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ARQUITETURA 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
- Truck links with interconnection VLAN

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
```
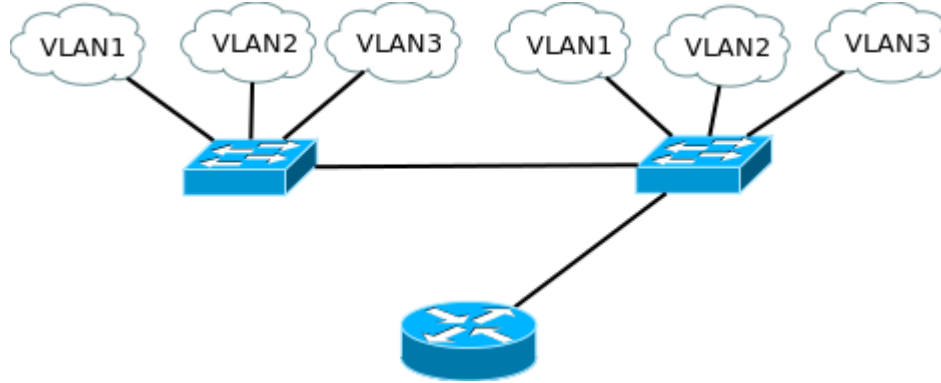if not, perform a `shutdown` followed by a `no shutdown` on the respective interface.
Place terminals at the different VLAN and test connectivity.
Verify the status of the Spanning-Tree Protocol with the commands:
`show spanning-tree` and `show spanning-tree brief` .

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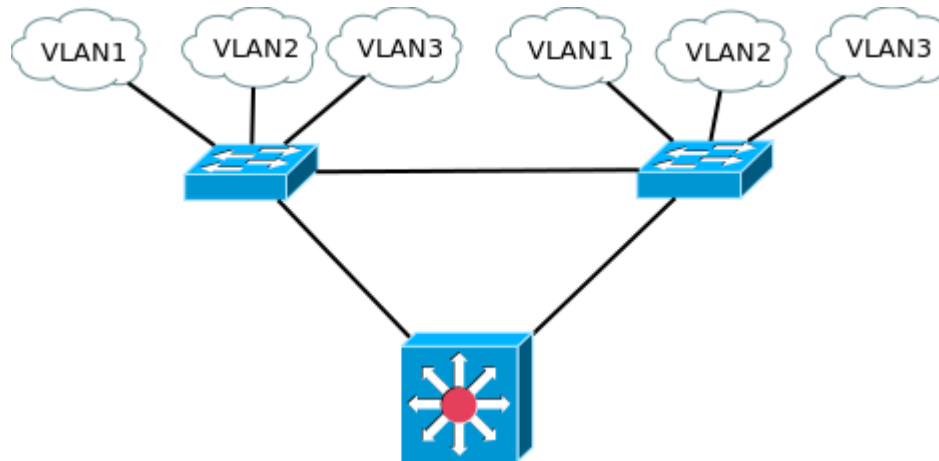
Configure 3 VLAN at the L3 Switch (VLAN1 ,2 and 3):
```
RouterSW# vlan database
RouterSW(vlan)# vlan 1
RouterSW(vlan)# vlan 2
RouterSW(vlan)# vlan 3
RouterSW(vlan)# exit
```

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.

Restricted trunk links

4. Assemble the following network with L3 Switches. VLAN 1 is end-to-end and all other VLAN are local. Use as L3 interfaces standard Ethernet interfaces or L2 interfaces (switching module) converted to L3 interfaces with the command `no switchport`.

Configure VLAN on the three Layer 3 switches: SWL3 A should have VLAN 1, 21, and 31; SWL3 B should have VLAN 1 only; and SWL3 C should have VLAN 1, 22, and 32.

Note: By default Cisco equipments have default VLANs that must be considered end-to-end (1002-1005) and cannot be deleted.
