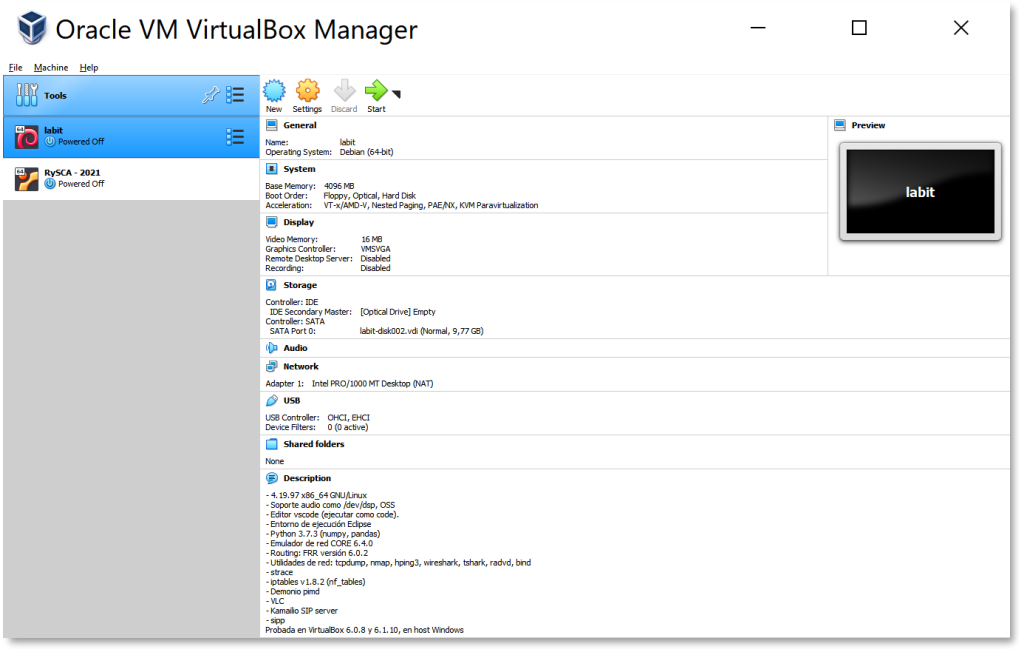
Instructions to install and configure VirtualBox with virtual machines for the labs in your computer

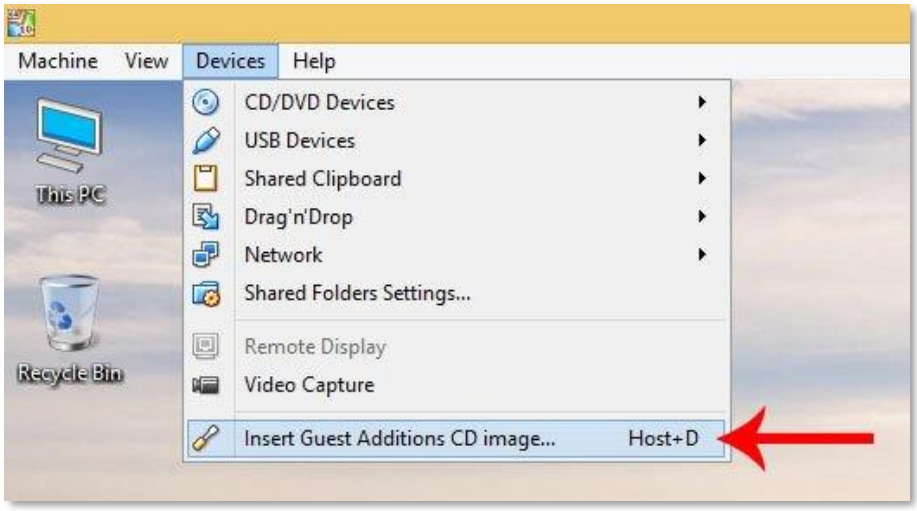
1. Installing the Virtual Machine

1. Download VirtualBox in your system (if you don't have it already) (www.virtualbox.org) and install it.
    a. Check https://www.virtualbox.org/manual/ch01.html#intro-installing for help.
    b. VirtualBox versions over 6.0 are recommended (if you get an error message stating that 32-bit Windows hosts are not supported, install version 5.2).
    c. Install the VirtualBox Extension Pack too (also available from www.virtualbox.org).
2. Download the VM you want to install:
    a. For **LAB_IT** that includes the CORE software (the size is 2.9 GB, and once uncompressed you will need 8.3 GB in your hard disk):
        - http://www.it.uc3m.es/fvalera/ro/labit.html
        - Login 'labsma', password 'amsbal'. It has superuser (root) capacity with the command sudo and the same password.
    b. For **LAB_UC3M** that includes a virtual version of the physical routers lab (around 4 GB):
        - http://www.it.uc3m.es/fvalera/ro/labuc3m.html
        - Login 'student', password '5tud3nt'. It has superuser (root) capacity with the command sudo and the same password.
3. Installing the VM
    a. Start VirtualBox
    b. Double-click into the VM (.ova file) that you want to install.
        - For LAB_IT tick into 'restart the MAC address of the network cards'.
    c. Click 'Import' to proceed with the installation.
    d. You can remove the downloaded image if you want since VirtualBox has already made a copy of the required information.



