REDES DE COMUNICAÇÕES 2

INTRODUCTION TO GNS3

GNS3 Basic Configurations

Choose your operating system (Linux/MacOS/Windows), download/install GNS3 (version>1.3) and related software (Wireshark, VirtualBox and QEMU) and start GNS3.

1. At (Preferences-General), verify/setup all storing and program paths, avoiding paths with spaces and non ASCII characters.

2. At (Preferences-Server) enable **local server**, define **127.0.0.1** as host binding address.
Note: You do not need an external virtual machine (VM) to run emulation/simulation software. At (Preferences-GNS3 VM) disable the option "Enable the GNS3 VM".

3. Download the following routers' firmware: (i) Router 7200 Firmware 15.1(4) IOS Image, and (ii) Router 3725 Firmware 12.4(21) IOS Image.

4. At (Preferences-Dynamips-IOS Routers") create two new router templates ("New" button on the bottom left):
  - **Router 7200** - recommended IOS image: 7200 with IOS 15.1(4) and network adapters C7200-IO- 2FE and PA-2FE-TX (4 FastEthernet → F0/0,F0/1+F1/0,F1/1), all other values can be the default ones;
   - **Switch L3** – will be a router 3725 with IOS image 12.4(21) and adapters GT96100-FE and NM-16ESW (1 FastEthernet + 16 port switch module). Choose option "This is an EtherSwitch router" when defining the device platform, all other values can be the default ones.

5. The definition of the "Idle-PC" value will allow the host machine to assign the correct amount of resources to the virtual devices. You must repeat this procedures every time your PC CPU reaches values higher than 90%. Check the CPU utilization with the "Task Manager" in Windows, top command in Linux and "monitor" in MacOS.
To define the "Idle-PC" value:
  - Click "Idle-PC finder" during template setup, OR
  - Add router to project, start it (should be the only one ON), open console (wait for prompt), left click the device and choose option "Auto Idle-PC", OR
  - Add router to project, start it (should be the only one ON), open console (wait for prompt), left click the device and choose option "Idle-PC", choose one value (prefer the ones marked with *) and verify the CPU utilization. If any "dynamips" process is using more than 5%-10% CPU choose another value.
This must be done for each router template, NOT each router! Each template will have a different "Idle-PC" value. All routers from the same template will share the same value.
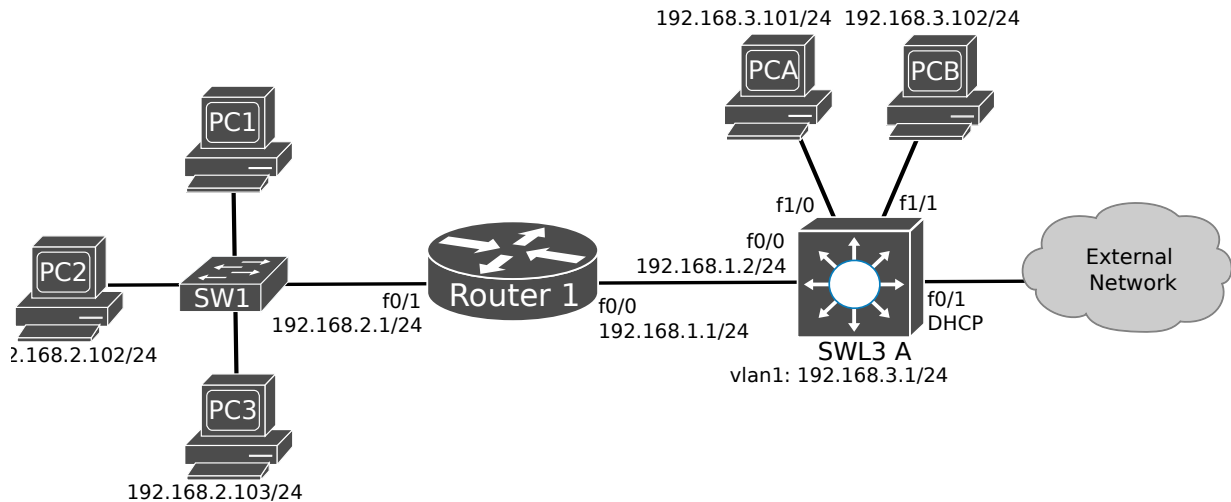**Note 1:** All devices from the same template must be equal in terms of virtual hardware.
Note 2: After changing any device hardware characteristic or adding/removing network modules, the "Idle-PC" value must be changed in the template. If necessary, create a new template with different characteristics/modules.
Note3: if you ever get a insufficient memory error on a Switch L3, you may increase it in the device template: (Right/click the device on the left bar) → Configure template → Memories and disks → RAM size → 256MiB.

