Universidad Carlos III de Madrid

Department of Telematic Engineering

Computer Networks

Practice: Routing

Bachelor in Informatics Engineering

1. Objective

The main objectives of these practices are to become familiar with the work environment (GNU /Linux) and routers to be used in the course (Linksys WRT54GS). Once familiar with them, you must configure an IP network whose connectivity is achieved initially by assigning static routes and then enabling the RIP routing protocol. To do so, we start from a scenario whose address structure has been already studied and planned beforehand.

In the sections corresponding to the IP network configuration, first you must have the addresses and static routes on both routers and the PCs that connect to the routers. Later, we employed a dynamic routing protocol (RIP) on routers.

Each PC has the TCP/IP stack available which enables the communication through the network interface. In order to get information about the TCP/IP stack implementation, we recommend to use the manual pages (e.g.. 'man 7 ip').

2. Laboratory Norms

Read the laboratory text fully and carefully before starting.

The laboratory evaluation is performed with a **document elaboration**. **This document must be delivered no later than a week after the third Lab session, by means of an aulaglobal submission entry.** This Lab is organised as a series of milestones that must be completed. **Once you are sure you have completed a milestone, take some screenshots justifying the accomplishment of that milestone and explain very briefly in a document the justification.** If you have problems with a milestone please contact the teacher.

In order to do the laboratory it is necessary to have a Telematics Engineering Department teaching lab user account. For some of the commands it is necessary to have *superuser* (administrator) privileges. For those commands (address configuration, route configuration, etc.) you should place in front of the command the word *sudo* (your user password will be required). If you have problems, ask the lab teacher.

More importantly, it is mandatory to download and install the Virtual Machine BEFORE THE LAB SESSIONS by following the instructions in this document.

Please consult the Linksys WRT54GS router manual available at http://www.it.uc3m.es/linksys/english

Milestone XX
The parts of the statement in this format show the milestones of the laboratory. Please fill a document section with each of these (brief section)

3. UC3M VM Installation

IMPORTANT: THIS STEP MUST BE DONE BEFORE STARTING THE LAB SESSION.

1. Download the "UC3M_18.05.2.ova" file from the following link (4GB approx.):

   https://drive.google.com/file/d/1gjb-a8e4cmDrRiugxawtpWl7jJ0GEA4l/view

2. Launch VirtualBox and click on:

   'File -> Import Appliance'

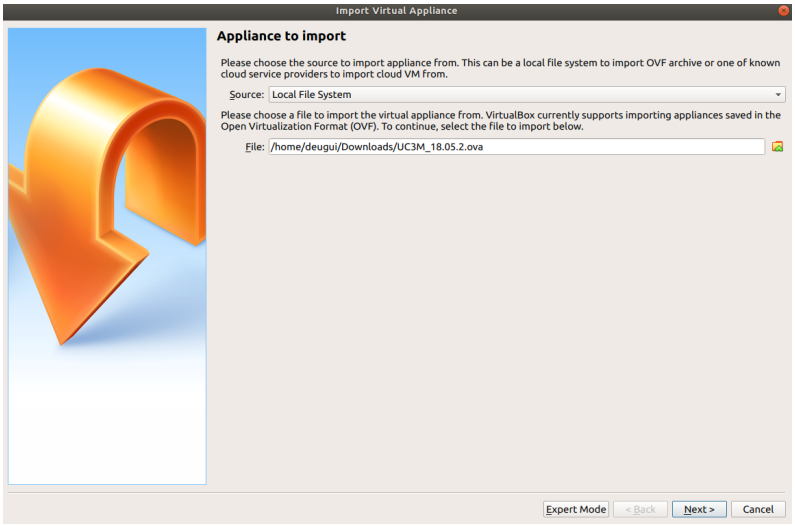
   or if you prefer:

   'Tools -> Import'

'Tools -> Import'

