REDES E SERVIÇOS

Objectives

- Study and test of the functionalities of the GNS3 emulator/simulator
- VLAN Routing

GNS3 Basic Configurations

Choose your operating system (Windows or Linux), download/install GNS3 and related software (Wireshark, VPCS, VirtualBox) and start GNS3 (with administrator/root permissions).

1. Install the Router IOS images (one per model) and define the a base configuration file with the following contents, that will prevent the router console timeout:

```
line con 0
exec-timeout 0 0
```

For each IOS image chose this base configuration file. Add one router of each model to your project and start them.

2. Go to (Edit-Preferences) and: (i) verify all storing and programs paths, (ii) test the Dynamips emulator and (iii) at the GUI Settings choose the option "Always use manual mode when adding links".

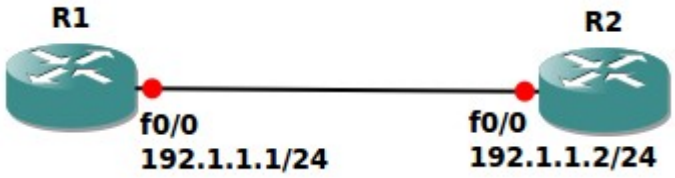
GNS projects

3. Create a new Blank Project (File Menu – CTRL+N) and give it a name.
Note: On old GNS3 version choose the option "Save IOS tartup configurations".
Note2: The option "Save nvrams..." is required to save the VLAN configurations.

4. Add a Router to the project, start a router, open the console of the Router, wait for the command prompt, and search/define the IdlePC value until the load of the PC processor becomes lower than 10%-15% (choose the values marked with *). If no value reduces the processor load, search new IdlePC values.
Note: the IdlePC value is applied to all equipments of the same model/firmware. The search/definition of the IdlePC must be made only once per model/firmware.
Note 2: if new slot cards are added to a router, the IdlePC may have to be redefined.
Note 3: When the console does no open, change the console port and restart GNS3.

Router configurations

5. Add a second router to your project and create a link between them. Save your project. Open the "topology.net" file (located in your project folder) with a text editor and analyze the network topology created by GNS3.



6. Configure the Routers according to the previous figure (e.g., IP address/mask, activation of interfaces). Save the configurations in the router(s):

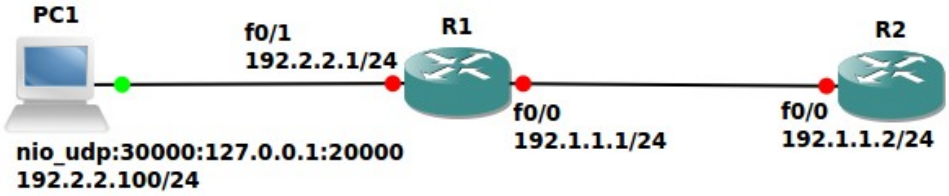
```
Router# write
```

And save the project. Analyze the configuration file(s) created in your project folder.
Test the connectivity between the Routers.

Capturing traffic

7. Start a capture on any link, open the capture (if necessary, start Wireshark from the captures window), generate some traffic in that link. Older GNS3 versions require the reload of the capture file (*reload capture file* button on toolbar).

Using Virtual Hosts/PCs



8. Virtual hosts/PCs can be implemented using VPCS (Virtual PC Simulator) which emulates PCs (in a server process) and provides remote access over UDP connections. VPCS provides 9 virtual PCs numbered from 1 to 9 which can be access by UDP ports from local ports 30000-30008 to remote ports 20000-20008.
In GNS3, add an host and choose the respective UDP connection: nio_udp:3000X:127.0.0.1:2000X for virtual PC (X+1) ans connect it with one of the routers. Start the VPCS interface (Tools → VPCS) and choose the correct PC by typing its number. Configure IP address and gateway with command:

```
ip   <address>   </mask>   <gateway>
```

Type `?` To see the remaining available commands, like ping, arp, etc....
Configure the PC and Router, and test connectivity between them.