GNS projects

1. Create a new Blank Project (File menu or CTRL+N) and give it a name. Add one router (Router1) to your project.

192.168.3.101/24 192.168.3.102/24

PCA PCB

f1/0   f1/1

f0/0
192.168.1.2/24

External
Network

PC1

PC2

SW1

f0/1
192.168.2.1/24

Router 1

f0/0
192.168.1.1/24

f0/1
DHCP

SWL3 A
vlan1: 192.168.3.1/24

2.168.2.102/24

PC3

192.168.2.103/24

2. Start Router1 and open the console of Router 1.

Router configurations

3. Preform the network configurations in Router1 (e.g., IP address/mask, activation of interfaces):
 Router1# configure terminal
 Router1(config)# interface FastEthernet 0/1
 Router1(config-if)# ip add 192.168.2.1 255.255.255.0
 Router1(config-if)# no shutdown
Save the configurations in the router(s):
 Router# write
And save the project or right-click the router and save configuration. Analyze the configuration (*.cfg) file created in your project folder.
Note: The *.gns3 and *.cfg files are the only ones required (maintaining the folder hierarchy) to transfer the GNS3 project to another computer or store the project in a repository (e.g., git).

4. According to the above network diagram; add a Layer3 switch (called "EtherSwitch router" in GNS3), connect it to Router1 using a Layer3 port (f0/0). Configure the Layer3 port (f0/0).
>> Test connectivity between Router1 and SWL3 A.
Note: Layer3 switches have Layer2 and Layer3 interfaces. Interfaces named f*/0 to f*/15 are Layer2 ports (switching module). All other should be Layer3 ports (usually f0/0 and f0/1).
Note2: a Layer3 switch Layer2 port (switching module) can be converted to a Layer3 (non-switch) port with the command: no switchport**.**

Capturing traffic

5. Start a capture on the link between the Router1 and SWL3A, open the capture (if necessary, start wireshark from the "Topology Summary" dock), generate some traffic in that link by performing a ping from a router to another.
>>Analyze the captured packets and verify that the source/destination MAC addresses match the respective MAC address of the interfaces of the routers.
To obtain the MAC address of an interface:
 Router# show interfaces FastEthernet 0/0
Note: In Linux, your user must belong to group *wireshark* (a re-login is required):
 sudo usermod -a -G wireshark username

Virtual PCs (vpcs)

6. Add an "Ethernet Switch" (SW1) and a "VPCS device" (PC1), and perform the link connection to Router1. Configure FastEthernet 0/1 interface of Router1:
```
Router1(config)# interface FastEthernet 0/1
Router1(config-if)# ip address 192.168.2.1 255.255.255.0
Router1(config-if)# no shutdown
```
PC1:
```
PC1> ip 192.168.2.101/24 192.168.2.1
```
and SWL3 A static routing:
```
SWL3A(config)# ip route 192.168.2.0 255.255.255.0 192.168.1.1
```
>> Test connectivity between PC1 and Routers 1 and SWL3 A.

Layer3 Switches VLAN interfaces

7. Add another two "VPCS devices" (PCA and PCB), and perform the link connections to SWL3 A Layer2 ports (swithing module). Configure vlan 1 interface of SWL3 A:
```
SWL3A(config)# interface vlan 1
SWL3A(config-if)# ip address 192.168.3.1 255.255.255.0
SWL3A(config-if)# no shutdown
```
Configure the new PC's addresses and gateway.
PCA:
```
PCA> ip 192.168.3.101/24 192.168.3.1
```
PCB:
```
PCB> ip 192.168.3.102/24 192.1683.1
```
>> Verify the status of all interfaces (show ip int br) and check that all connected links are operational (status should be up/up).
>> Test connectivity between PCA and PCB and the other devices.
Note1: Interface vlan1 is the default virtual Layer3 interface associated with all Layer2 ports of the switching module.
Note2: If some port status is (up/down) means that the connection cable was not detected. Restart the device or perform a shutdown/no shutdown **on the interface.**

(Optional) Interconnection with virtual machines (VirtualBox)

8a. Go to (Edit-Preferences-VirtualBox-VirtualBox VMs" and create a new VM template based on an existing VirtualBox machine. Use an Debian LXDE VirtualBox appliance available to download here (login/password: labcom/labcom).
Note1: To use the VM in GNS3, the VM should be powered off and the network adapter should be "not attached".
Note2: To connect the VM to the Internet, start the VM from VitualBox GUI with the network adapter attached to "NAT".
Note3: To use multiple VM instances, you may clone the original machine.