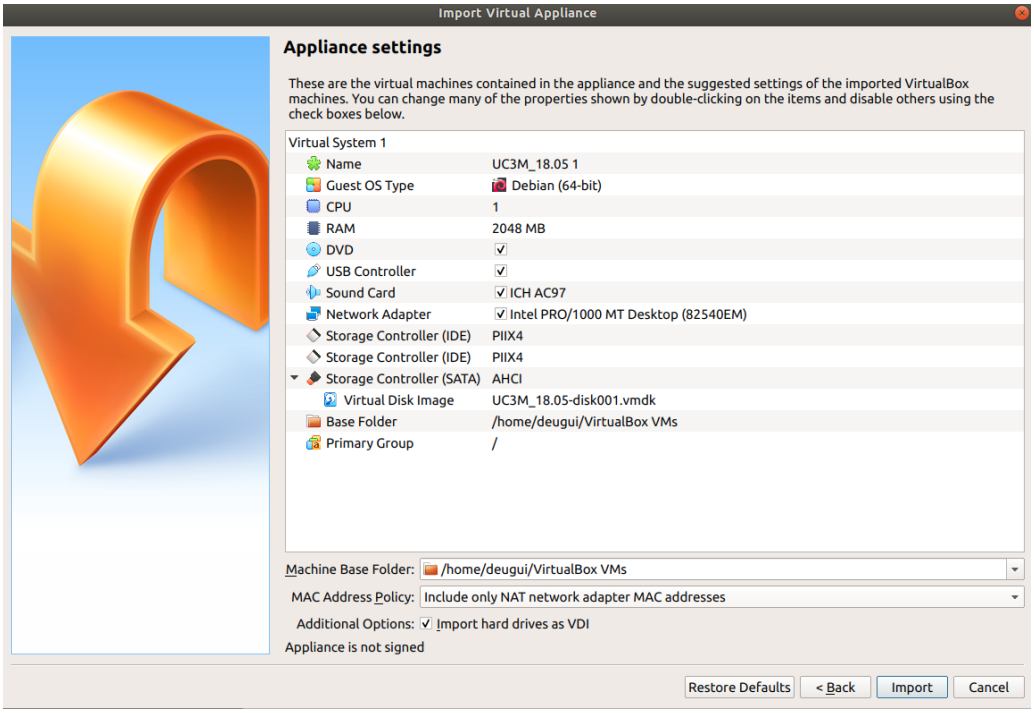
3. A window pops, where we select the following values:

   Source: Local File System
   File: PATH/T0/.ova previously downloaded



'Import Virtual Appliance' I

4. Click on "Next" and check out the window which pops up:



'Import Virtual Appliance' II

5. Make sure the fields "Guest OS type" and "RAM" are the shown in the image and "DVD", "USB controller", "Sound Card", "Network Adapter" are marked.
6. Click "Import" and wait until the end of the process.

4. UC3M v2 Virtual Machine Setup

1. Follow the installation instructions (available on aulaglobal).
2. Open VirtualBox and launch the "UC3M_18.05" Virtual Machine.
3. Open a Terminal and introduce **TWICE** the following command:

   lightning update

   lightning update

4. Once the lightning has been correctly updated it is time to set up the Laboratory scenario. To do so, write the following command in the Terminal window:

   lightning start RYSCA/p_encam_a

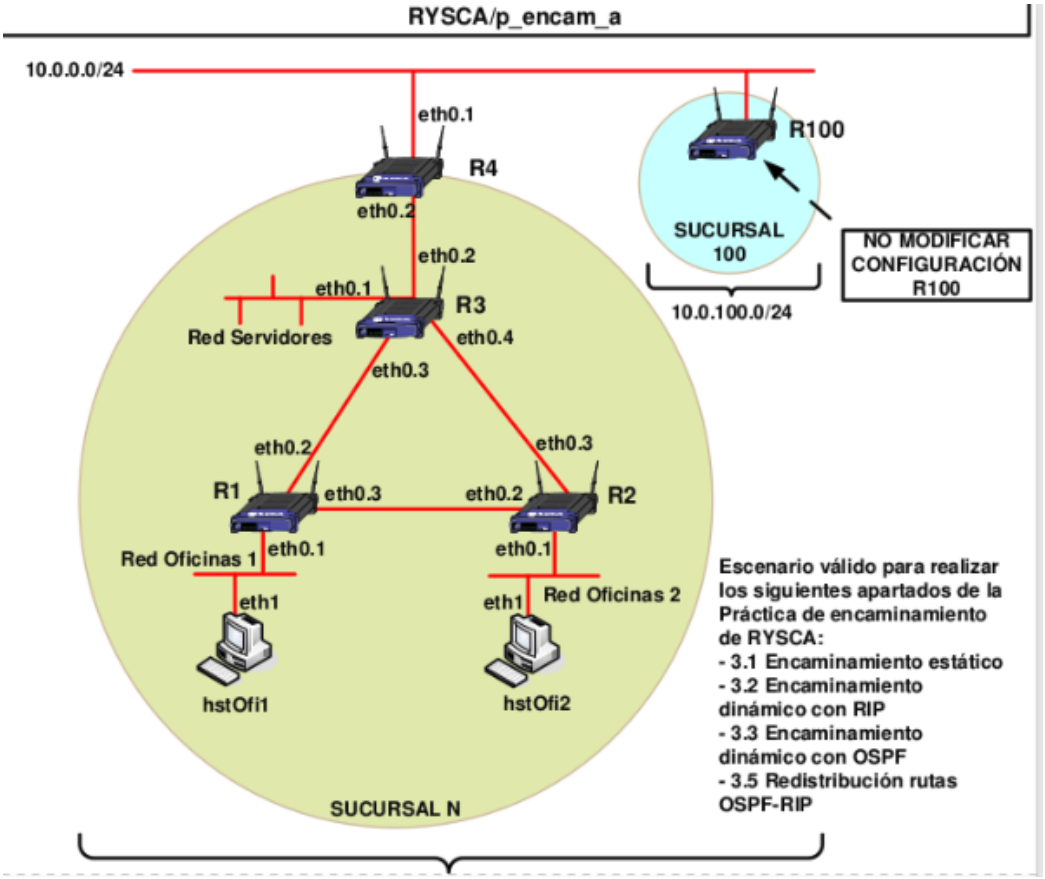
5. Wait until the whole setup is done.
6. You will see a figure with the "IP addressing Exercise" topology, which is going to be the topology for this Laboratory too. In addition to this figure a couple of terminals are open, each of them corresponding to a particular router or host.
7. Now you are ready to work with the topology as if you had it set up in the laboratory with the physical equipment (PCs and Linksys WRT54GS routers).
8. If you want to stop the created scenario just execute the following command:

   lightning stop

9. If you don't want to lose your work progress when you leave, please do not power off the virtual machine, just click on the "Save the machine state" button when closing the VM window.

