


Info: Installing and using UC3M Virtual Lab v2	 Universidad Carlos III de Madrid
UC3M Virtual Laboratory v2. Last modification : 05-09-2024	2024-2025

Introduction

1 Objective

The objective of this document is to guide you through the installation of the Virtual Machine (VM) hosting UC3M Virtual Laboratory (lightning) in your personal computer and to show you how to use it. This VM has been prepared with the VirtualBox hypervisor. VirtualBox is available from Windows, Linux and Mac computers powered by an Intel Processor (CPU) or compatible. As of writing, testing versions of VirtualBox for the ARM processors in newer Apple equipment have not been tested. There is an alternative for running lightning on these boxes.

You have additional installation and use video tutorials for the UC3M Virtual Lab on the YouTube channel CacharREDando: <https://www.youtube.com/CacharREDando>

2 Working environment

Download the image to your device, as described in Section 1.2 (the image weighs aprox. 4GBytes). It is possible that you need this image to reinstall the VM in case it stops working. It is advisable to keep a backup of the image file. However, you can delete it from your device once the VM is correctly installed. VirtualBox generates its own files in a different directory.

The image has been prepared on the VirtualBox [**vbox**] hypervisor version **7.0**. This is the mandatory version for executing lightning.

In addition to the software needed in the laboratories, the VM includes a reasonable number of auxiliary programs to help you when executing the labs. **Avoid installing additional software on your own.** In some courses, you may need additional software, which you will need to install when indicated to do so by your professor.

1 Installing VirtualBox and the UC3M Virtual Laboratory image

A precondition to using the UC3M Virtual Laboratory on your device is that you install VirtualBox. Access the VirtualBox Web page [[vbox](#)], download the version suitable for your Operating System and install it, following the installation instructions for your Operating System (OS).

1.1 Activating the virtualisation extensions of your processor

To efficiently execute the VM with the UC3M Virtual Lab, you need to activate the **virtualisation extensions** in your host. Depending on the manufacturer, these are known as VT-x or AMD-V. On Windows or Linux systems, the VM will not work if they are not enabled.

The virtualisation extensions are controlled by the BIOS or UEFI system in your device, which you will access during the boot process as follows:

- BIOS:
 - After powering on or rebooting your device **and before the OS is loaded** press the special key (Del, F2, F9, F12, etc.) as shown in your device's instructions, to access the BIOS.
- UEFI: (in case your Operating System is Windows 10/11)
 1. From the main Windows menu, select "Reboot" while pressing the "Shift" key.
 2. Select "Solve problems" in the blue screen with the OS Restore options
 3. Select "Advanced options" if it doesn't pop up automatically.
 4. Select "UEFI firmware configuration" and reboot.

Once you are in BIOS/UEFI configuration mode, browse until you find the virtualisation extensions options, make sure they are **active** and exit *saving changes*. **Don't change anything else!** Figures 1.1 and 1.2

show how to access the virtualisation options in two of the most common BIOS/UEFI firmwares:

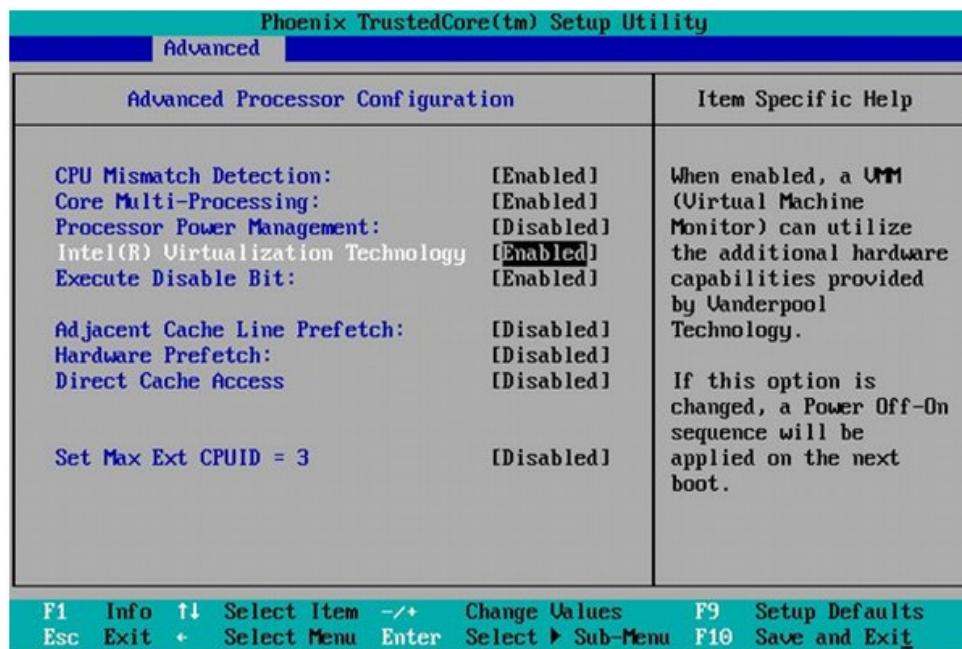


Figure 1.1: BIOS/UEFI: checking VT-X/AMD-V



Figure 1.2: BIOS/UEFI: checking virtualisation extensions

Further information can be found in the Internet. Possible references are either the general introduction provided in [enable-virt-linux] or a Windows 11 specific guide provided by Microsoft Corp. [enable-virt-ms].

1.2 Downloading the appliance and creating the Virtual Machine

While downloading and installing VirtualBox, download the UC3M Virtual Lab image from: https://drive.google.com/file/d/1KPTRL2rsU1PsIn0GH9wYbTToRjEh4a6L/view?usp=drive_link

Since this file is rather large, it is recommended that you save it in an external drive for backup purposes and in order not to overload your device storage space.

Once you have downloaded this file and installed VirtualBox, create the actual UC3M Virtual Lab VM as follows:

1. From the Web browser:
 - once the download process has finished and if your Web browser allows you to open the file you just downloaded, select this option, or
 - open the folder where you downloaded the file and continue using the file browser.
2. From the file browser:
 - double-click on the Open Virtual Appliance (OVA) file you just downloaded and proceed
3. From VirtualBox
 - Select File → Import appliance' from main menu:

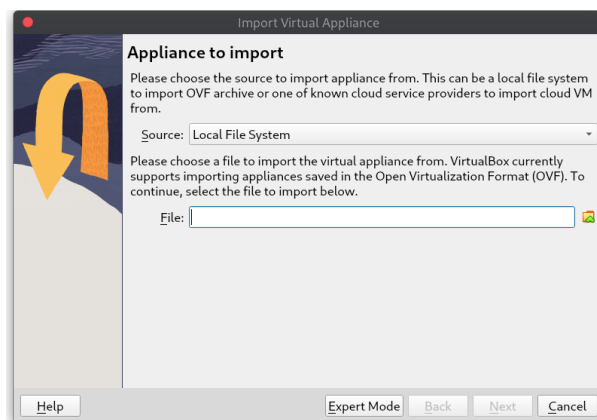


Figure 1.3: OVA selection dialog

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- Browse using the file selector dialog provided by VirtualBox, find the OVA file you just downloaded and select it.

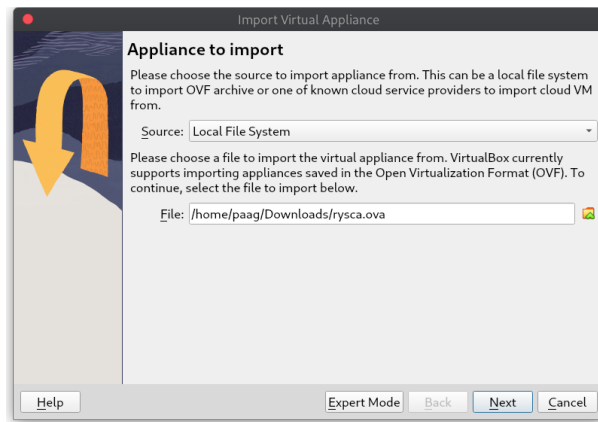


Figure 1.3: The OVA ready to be imported

Click on “Next”

