# FUNDAMENTOS DE REDES

# ACCESS AND DISTRIBUTION NETWORKS

## Objectives

- VLAN definition
- Inter-VLAN routing
- Usage of L2 and L3 Switches
- Access and distribution network design and interconnection
- Trunk links

## Access Network (VLAN) Deployment

1. Using GNS3, assemble the depicted network. Configure 3 VLAN at the switches:
 - Ports 1-2: VLAN1 (sub-network 10.1.1.0/24)
 - Ports 3-4: VLAN2 (sub-network 10.2.2.0/24)
 - Ports 5-6: VLAN3 (sub-network 10.3.3.0/24)
 - Ports 7-8: Inter-switch/Tagged/802.1Q (native VLAN 1)

To implement a Layer2 switch you can use a GNS3 basic "Ethernet Switch" or a switching module (NM-16SW) on a Router (GNS3 EtherSwitch router) with IP routing disabled (ports f1/0 to f1/15).
**Note: A GNS3 basic "Ethernet Switch" do not support Spanning Tree Protocols.**
To configure an "Ethernet Switch" use the GUI.
To configure an "EtherSwitch router" as a L2 Switch:

```
EtherSwitch# vlan database                          !VLANs must be created on the
EtherSwitch(vlan)# vlan 1                            ! equipment database
EtherSwitch(vlan)# vlan 2                            !To remove a VLAN use:
EtherSwitch(vlan)# vlan 3                            ! "no vlan x"
EtherSwitch(vlan)# exit
EtherSwitch# configure terminal
EtherSwitch(config)# no ip routing                  !Disables IPv4 routing
EtherSwitch(config)# interface f1/1
EtherSwitch(config-if)# switchport mode access      !Defines as an access port
EtherSwitch(config-if)# switchport access vlan 1    !Specifies the port VLAN
EtherSwitch(config-if)# interface f1/2
EtherSwitch(config-if)# switchport mode access
EtherSwitch(config-if)# switchport access vlan 1
EtherSwitch(config-if)# interface range fastEthernet 1/3 – 4      !To configure multiple ports
EtherSwitch(config-if-range)# switchport mode access
EtherSwitch(config-if-range)# switchport access vlan 2
EtherSwitch(config-if-range)# interface range fastEthernet 1/5 – 6
EtherSwitch(config-if-range)# switchport mode access
EtherSwitch(config-if-range)# switchport access vlan 3
EtherSwitch(config-if-range)# interface range fastEthernet 1/7 – 8
EtherSwitch(config-if-range)# switchport mode trunk              !Defines as Trunk port
EtherSwitch(config-if-range)# switchport trunk encapsulation dot1q     !By default all
                                                                ! VLAN are transported
```

Note: To show the existing VLAN use the command: `show vlan-switch`
**Troubleshooting 1**: When creating the VLAN, if a flash memory space error occurs, run the command
```
EtherSwitch# erase flash:
```
to erase the flash, and after, create the missing VLAN.
**Troubleshooting 2**: Verify if all the interfaces with connections are `up` with the command:
```
show ip interface brief
```
if not, perform a `shutdown` followed by a `no shutdown` on the respective interface.
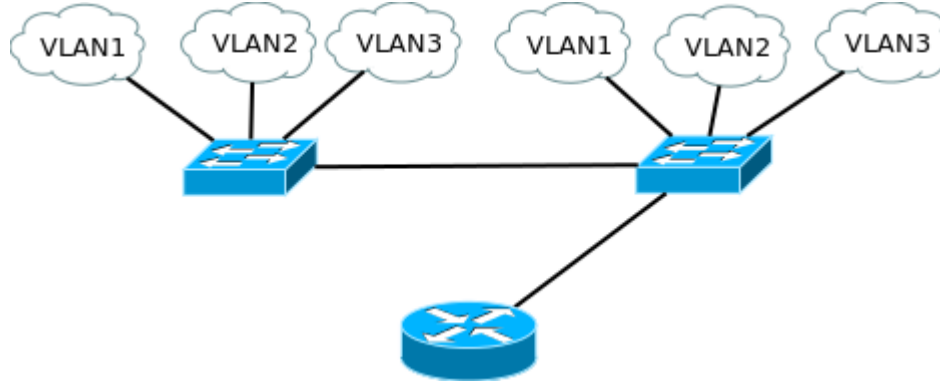Place terminals at the different VLAN and test connectivity.
Verify the status of the Spanning-Tree Protocol with the commands:
`show spanning-tree` and `show spanning-tree brief` .

