopback lo vxrd-svcnode-ip 2.2.2.2
cumulus@cumulus:~$
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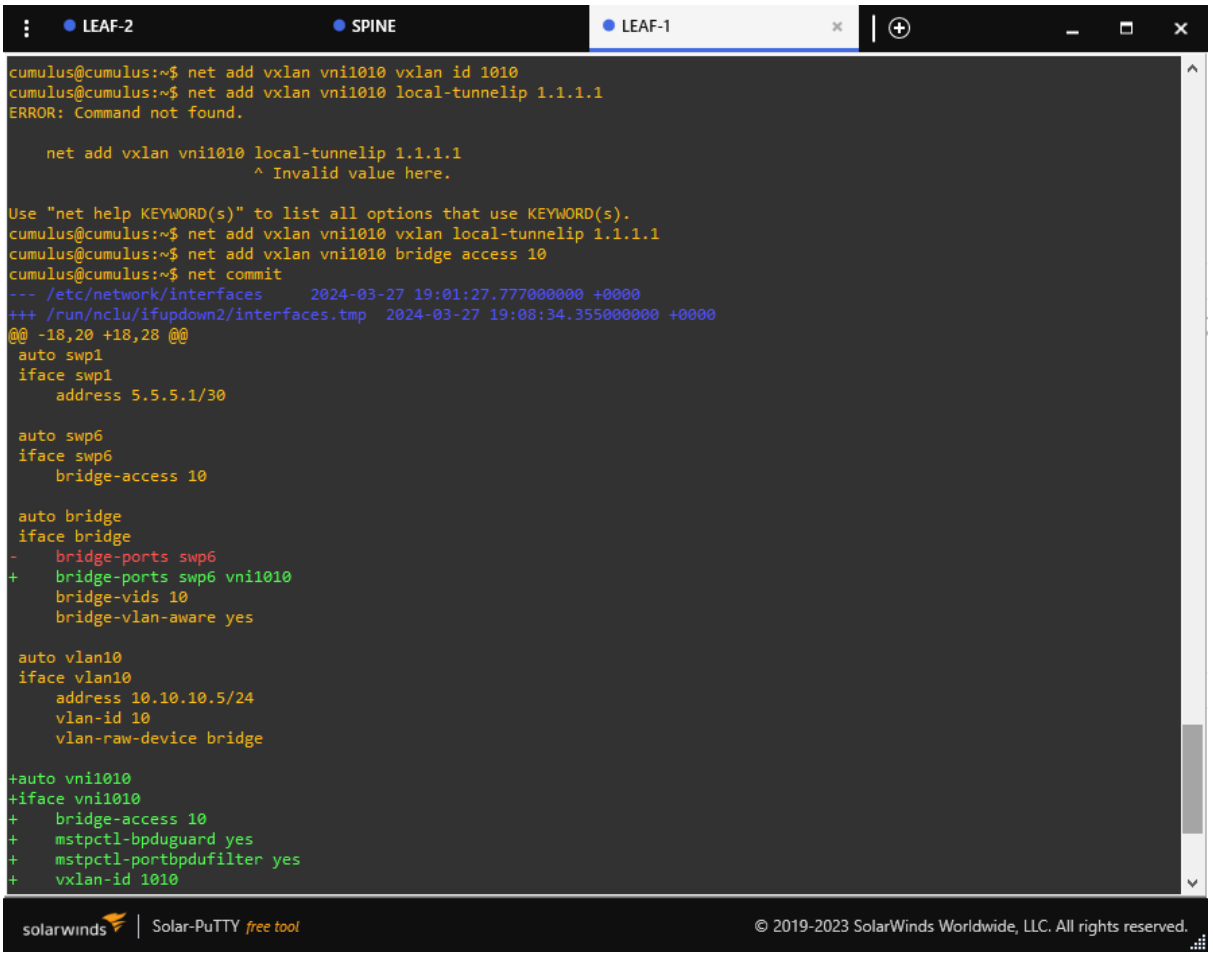
Mapeo VLAN-VXLAN en VTEP: Configuración de la VLAN 10 para vincularse con el VNID 1010.