5. Network configuration

This section is to configure the IP network corresponding to the specified in routing exercise. The logical architecture of the scenario is shown in Figure 2. This scenario corresponds to the network topology of a particular branch. Assign addresses to the network based on the results of addressing exercise.



The design requirements for the Figure 2 scenario are as follows:

- The address range available for the branch is 10.0.100.0/24
- The core network interconnecting all branches has the address range 10.0.0.0/24.
- Linksys WRT54GS routers will be used, each with 5 LAN (Ethernet) interfaces.
- Each branch has several areas, namely Office 1 (hstOfi1), Office 2 (hstOfi2) and a Server room (Red Servidores). Because of the nature of the work performed in each area, independent networks are required, and are interconnected as shown in the diagram of Figure 2. This scheme provides a certain redundancy against link failures. Take this redundancy into consideration when designing the routing tables required in the routers.
- The network of Office 1 must have capacity to service up to 100 connected pieces of equipment (PCs, printers, etc.).
- The network of Office 2 must have capacity to service up to 25 connected pieces of equipment (PCs, printers, etc.).
- The Servers network must have capacity to service up to 10 connected pieces of equipment.

- Addresses must also be assigned to the different point-to-point networks used to interconnect the routers.

5.1. Steps to follow

The steps to carry out the practice are the following:

1. Assign IP addresses to the router interfaces (R1, R2 and R3) and to the hosts (hstOfi1 and hstOfi2) and check that connectivity exists between PCs hstOfi1, hstOfi2 and the routers R1, R2, respectively, using, for example the **ping** command.

2. Assign IP addresses to each of the point-to-point network that interconnects the routers R1, R2 and R3 and check connectivity.

3. Configure the required static routes in R1, R2, R3 and in the PCs connected to the different networks to insure total connectivity between all subnets. Check that connectivity exists between the different subnets using, for example, the ping command. Check also that the route taken by the packets is the right one, using the **traceroute** command (from the routers as well as from the PCs).

4. "Connect" R4 and configure the necessary routes in all pieces of equipment to insure connectivity of the global scenario.

5. Configure in the routers the additionally required backup routes, in such a way that if a link is broken between R1, R2 y R3, global connectivity is not lost. To simulate a link failure, use the interface configuration command **shutdown** to disable the interfaces of each of the two routers connected to the link (if you have doubts on this point, consult with the lab teacher).

Milestone 1 (6 points)
Check that from any router and PC you have IP connectivity with any network interface of all pieces of equipment of the scenario (and that the route taken by the packets is the best possible). Check that global connectivity is maintained, even in the event of a link failure between R1, R2 y R3. Once the required configuration has been done, and the functionality checked, fill a document section with this milestone.

6. Remove the static routes previously configured in the routers. Now the RIP routing protocol will be used.

7. Enable and configure the dynamic routing protocol RIP in the corresponding router interfaces. Verify, using the router's visualization commands, that the RIP protocol is working correctly.

Milestone 2 (2 points)
Check that from any router and PC you have IP connectivity with any network interface of all pieces of equipment of the scenario (and that the route taken by the packets is the best possible). Verify, using the router's visualization commands, that the RIP protocol is working correctly. Once the required configuration has been done, and the functionality checked, fill a section of the document to be delivered with this milestone (some screenshots and some sentences of explanation).

8. Disconnect the cable interconnecting routers R1 and R2 (using **shutdown** command).

Milestone 3 (2 points)
Verify that after some time, the routing protocol restores a path between the two office subnets. Verify that with the link between R1-R2 down – and once the convergence time has elapsed (knowing that the routers used are not capable of detecting the failure/recovery of a link when it happens) – from any router and PC you have IP connectivity with any network interface of all pieces of equipment of the scenario (and that the route followed by the packets is the best possible). Verify, using the router's visualization commands, that the RIP protocol is working correctly. Once the required configuration has been done, and the functionality checked, fill a final section in your document with this milestone.

6. References

[1] GNU/Linux manual (**man <command>**)

[2] Linksys WRT54GS router configuration manual, http://www.it.uc3m.es/linksys/english

[3] Linux Advanced Routing & Traffic Control HOWTO, http://www.lartc.org/howto

[4] Linux Networking HOWTO, http://www.tldp.org/HOWTO/Net-HOWTO/