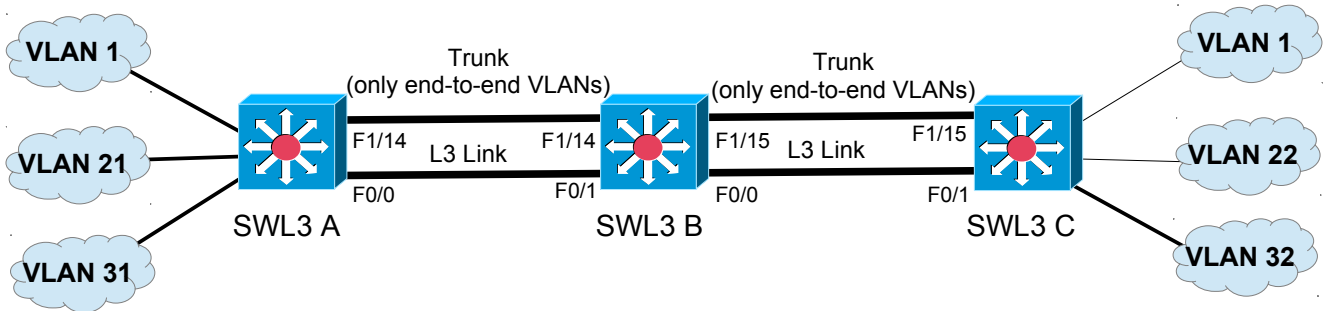
Configure VLANs, assuming that trunk ports are f1/14 and f1/15 in all three Layer 3 switches:
```
SWL3*(config)# interface range FastEthernet 1/14 - 15
SWL3*(config-if-range)# switchport mode trunk
SWL3*(config-if-range)# switchport trunk allowed vlan 1,1002-1005
```
Guarantee that all L3 switches have IPv4 Routing active: `ip routing`

Configure interfaces IP addresses assuming that VLANs have the network 10.0.<#vlan>.0/24, the IP network between SWL3A and SWL3B is 10.1.0.0/24 and the network between SWL3B and SWL3C is 10.2.0.0/24. Configure a routing protocol.
```
SWL3*(config)# router rip
SWL3*(config-router)# version 2                    ! Required because of subnets
SWL3*(config-router)# network 10.0.0.0
```
>> Analyze the routing tables. Should remote VLANs be accessible via VLAN1? Why not?

5. All end-to-end VLANs must not transport traffic (unless it is required). All access VLANs sinterfaces shold be configured as **passive interfaces** (network is announced using other interfaces, but not routing information is propagated).
```
! VLAN1 should not be used to transport L3 Traffic
 SWL3*(config-router)# passive-interface vlan 1
```
>> Analyze the routing tables, test connectivity and capture/analyze the packets on the trunk and L3 links.
>> Explain the captured packets.

Remember this:

To perform a ping from VLAN1 interface on SWL3A (e.g., 10.0.1.1) to VLAN22 interface on SWL3C (e.g., 10.0.22.3), use the ping command defining its source:
 SWL3A# ping 10.0.22.3 source 10.0.1.1
Without source the ping source IP address is the output interface address defined by the routing table.

Interconnection VLAN

6. Remove the L3 links between SWL3. Analyze the routing tables and explain the lack of connectivity. Create an interconnection VLAN (e.g., VLAN 101 with IP network 10.1.0.0/24) and reconfigure the network to have full connectivity between the VLANs. Start by changing the trunks restrictions:

```
SWL3*(config-if-range)# switchport trunk allowed vlan 1,101,1002-1005
```

Note: <u>Only the interconnection VLAN should transport L3 traffic. This VLAN should be the only non passive VLAN interface.</u>

>> Analyze the routing tables, test connectivity and capture/analyze the packets on the trunk links.

>> Explain how remote (local) VLAN IP networks are learned (RIP over VLAN 101) and how local traffic is routed (packets marked with 802.1Q tag 101)