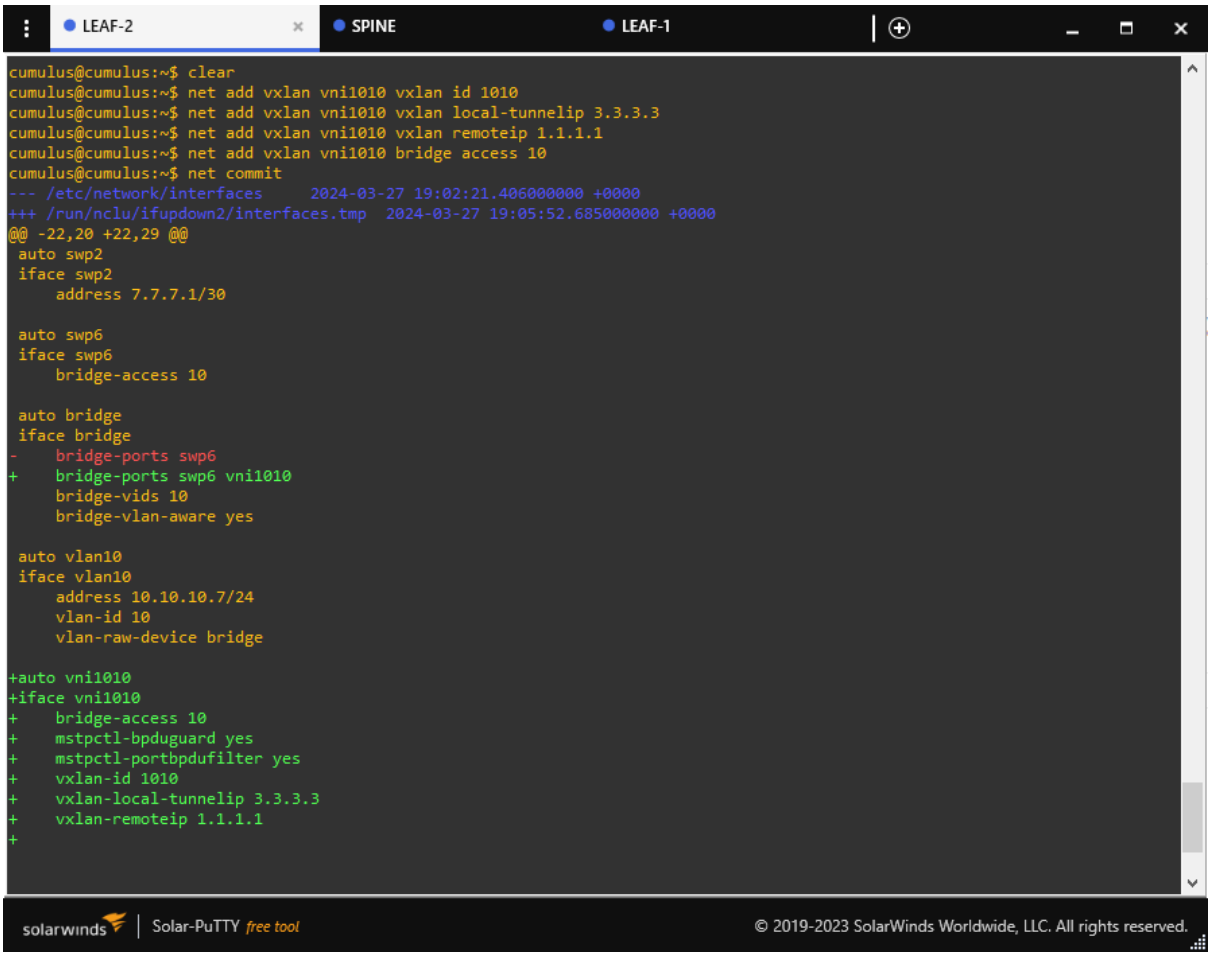
Explicación:

Los VTEP son como los “guardianes” que traducen entre las VLAN y las VXLAN. Configuramos una tabla que dice: “La VLAN 10 se traduce al VNID 1010”. Así, los datos de la VLAN 10 pueden viajar por la red VXLAN usando ese VNID.