8b. Add PC2 as an end device based on the created VM template. Configure its IPv4 address and gateway. You may use the network Manger graphical interface or disable the network Manager service and configure the network using the command line. Note that, the command line configurations are not persistent (will disappear after a reboot), as root do:
```
systemctl stop network-manager            (arch Linux: systemctl stop NetworkManager)
ip link set up dev enp1s0
ip addr add 192.168.2.102/24 dev enp1s0
ip route add default via 192.168.2.1
```
Test connectivity to the other network devices.
Note: your virtual Ethernet port may have another name. List devices with ip addr to identify it.

(Optional) Interconnection with virtual machines (QEMU)

9a. Go to (Edit-Preferences-QEMU-QEMU VMs" and create a new VM template based on an existing virtual disk image (*.img). Use an Debian LXDE QEMU virtual disk (LabComServer2.qcow2) available to download here (login/password: labcom/labcom). Choose console type "none".
Note1: In Linux, QEMU uses Linux KVM and it's much faster than VirtualBox.
Note2: To use the VM in GNS3, the VM should be powered off.
Note3: To connect the VM to the Internet, start the VM from the command line (or *virt-manager*) using the command "qemu-system-x86_64 -m 1024 -enable-kvm LabComServer2.qcow2".
Note4: To use multiple VM instances, you may copy the original VM disk file "LabComServer2.img" and start another VM.
Note5: In Windows, QEMU requires HAXM, see how to install here. Also, replace option "-enable-kvm" with option "-accel hax" when running from the command line.

9b. Add PC3 as an end device based on the created VM template. Configure its IPv4 address and gateway. You may use the Network Manger graphical interface or disable the Network Manager service and configure the network using the command line. Note that, the command line configurations are not persistent (will disappear after a reboot), as root do:
```
 systemctl stop network-manager                 (arch Linux: systemctl stop NetworkManager)
 ip link set up dev enp1s0
 ip addr add 192.168.3.102/24 dev enp1s0
 ip route add default via 192.168.2.1
```
Test connectivity to the other network devices.
Note: your virtual Ethernet port may have another name. List devices with ip addr to identify it.

(Optional) Interconnection with the host machine

10. (Windows) PC3 should be your host machine. This connection requires a virtual interface. The simplest solution is to use a VirtualBox Host-only network/interface. In VirtualBox interface go to (File-Preferences-Network-Host-only networks) and create a new network (with disabled DHCP server). This step will create a new virtual network interface on your host machine, configure it with PC3 IPv4 address. Define a route to the GNS3 network, using a Command Prompt as Administrator:
```
  route ADD 192.168.1.0 MASK 255.255.255.0 192.168.2.1
```
In GNS3, add your host machine connection as an end device "Cloud" and perform network connection using the respective VirtualBox interface.
>>Try to ping Router1 and SWL3A from the host machine, and vice-versa.
>> Add any additional static routes and retest connectivity.
Note: if a newly created interface does not appear on the "Cloud" list: reboot Windows.

10. (Linux) PC3 should be your host machine.. Verify if the machine has a **tap interface** if not create one:
With the command *tunctl* (part of the *uml-utilities* package): sudo tunctl -u your_user_name
Or, with the command *ip*: sudo ip tuntap add dev tap0 mode tap
Add a "Cloud" end device into your project. Right-click the Cloud and choose Configure. To connect to the host machine, click on cloud's name under Clouds, choose the **NIO TAP** tab and add a tap interface (usually tap0 or tap1). Configure your host machine tap interface (IP address and mask) and define a route to the GNS3 network, as root do:
```
 ip link set up dev tap0
 ip addr add 192.168.2.103/24 dev tap0
 ip route add 192.168.1.0/24 via 192.168.2.1
```
>> Try to ping Router1 and SWL3A from the host machine, and vice-versa.
>> Add any additional static routes and retest connectivity.
Note: this method can also be used to interconnect VMs with GNS3. Just define the VMs network adapter as Host-only → vboxnet interface, or Bridged → tap interface.

(Optional) Interconnection with external networks

11. To connect a GNS3 network to other external networks, add a "Cloud" end device into your project. On cloud's configuration interface, choose the **Ethernet Interfaces** tab and add one of the host machine's Ethernet/Wifi interfaces (by default all interfaces should be already added). Connect the cloud to SWL3 A using the desired (external) interface.

12. Connect your host machine Ethernet interface to lab's network. Configure Router2 to obtain its FastEthernet 0/1 interface by DHCP:
 SWL3A(config)# interface FastEthernet 0/1
 SWL3A(config-if)# ip address dhcp
 SWL3A(config-if)# no shutdown
>>Verify that the router was able to connect and obtain an IPv4 address and gateway from the external network:
 SWL3A# show ip interface brief
 SWL3A# show ip route