(Extra) Interconnection with the host machine

9 (Windows). Verify if the machine has a **Microsoft Loopback adapter,** if not create one (run Hdwwiz.exe, and choose advanced mode). Add a *Cloud* into your project. Right-click the *Cloud* and choose *Configure*. Click on cloud's name under *Clouds,* choose the **NIO Ethernet** tab and choose your card (loopback).

9 (Linux). Verify if the machine has a **tap interface** if not create one with the command *tunctl* (part of the *uml-utilities* package). Add a *Cloud* 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).
8. Configure your host interface (IP address and mask) and connect the cloud to one router (with the Ethernet interface configured). Try to ping the router from the host machine, and vice-versa.

(Extra) Interconnection with the real network

10. To connect to other networked machines, click on cloud's name under *Clouds,* choose the **NIO Ethernet** tab and choose one of yours real Ethernet interfaces. Windows user should use the "Generic Ethernet" box and Linux users the "Linux Ethernet" box.

11. Connect your host PC to your neighbors PC (using a switch), and from your emulated Router ping your neighbors emulated Router, and vice-versa.
Note: You need to negotiate the IP network addresses with your neighbors.

(Extra) Interconnection with virtual machines

12. Choose a VM software:

Using VirtualBox:

Verify if VirtualBox is installed and configured, if not do it so. Choose a VirtualBox appliance from http://www.gns3.net/appliances/ (for example Microcore Linux), add a cloud associated with the VirtualBox interface and test it in your GNS3 project. You can also associate the VM ans GNS3 Cloud to a TAP interface (this makes things independent from the virtual networks manager from VirtualBox).

Note: Newer versions of GNS3 (>8.1) have a tighter integration with VirtualBox.

Note 2: You can use any of your VMs.

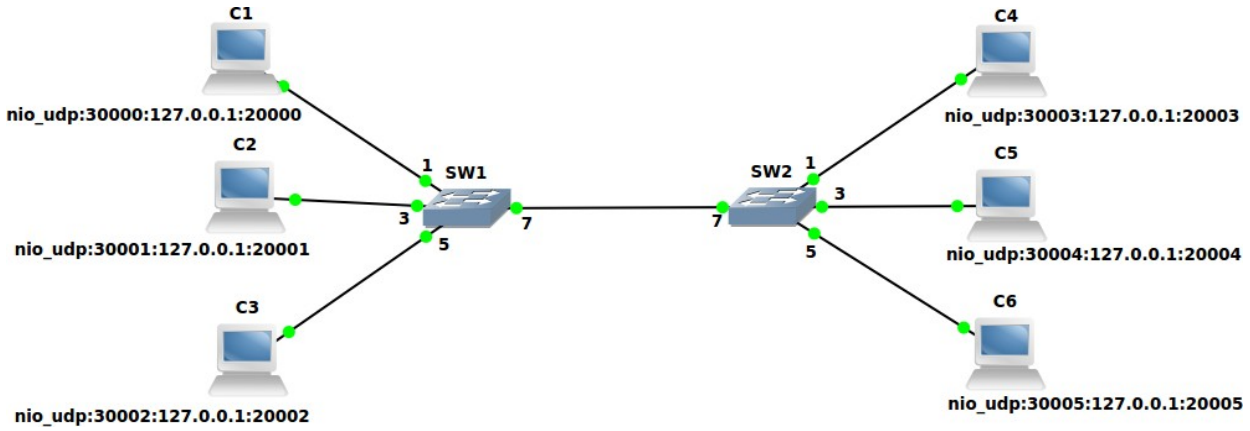
Note 3: You can create new virtual networks in VirtualBox (each will have an interface at the host machine). Different VMs can be in different virtual networks, and connected to the GNS3 network at different points.