4. At this point, in any of the previous procedures, a dialog with the VM characteristics will appear:

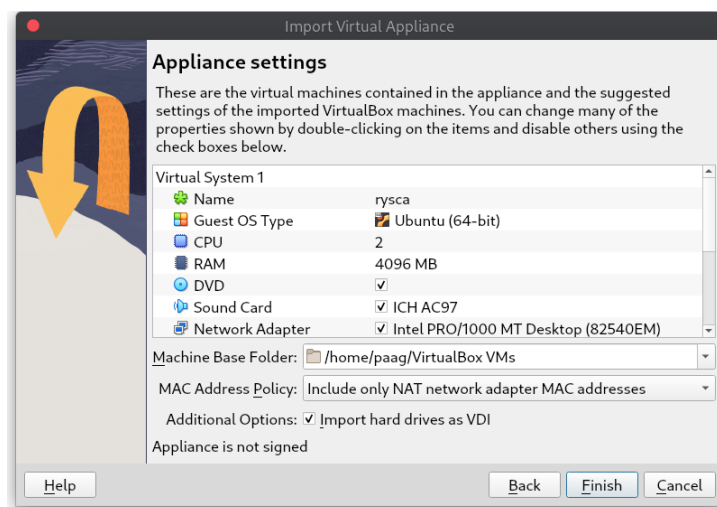


Figure 1.4: Characteristics of the VM stored in the OVA file.

Click on the **Finish** button.

5. Wait until the VM has been imported into VirtualBox.

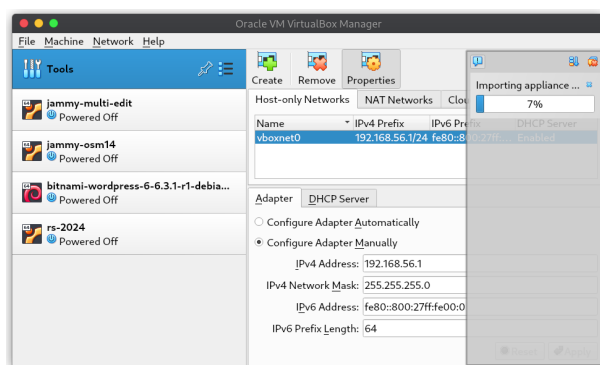


Figure 1.5: Progress dialog while creating the VM.

6. At this point, the VM should appear in the main VirtualBox window:

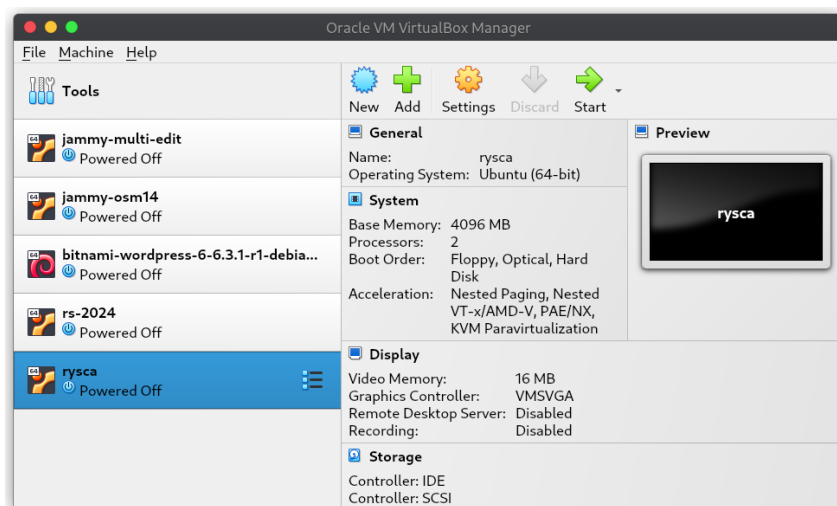


Figure 1.6: The VM was created and is ready to use

1.3 Using the Virtual Machine

Once the VM is running, it is advisable to install the *VirtualBox Guest Additions* to optimise the performance and functionality provided by the VM a.k.a. *guest*.