En LEAF-1:



En LEAF-2:


LEAF-2
SPINE
LEAF-1
cumulus@cumulus:~$ clear
cumulus@cumulus:~$ net add vxlan vni1010 vxlan id 1010
cumulus@cumulus:~$ net add vxlan vni1010 vxlan local-tunnelip 3.3.3.3
cumulus@cumulus:~$ net add vxlan vni1010 vxlan remoteip 1.1.1.1
cumulus@cumulus:~$ net add vxlan vni1010 bridge access 10
cumulus@cumulus:~$ net commit
--- /etc/network/interfaces 2024-03-27 19:02:21.406000000 +0000
+++ /run/nclu/ifupdown2/interfaces.tmp 2024-03-27 19:05:52.685000000 +0000
@@ -22,20 +22,29 @@
auto swp2
iface swp2
address 7.7.7.1/30
auto swp6
iface swp6
bridge-access 10
auto bridge
iface bridge
- bridge-ports swp6
+ bridge-ports swp6 vni1010
bridge-vids 10
bridge-vlan-aware yes
auto vlan10
iface vlan10
address 10.10.10.7/24
vlan-id 10
vlan-raw-device bridge
+auto vni1010
+iface vni1010
+ bridge-access 10
+ mstpctl-bpduguard yes
+ mstpctl-portbpdufilter yes
+ vxlan-id 1010
+ vxlan-local-tunnelip 3.3.3.3
+ vxlan-remoteip 1.1.1.1
+
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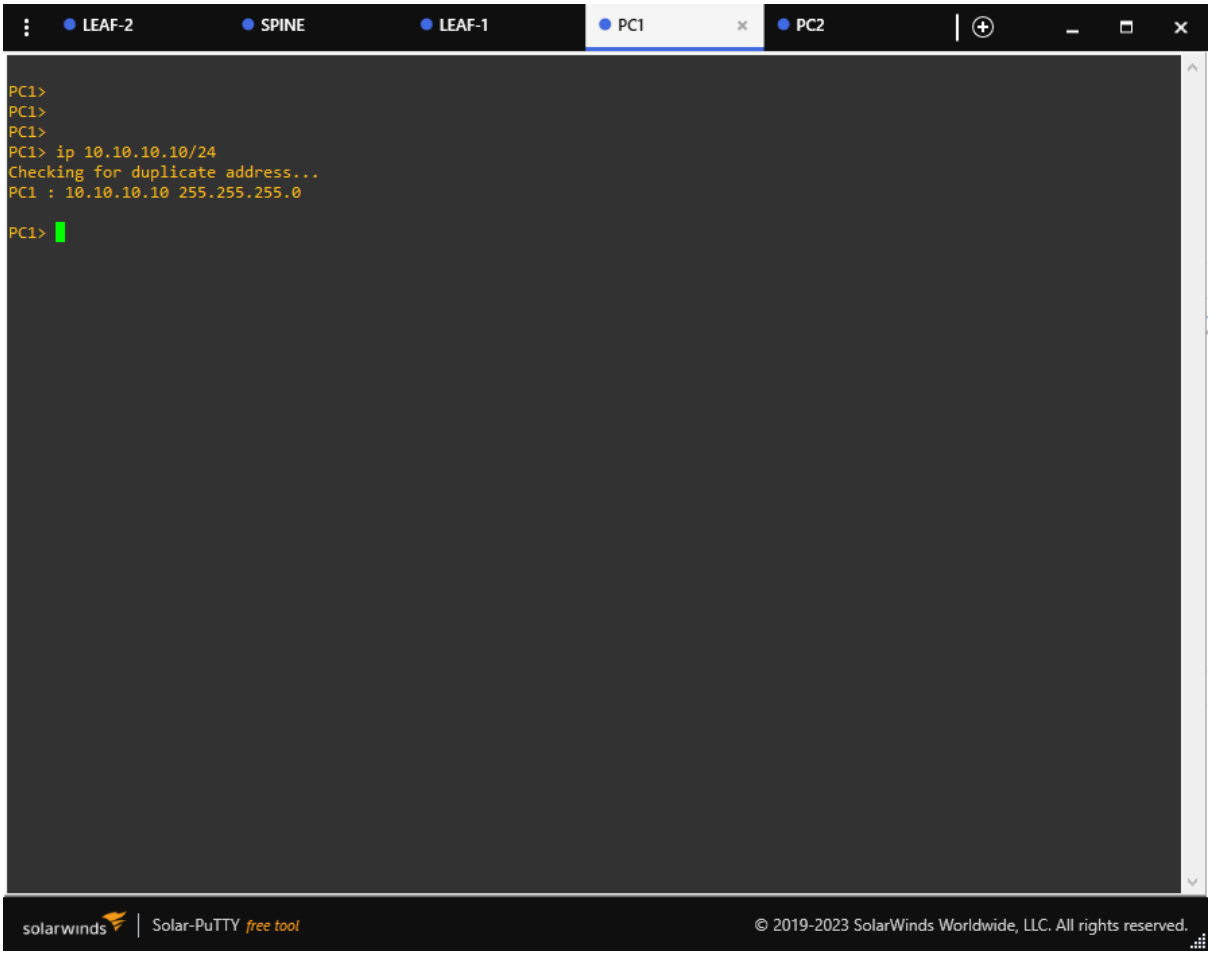
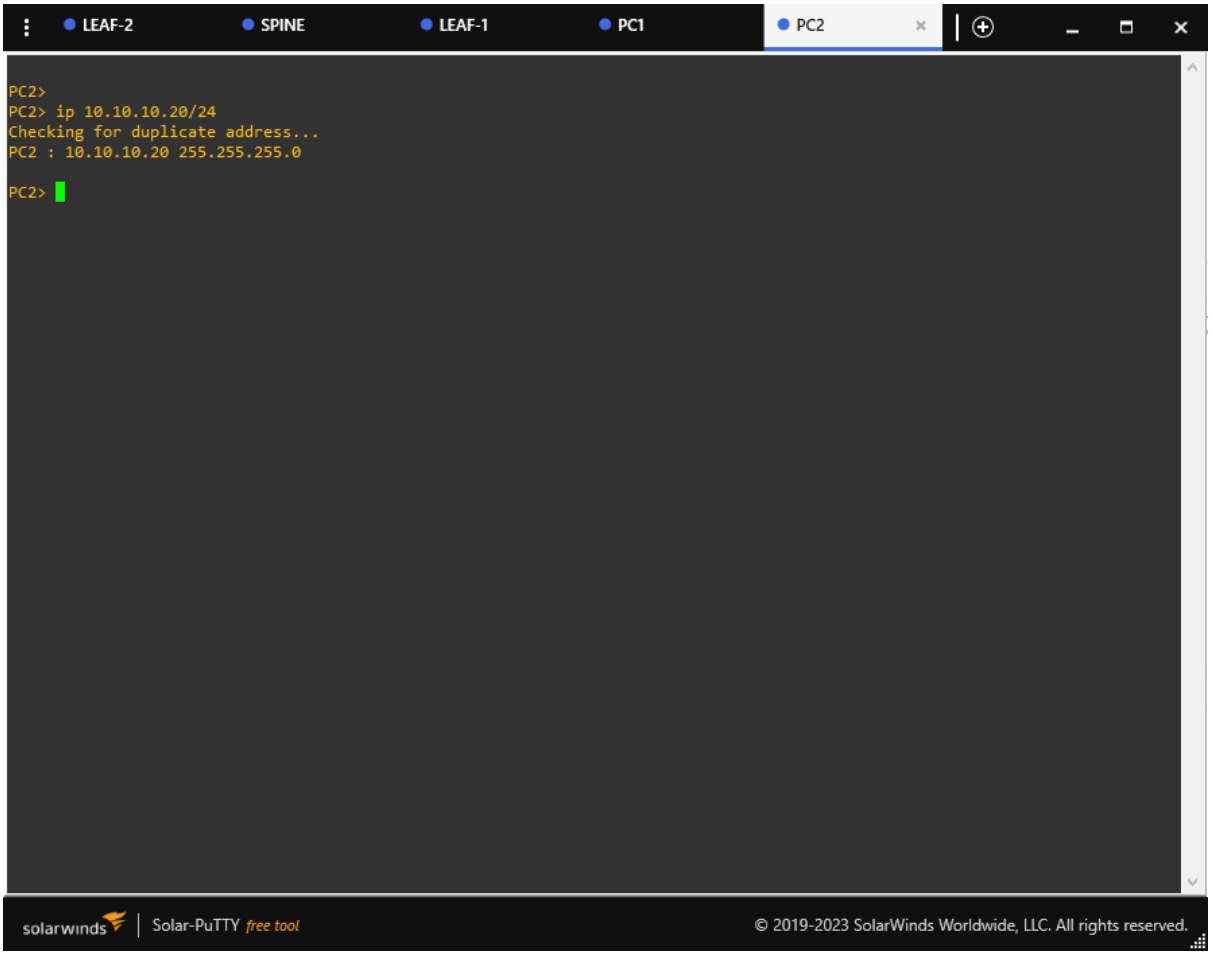
Comprobación de Conectividad de extremos a extremo:
Configuracion de vPC-1:
Vamos a la consola de la PC-1, y ejecutamos:

- ip 10.10.10.10/24



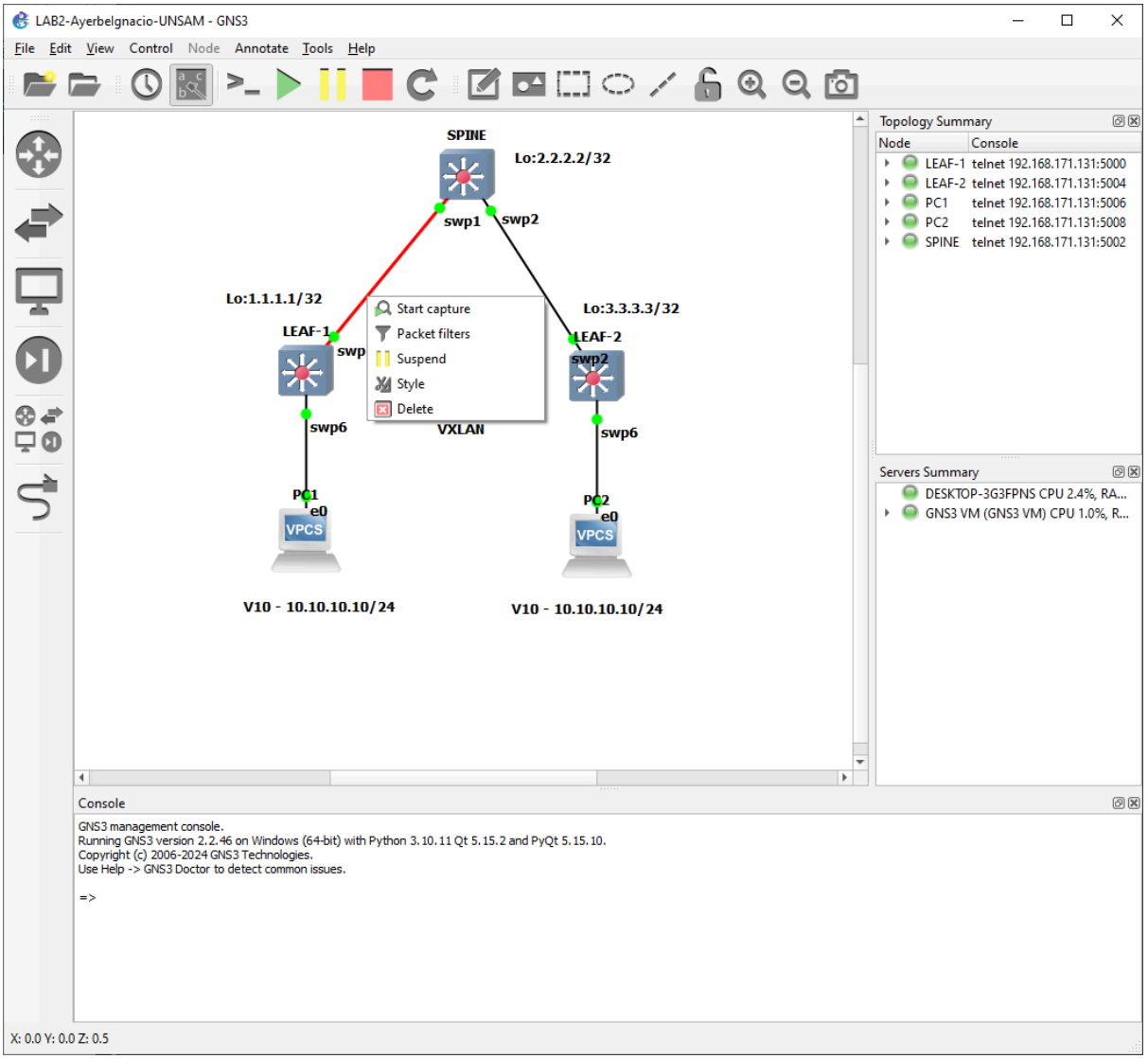
Lo mismo con la PC-2, pero ejecutamos:

- ip 10.10.10.20/24

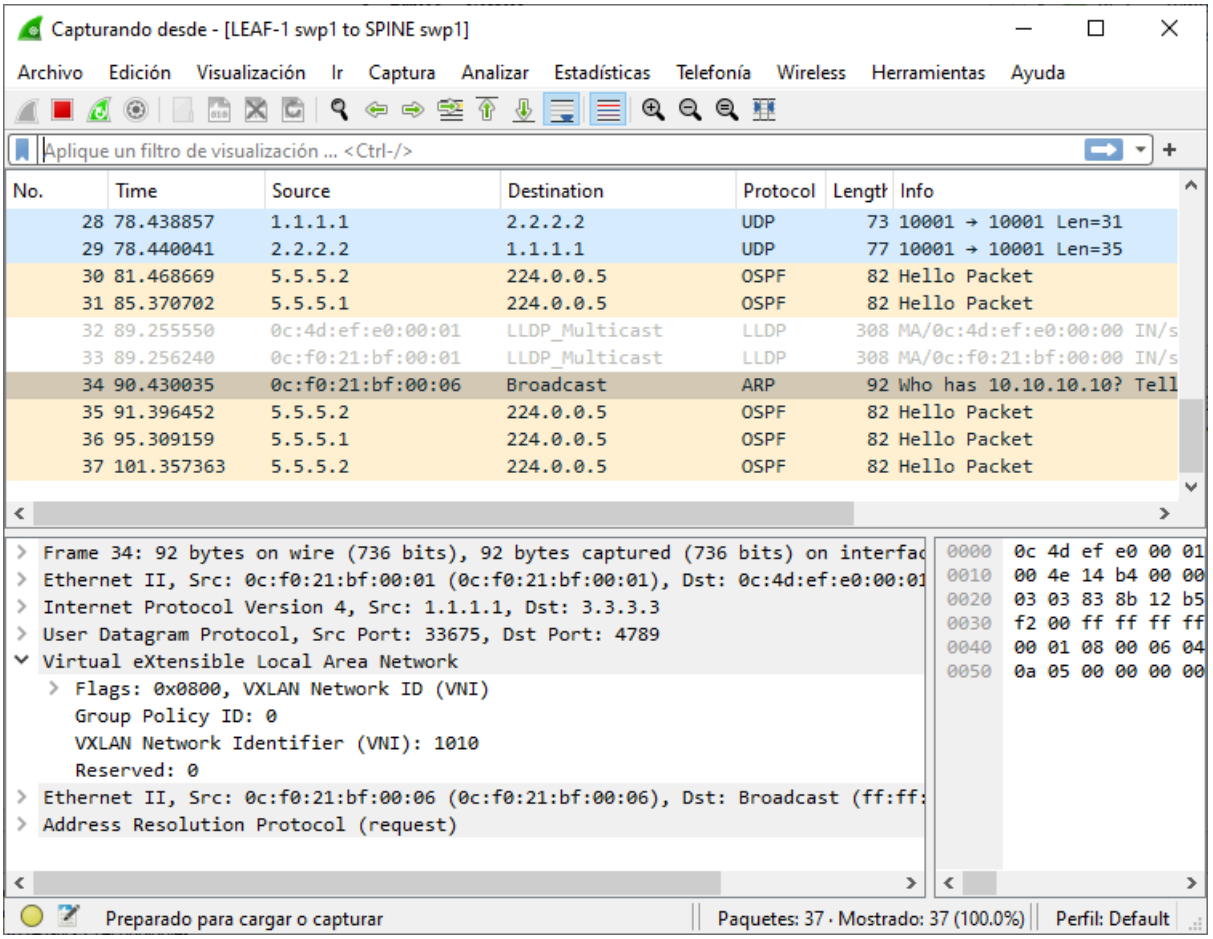


Lo que hicimos fue conectar las PCs entre sí dentro de la misma VLAN y bajo la misma subred IP. Ya que le estamos asignando la misma máscara subred de 24 bits (255.255.255.0), con diferentes direcciones IP cada una, les permite comunicarse entre sí.

Captura con Wireshark:
click secundario sobre el enlace que une a LEAF-1 y SPINE, y selecciono ‘Start Capture’



En las peticiones ARP o ICMP, se observa la encapsulación adicional de VXLAN con el VNID 1010



Se puede ver cada VTEP, en las direcciones MACs de LEAF-1, ejecutando:

- net show bridge macs

Esto nos muestra que, en el LEAF-1 se ha aprendido la MAC del LEAF-2, atreves de la VNI 1010, a pesar de estar en otro lugar físico y separado por diferentes IPs.