Note 4: In Microcore Linux change to Portuguese keyboard with

```
loadkmap < /usr/share/kmap/qwerty/pt-latin1.kmap
```

VLAN Routing

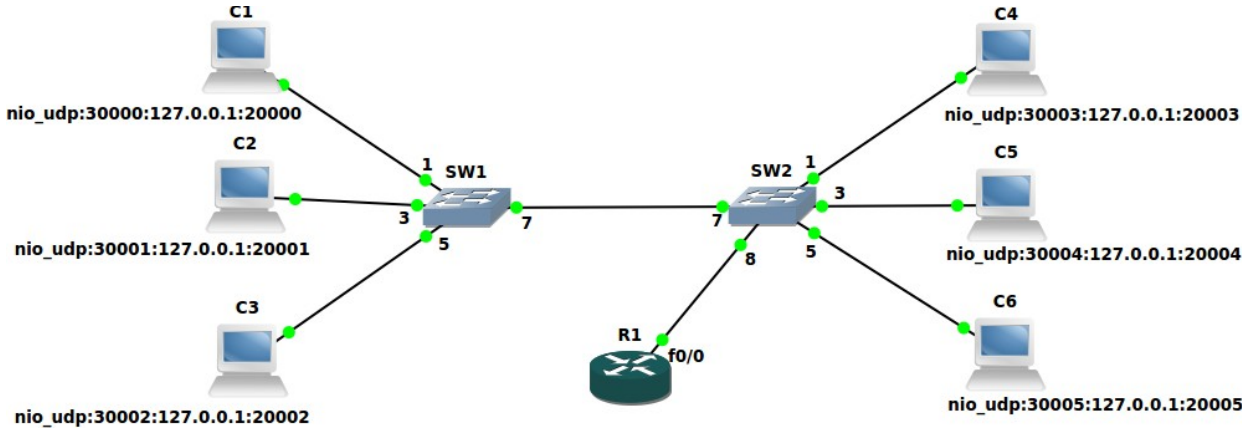
Access Network (VLAN) Deployment



1. Assemble the depicted network. Configure 3 VLAN at the switches:
- Ports 1-2: VLAN1 (sub-network 10.1.1.0/24, IPv4 C1:10.1.1.11, IPv4 C4: 10.1.1.14)
- Ports 3-4: VLAN2 (sub-network 10.2.2.0/24, IPv4 C2:10.2.2.12, IPv4 C5: 10.2.2.15)
- Ports 5-6: VLAN3 (sub-network 10.3.3.0/24, IPv4 C3:10.3.3.13, IPv4 C6: 10.3.3.16)
- Ports 7-8: Inter-switch/Tagged/802.1Q (dot1q, with native VLAN 1)

Place hosts in different VLAN and test connectivity.