In the VirtualBox VM window menu, select “Devices → Insert Guest Additions CD image”. A popup will appear. Make sure that the “Open Autorun Prompt” option is selected and click on the **Ok** button.

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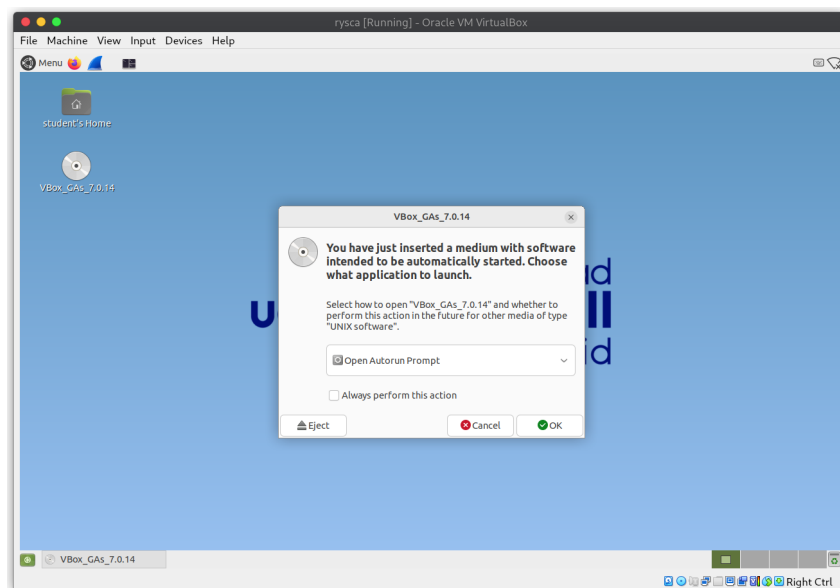


Figure 1.7: Installing the VirtualBox Guest Additions

Confirm that you want to **Run** the software and proceed. You will be asked for the user password (Remember: 5tud3nt) and watch the kernel modules being created and installed.

Note: during the process the virtual display size may change. This is normal and you can proceed ahead.

Once the Guest Additions have been installed, press Enter as instructed by the installation procedure:

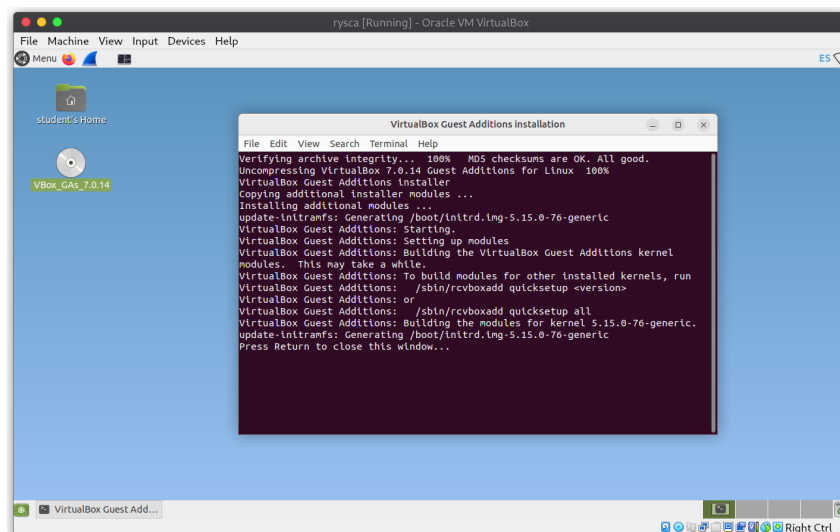


Figure 1.8: The Guest Additions have been installed

Press **Enter**, eject the Guest Additions CD image (right-click on the icon) and shutdown the VM.