## Inter-VLAN Routing with Router

2. Assemble the depicted network by adding a router (Cisco 37xx).

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-if)# encapsulation dot1Q 1 native          !VLAN1
Router(config-if)# ip address 10.1.1.1 255.255.255.0
 !
Router(config-if)# interface FastEthernet0/0.2
Router(config-if)# encapsulation dot1Q 2                 !VLAN2
Router(config-if)# ip address 10.2.2.1 255.255.255.0
 !
Router(config-if)# interface FastEthernet0/0.3
Router(config-if)# encapsulation dot1Q 3                 !VLAN3
Router(config-if)# ip address 10.3.3.1 255.255.255.0
```

Verify the routing table. Place terminals at the different VLAN, configure the respective gateways (router sub-interfaces) and test connectivity. Capture the packets being exchanged between the Router and (right) Switch. Explain how packets are assign to the respective VLAN/sub-interface.

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

3. Replace the Router by a L3 Switch.
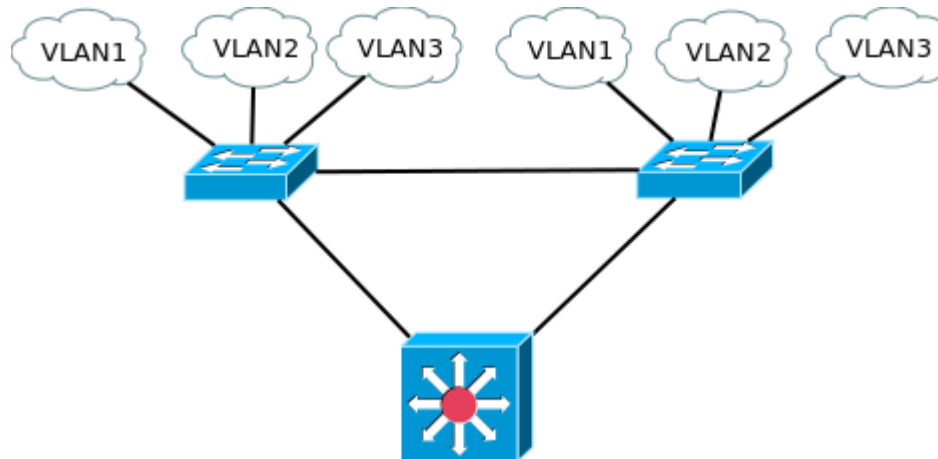


Configure 3 VLAN at the L3 Switch (VLAN1 ,2 and 3):
```
RouterSW# vlan database
RouterSW(vlan)# vlan 1
RouterSW(vlan)# vlan 2
RouterSW(vlan)# vlan 3
RouterSW(vlan)# exit
```

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)# 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                         !forces the port to be always up
RouterSW(config)# interface Vlan 2
RouterSW(config-if)# ip address 10.2.2.1 255.255.255.0
RouterSW(config-if)# no autostate                         !forces the port to be always up
RouterSW(config)# interface Vlan 3
RouterSW(config-if)# ip address 10.3.3.1 255.255.255.0
RouterSW(config-if)# no autostate                         !forces the port to be always up
```
Verify the routing table. Place terminals at the different VLAN, configure the respective gateways (Vlan virtual interfaces) and test connectivity. Capture and explain the packets being exchanged between the L2 and L3 Switches.