Inter-VLAN Routing with Router

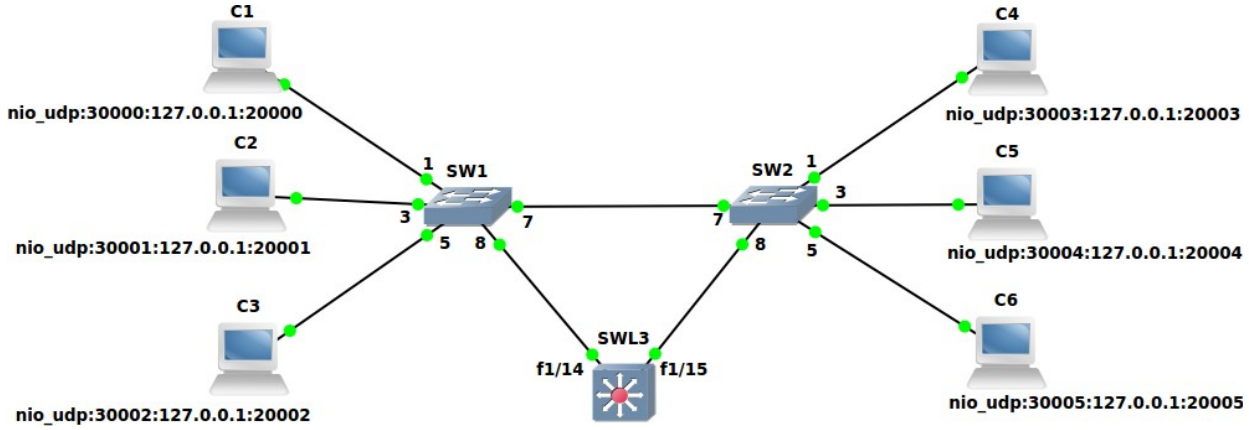


2. Assemble the depicted network by adding a router. Configure the router to support sub-interfaces and Inter-VLAN (802.1Q) routing:

```
Router(config)# interface FastEthernet0/0
Router(config-if)# no shutdown
Router(config-if)# interface FastEthernet0/0.1
Router(config-subif)# encapsulation dot1Q 1 native          !VLAN1
Router(config-subif)# ip address 10.1.1.1 255.255.255.0
!
Router(config-if)# interface FastEthernet0/0.2
Router(config-subif)# encapsulation dot1Q 2                 !VLAN2
Router(config-subif)# ip address 10.2.2.1 255.255.255.0
!
Router(config-if)# interface FastEthernet0/0.3
Router(config-subif)# encapsulation dot1Q 3                 !VLAN3
Router(config-subif)# ip address 10.3.3.1 255.255.255.0
```

3. Place hosts in the different VLAN, configure the respective gateways (router sub-interfaces) and test connectivity. Capture the packets being exchanged between the Router and (right) Switch.

Inter-VLAN Routing with a L3 Switch (and redundant links)



4. Configure 3 VLAN at the L3 Switch (VLAN1 ,2 and 3):

```
RouterSW# vlan database
RouterSW(vlan)# vlan 1
RouterSW(vlan)# vlan 2
RouterSW(vlan)# vlan 3
RouterSW(vlan)# exit
```

Verify the L3 Switch VLANs table: `show vlan-switch`.

Configure the L3 Switch's L2 ports (fastEthernet slot 1), port 0: VLAN1, ports 1-8: VLAN2, ports 9-12: VLAN3 and ports 13-15: Inter-switch/Tagged/802.1Q:

```
RouterSW(config)# ip routing                                ! Activates IPv4 routing
RouterSW(config)# interface f1/0
RouterSW(config-if)# switchport mode access
RouterSW(config-if)# switchport access vlan 1
RouterSW(config-if)# interface range fastEthernet 1/1 - 8
RouterSW(config-if-range)# switchport mode access
RouterSW(config-if-range)# switchport access vlan 2
RouterSW(config-if-range)# interface range fastEthernet 1/9 - 12
RouterSW(config-if-range)# switchport mode access
RouterSW(config-if-range)# switchport access vlan 3
RouterSW(config-if-range)# interface range fastEthernet 1/13 - 15
RouterSW(config-if-range)# switchport mode trunk
RouterSW(config-if-range)# switchport trunk encapsulation dot1q
```

Configure the Switch L3 virtual (Vlan) interfaces:

```
RouterSW(config)# interface Vlan 1
RouterSW(config-if)# ip address 10.1.1.1 255.255.255.0
RouterSW(config-if)# no autostate
RouterSW(config)# interface Vlan 2
RouterSW(config-if)# ip address 10.2.2.1 255.255.255.0
RouterSW(config-if)# no autostate
RouterSW(config)# interface Vlan 3
RouterSW(config-if)# ip address 10.3.3.1 255.255.255.0
RouterSW(config-if)# no autostate
```

Verify the routing table (`sh ip route`). Place hosts in different VLAN, configure the respective gateways (Vlan virtual interfaces) and test connectivity. Capture the packets being exchanged between the Router and L3 Switch. Analyze the switching module forwarding table (`show mac-address-table`) in L3 Switch.