Select “Machine → ACPI shutdown” in the VirtualBox VM window menu and **Shutdown** in the

Shutdown dialog inside the guest.

At this point, it is advisable to enable file-system sharing between host and guest, as shown in the next section.

1.4 Host-guest communications

Once the VM is **shut down**, click on the *Shared folders* section of the VM and click on the *Add folder icon*:

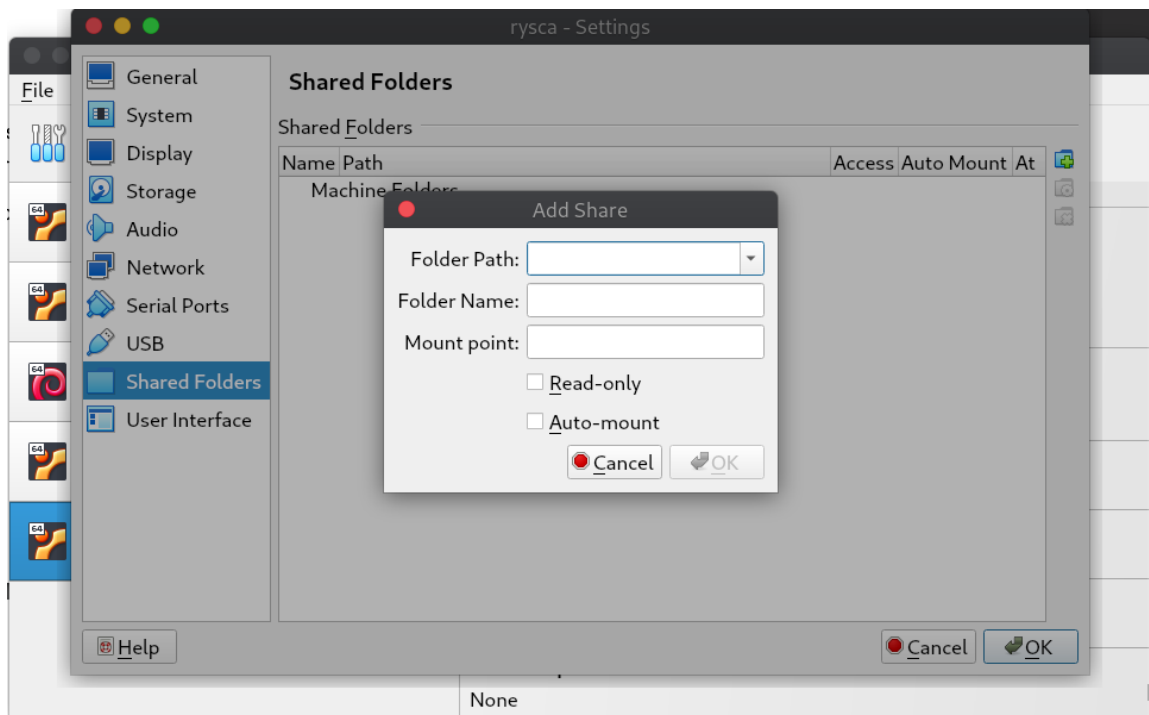


Figure 1.9: Compartiendo ficheros entre la VM y el ordenador

The meaning of the different items in this dialog is the following:

- **Folder path:** Click here to select the folder in your *host* that you want to share with the VM
- **Folder name:** Folder name inside your *guest*
- **Mount point:** Leave this empty
- **Read only:** Don't select this unless you only want to read files from the *host* but don't want to modify them
- **Auto-mount:** Select this to have the folder automatically mounted.

Additionally, you will need to add the `student` user to the `vboxsf` group to have full access to the folder.

