

POLITECNICO DI TORINO

PROGETTO DI RETI LOCALI

Lab 3: Virtual LANs

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Acknowledgments

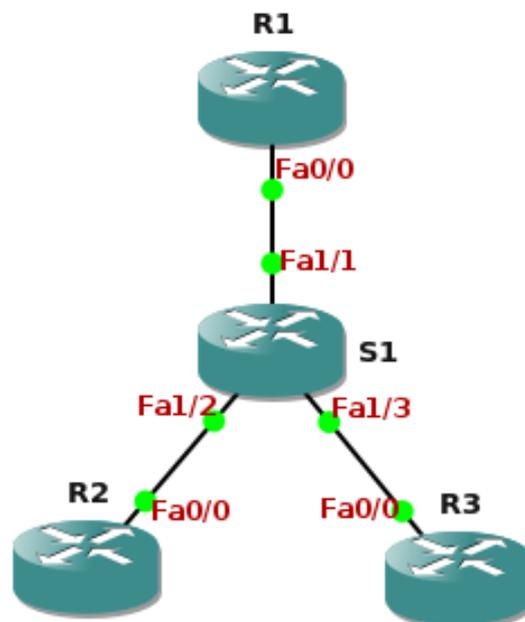
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1 Introduction

In this lab assignment we are going to simulate a scenario in which two host belong to different VLANs can exchange traffic through a one-arm router, connected to the same switched network of the previous hosts. Hosts are connected to the switch in *access mode*, while the router is connected in *trunk mode*.

2 Topology

The topology for this tutorial is represented in the following picture:



R1, R2 and R3 are *Cisco 2691* routers without any added module, as you are going to use just the routed interfaces there. S1 is a *c2691* router with a *NM-16ESW* module providing switching interfaces; we use only those interfaces in this lab.

Hosts are simulated by the two machines R2 and R3, which belonging to two different VLANs (VLAN 12 and VLAN 13) and are connected to the same switch S1. The two corresponding interfaces on the switch are configured in the *access mode*, so that the traffic flowing through them will be automatically identified with the corresponding VLAN ID. The switch is connected via a third link (in *trunk mode*) to the R1 device (actually acting as a router), which will provide the routing between the two VLANs.

2.1 IP addressing plan

This lab assignment requires the definition of a proper IP addressing schema for the network, which must be coherent with the VLANs configured. This step is left to the student's choice.

3 Preparing the lab configuration

Log-in in the network emulation system and create the network topology as depicted in the figure above.

Before starting the network, you must add flash memory to S1:

- right click on S1 → configure → Memories and disks
- add 500 MiB in the slot 'PCMCIA disk0'
- apply

Now you can start all the devices.

Finally, open all the configuration consoles of the network devices involved in the lab and be ready to interact with them.

3.1 Switch (S1)

Now you will set up the interfaces of the switch in order to correctly configure the VLANs.

- Enter the S1 console in privileged mode. Type:

```
vlan database
  vlan 12
  vlan 13
exit
```

This will "create" the VLANs in the internal VLAN database of the switch.

- Now you will configure `FastEthernet1/2` and `FastEthernet1/3` to work in access mode (traffic through them will be considered belonging to the corresponding VLAN), and `FastEthernet1/1` in trunk mode (traffic from different VLANs will flow through it). In the global configuration mode, write:

```
interface FastEthernet1/2
  switchport access vlan 12
exit
interface FastEthernet1/3
  switchport access vlan 13
exit
interface FastEthernet1/1
  switchport mode trunk
exit
```

3.2 Router (R1)

On this router we have to configure the `FastEthernet0/0` interface acting as *one-arm* router. The required configuration commands are summarized as follows:

- Set manually the speed and duplex of the link as you did in the first lab assignment, since the automatic negotiation does not work.
- You now have to configure the `FastEthernet0/0` on R1 in trunk mode, i.e. the traffic is encapsulated in 802.1q. You will have to setup two so-called *sub-interfaces*, one for each VLAN you are going to use. Enter the configuration mode and type:

```
interface FastEthernet0/0.2
  encapsulation dot1q 12
exit
interface FastEthernet0/0.3
  encapsulation dot1q 13
exit
```

The command `encapsulation dot1q <number>` tells the router that the link is in trunk mode, and that that interface must send/receive only traffic whose VLAN-ID is `<number>`.

- You now have to configure a proper IP address for each sub-interface, so that the router will be able to correctly route the traffic between the VLANs. The choice of the proper IP addresses derive from the IP addressing plan defined by the student.

Remember that you have to configure both `FastEthernet0/0.2` and `FastEthernet0/0.3` with a different IP address, coherently with the VLANs they belong to. Do not configure an IP address on `FastEthernet0/0` on R1, since this address would be used only in case of not-encapsulated traffic.

Tip: the command for configuring IP addresses on Cisco interfaces is `ip address <address> <netmask>`, issued in the selected interface configuration mode.

- The student is invited to determine whether a set of IP static routes are required for this assignment to work. In case, the command to configure static routes on Cisco devices is `ip route <address> <netmask> <next_hop>`, issued in configuration mode.

3.3 Routers (R2 and R3)

The configuration of those routers looks simpler than the one related to R1, as we have to configure here only an IP address on a standard interface (`FastEthernet0/0` on both routers), exactly in the same way as we did in the first lab assignment. Please remember also to set manually the speed and duplex of these links.

Finally, please note that in this case we do not need to configure any sub-interface, as we do not configure VLANs on those routers (acting as hosts).

Warning: the student is invited to determine whether a set of IP static routes are required for this assignment to work. In case, the command to configure static routes on Cisco devices is `ip route <address> <netmask> <next_hop>`, issued in configuration mode.

4 VLAN analysis

The lab configuration is now done. You can now enter in R2's console and ping the R3's IP address.

If everything looks fine and the ping command gets a reply, please answer to the following questions:

1. Report the IP addresses assigned to the various entities, possibly using a picture of the network. Specify, for the configuration on R2 and R3, which is their default gateway.
2. Capture the packets of a ping session between R2 and R3 on the three links.
 - Compare the differences between packets on the access links and the trunk link. Which new fields are added?
 - On the trunk link, why are some IP packets apparently present twice? Check them carefully and find the differences.