In a terminal window, inside the *guest*, type the following command:


```
sudo usermod -aG vboxsf student
```

1.5 User and password

The default user in the UC3M Virtual Lab VM is `student` and the password is `5tud3nt`. You need this password to raise privileges to execute specific system commands using the `sudo` program.

As explained further on, the `lightning` command used to start the UC3M Virtual Lab may also ask you for the password, since it executes some commands that need privilege elevation.

2 Using the UC3M Virtual Laboratory v2

The UC3M Virtual Laboratory v2 is launched with the `lightning` command. This section describes the operation of the UC3M Virtual Lab

2.1 First launch

It is very important to synchronise the state of the UC3M Virtual Lab software with the last version on the first boot. Make sure that you have Internet access from the VM and execute the following command **twice**:

```
lightning update
```

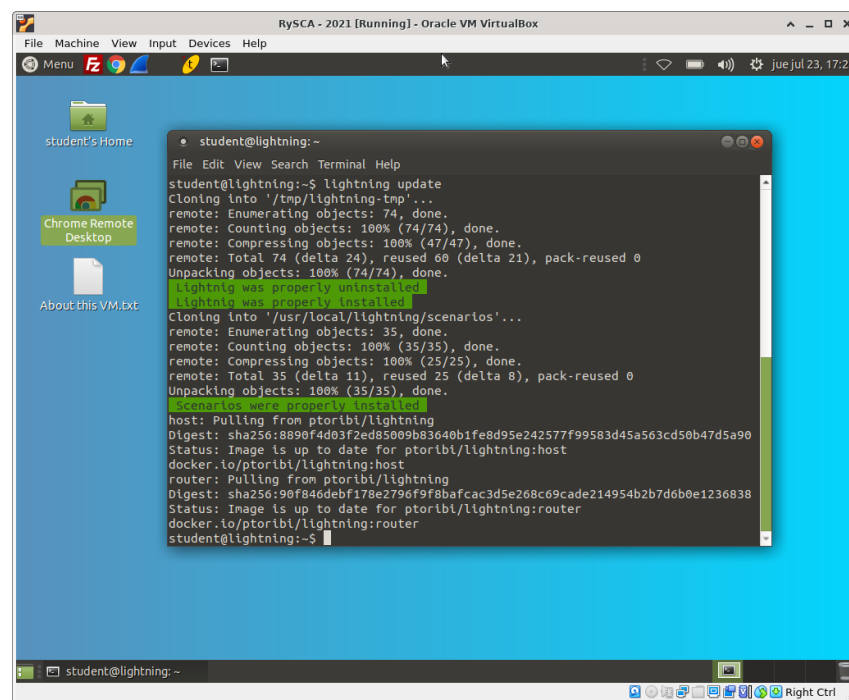


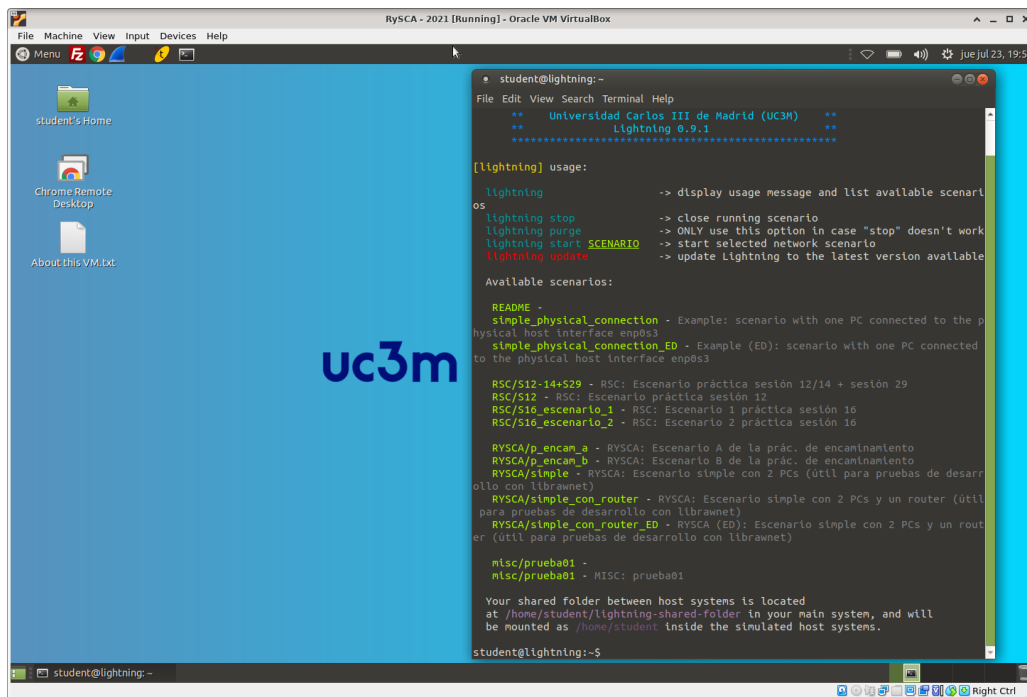
Figure 2.1: Updating the UC3M Virtual Lab to the latest version

2.2 Using the UC3M Virtual Lab

The UC3M Virtual Laboratory is easy to use and will allow you to do the router configuration laboratories as well as the programming modules with `librawnet`.

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The UC3M Virtual Lab includes different network scenarios with routers and final systems to invoke. A full listing of the scenarios shipped with the VM and a detailed help page is printed out when you call the `lightning` program without any further parameters, as shown in the following figure:



```
student@lightning: -  
File Edit View Search Terminal Help  
** Universidad Carlos III de Madrid (UC3M) **  
** Lightning 0.9.1 **  
*****  
[lightning] usage:  
lightning -> display usage message and list available scenarios  
lightning stop -> close running scenario  
lightning purge -> ONLY use this option in case "stop" doesn't work  
lightning start SCENARIO -> start selected network scenario  
lightning update -> update Lightning to the latest version available  
  
Available scenarios:  
  
README -  
simple_physical_connection - Example: scenario with one PC connected to the physical host interface enp0s3  
simple_physical_connection_ED - Example (ED): scenario with one PC connected to the physical host interface enp0s3  
RSC/S12-14+S29 - RSC: Escenario práctica sesión 12/14 + sesión 29  
RSC/S12 - RSC: Escenario práctica sesión 12  
RSC/S16_escenario_1 - RSC: Escenario 1 práctica sesión 16  
RSC/S16_escenario_2 - RSC: Escenario 2 práctica sesión 16  
RYSKA/p_encam_a - RYSKA: Escenario A de la prác. de encaminamiento  
RYSKA/p_encam_b - RYSKA: Escenario B de la prác. de encaminamiento  
RYSKA/simple - RYSKA: Escenario simple con 2 PCs (útil para pruebas de desarrollo con librawnet)  
RYSKA/simple_con_router - RYSKA: Escenario simple con 2 PCs y un router (útil para pruebas de desarrollo con librawnet)  
RYSKA/simple_con_router_ED - RYSKA (ED): Escenario simple con 2 PCs y un router (útil para pruebas de desarrollo con librawnet)  
misc/prueba01 -  
misc/prueba01 - MISC: prueba01  
  
Your shared folder between host systems is located  
at /home/student/lightning-shared-folder in your main system, and will  
be mounted as /home/student inside the simulated host systems.  
student@lightning:~$
```

Figure 2.2: Listing the scenarios shipped with the UC3M Virtual Lab

To start working on a scenario, just type `lightning start <scenario>`. For example to start the scenario `RYSKA/simple_con_router`, the command would be:

```
lightning start RYSKA/simple_con_router
```

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as shown in the following figure:

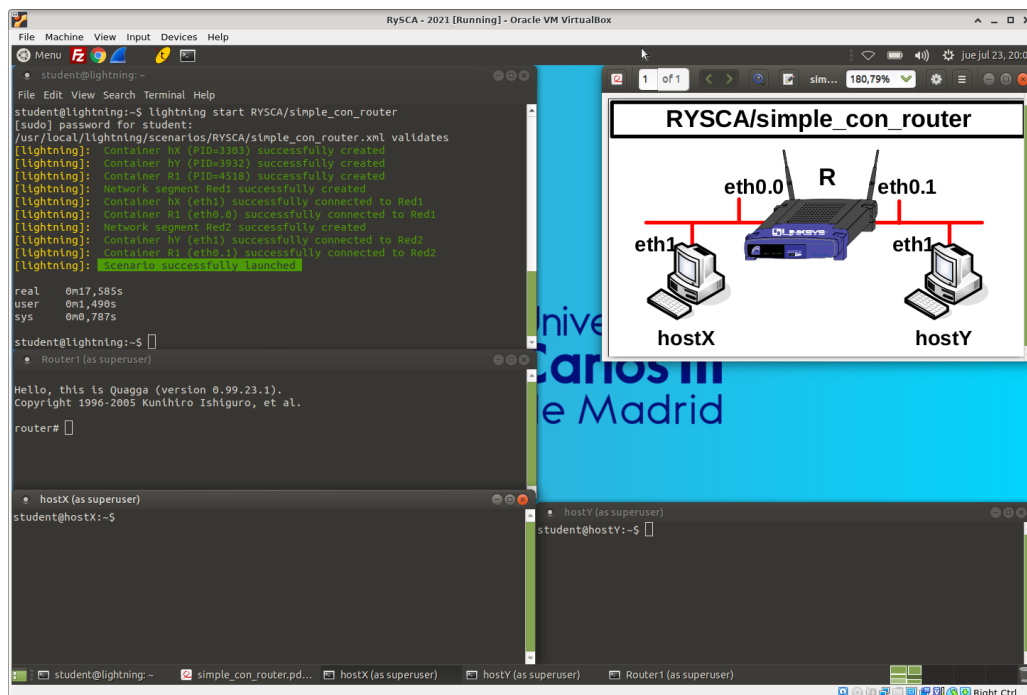


Figure 2.3: Escenario RYSCA/simple_con_router lanzado

Once the scenario is successfully launched, a terminal window will be created for each of the routers and/or final systems involved in the scenario. The interaction with each emulated device in the scenario is exactly the same as with a real device. For example, you will be able to launch Wireshark and compile code with `rawnetcc` on a final system inside the UC3M Virtual Lab.

To stop or destroy a scenario, use the command

```
lightning stop
```

and in case of trouble launching a scenario, it is advisable to reset the UC3M Virtual Lab to a clean state with

```
lightning purge
```

You can hibernate the VM (i.e. stop the VM saving its state) and resume work when launching it again, as long as you don't try to open another scenario before.

2.3 Accidents while using the UC3M Virtual Lab

While using the UC3M Virtual Lab, it can happen that you *accidentally* kill one of the terminals. If it is the terminal you used to launch `lightning`, you may open a new terminal from the desktop menu and use that at any time.

If you closed a terminal that accesses one of the emulated devices in a running scenario, go to the terminal where you launched the UC3M Virtual Lab and issue the following command to recover the access to the device:

```
lightning newtty <device>
```

substituting <device> with the name of the device in the scenario. For example, if your scenario has a PC called PCA and you killed it, you will recover access to it with the command

```
lightning newtty PCA
```

2.4 File sharing inside the UC3M Virtual Lab

It is also possible to share files between the emulated *final systems* and the Guest OS. Files contained in the `~/lightning-shared-folder` folder of the `student` user in the Guest OS are placed in the home directory of the default user in the emulated final system. This allows you to place code or Wireshark capture files and share them between the guest OS and the emulated final system.

Acronyms

CPU	Processor
OS	Operating System
OVA	Open Virtual Appliance
VirtualBox	VirtualBox
UC3M Virtual Lab	UC3M Virtual Laboratory
VM	Virtual Machine