2. Inside the Virtual Machine

1. To start the VM
    a. Click on 'start' to initialize the VM
2. To close the VM
    a. To close the VM select 'System -> Shut Down' in the VM menu.
    b. Another alternative is to use the VirtualBox 'File' -> 'Shut Down' -> 'Save the machine state'. This is basically 'suspending' the system (you will need extra hard disk space to do it).
    c. But DO NOT use VirtualBox 'File' -> 'Shut Down' -> 'Power off the machine', because it is equivalent to powering the system off and it does not facilitate an ordered file system shut down (in case this is important for you).
3. Install Guest Additions (GA) into the VM (you must repeat this in all the VMs you want)
    a. The GA allow you to have extra functionalities like have a larger screen (resize), share files with your host operating system, copy&paste with your host operating system, etc. In order to do this:
        - Start the VM
        - In the menu 'Devices' available in the VirtualBox screen of the VM, select 'insert Guest Additions CD image'.



        - Open a terminal in the VM and run:

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1. sudo mkdir -p /media/cdrom
2. sudo mount -r -t iso9660 /dev/hdc   /media/cdrom/
3. sudo bash /media/cdrom/autorun.sh
4. sudo umount /dev/hdc
```

        - You may get a message stating that you already have a previous version already installed. Install this new version in any case.
    b. Once installed (it may take a short while), reboot the VM.
        - In case the resolution has not been automatically adapted you can do it at Preferences->Monitor settings

3. Performance improvement

For further performance configuration:

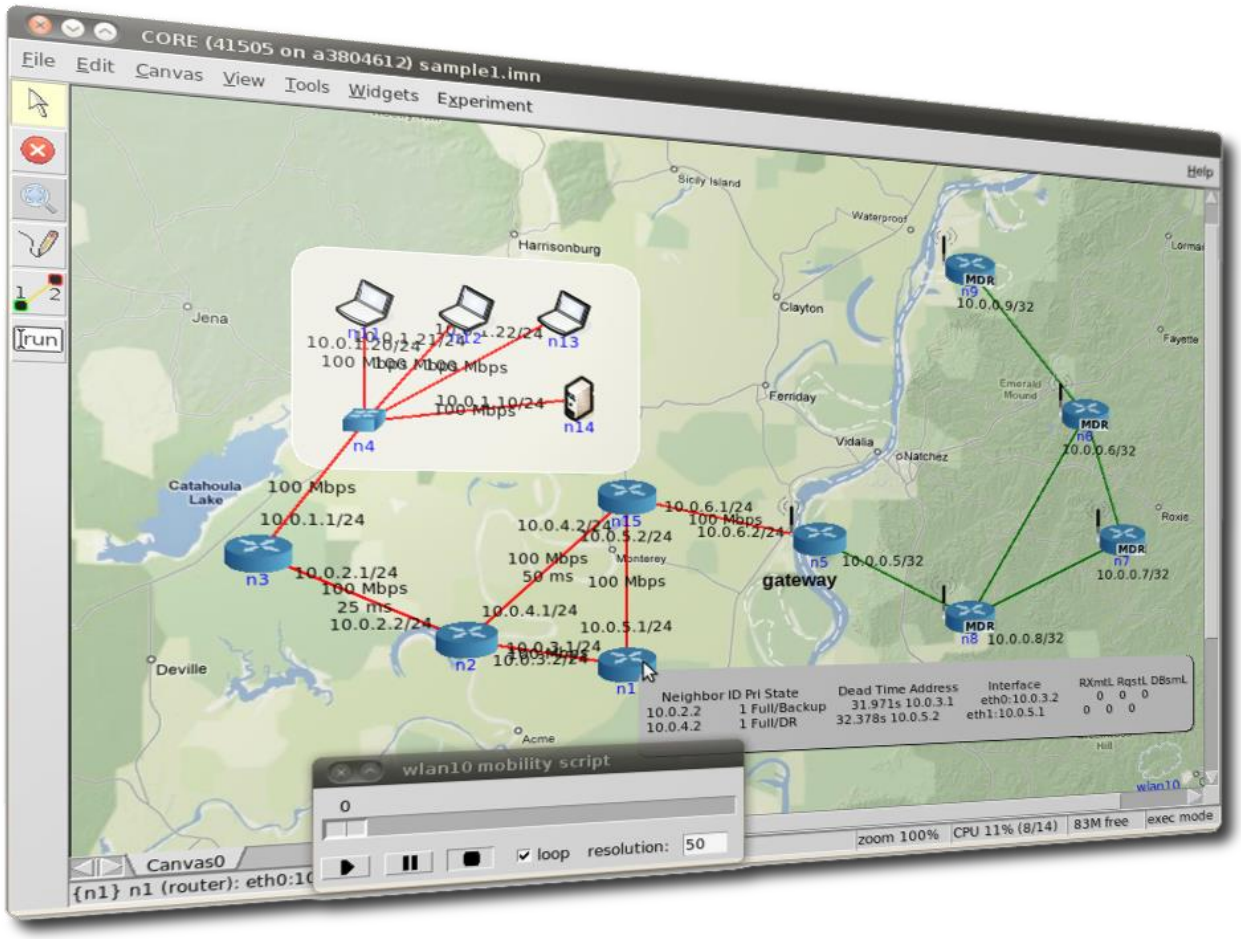
1. In your equipment BIOS/UEFI be sure to enable the performance enhancements to run virtual machines (it depends on the equipment but they typically include support for VT-x or AMD-V).
    a. To configure the BIOS you have to press a special key when the computer is initializing and before your Operating System is loaded (F8, F2, DEL, ESC, etc. it may change depending on the computer).
    b. To configure the UEFI in Windows 10 for instance, go inside the Start Menu and then Settings
    ->Update&security->Recovery
        - Under Advance Startup, click on "Restart now"
        - Then Troubleshoot -> Advance Options -> UEFI Firmware Settings -> Restart
        - You can check this video for more details: https://www.youtube.com/watch?v=ZqObRbu1DRo
    c. Once inside the BIOS/UEFI check in the menu for the Virtualization option and enable it in case it is disabled.
    d. In case you see any error related to this after the software installation, you can deactivate the support for VT-x/AMD-V in VirtualBox: choose -> Settings -> System -> Acceleration -> DISABLE the option 'Enable VT-x/AMD-V'. **But you should first try to configure your computer BIOS/UEFI properly because disabling VT-x/AMD-V support is associated with a notorious performance penalty**.
2. In some cases, the tool may indicate that there is are 'Invalid settings detected' in the VM system settings. It is normally because the selected memory is too high compared to the total memory available in the equipment. In general, it is better if you fix this.
3. In order to improve the system performance, you should normally check:
    a. System -> Mother board -> Hardware clock in UTC
    b. System -> Processor -> enable PAE/NX
    c. System -> Processor -> enable nested VT-x/AMD-V (check step 'a')
4. Some of these options may require changes in the BIOS. You may see some of these errors in this case:
    a. PROBLEM: VT-x / AMD-V hardware acceleration not available
    b. PROBLEM: System Acceleration Problem
    c. PROBLEM: OK option in grey
    d. PROBLEM: Acceleration tab in grey
    e. PROBLEM: Processor arrow in grey

4. Extras

- You can update the installed packages if the 'Software Updater' asks you to do so but we do NOT recommend updating the Ubuntu version (in this case LUbuntu) included in the VM to a newer one (just update the different packages).
- You can install/delete packages or to configure the VM using the command sudo dpkg with the provided password. That way you can install your favorite text editor, etc.
- You can adapt your keyboard settings you can do it in Preferences -> Keyboard Input Methods -> Input Method
- You can only change the configuration of the VM (VirtualBox interface) when the VM is stopped (and not when it is just saved).
- To copy files to/from your VM you have several options:
  a. Open a browser (Firefox) inside the VM and get your files from your favorite server (Drive, Dropbox, etc.)
  b. Insert a removable device (USB stick) and in the VM configuration, 'Devices' -> 'USB', select the corresponding device. The USB stick will not be visible for the external operating system and will be mounted into the VM.
  c. Permanently mount a shared folder with your host VM (only in case you have installed the Guest Additions):
     - Shut the VM down, open the configuration of the VM in VirtualBox and select 'Shared folders'. Add the folder you want and select 'Auto-mount'
     - In the figure below we make your 'C:\temp\sharedfolder' to have the same contents as '/sharedfolder' (in some environments this may not work due to the access rights needed to access the system. In general, VirtualBox need to have access to all the folders starting from the root one. Be sure to grant this access rights particularly in Linux or Mac)
- Some other common problems:
  a. PROBLEM: Kernel driver not installed (error on macOS)
     - In your computer go to System Preferencies / Security & Privacy and click in "Allow" for "software from Oracle America, Inc."
  b. PROBLEM: The virtual machine does not detect my keyboard
     - Increase the video memory (in VM display settings)
  c. PROBLEM: Inside the virtual machine the keyboard keys display a different letter/number/character
     - Change the Keyboard language
  d. PROBLEM: Nothing happens when I click on "Insert Guest Additions CD image"
     - The window has not prompted but the virtual CD is already there
  e. PROBLEM: I can't write the route to the Guest Additions
     - The route may vary depending on your computer (hint: You can use the Tab Key on your keyboard for autocompleting the names of folders files when writing)
  f. PROBLEM: After writing and clicking "sudo ./VBoxLinuxAdditions.run", I try to write down the password and nothing happens in the terminal
     - Although no letters are displayed on window; you are still writing. Write the password "core" and hit enter on your keyboard.

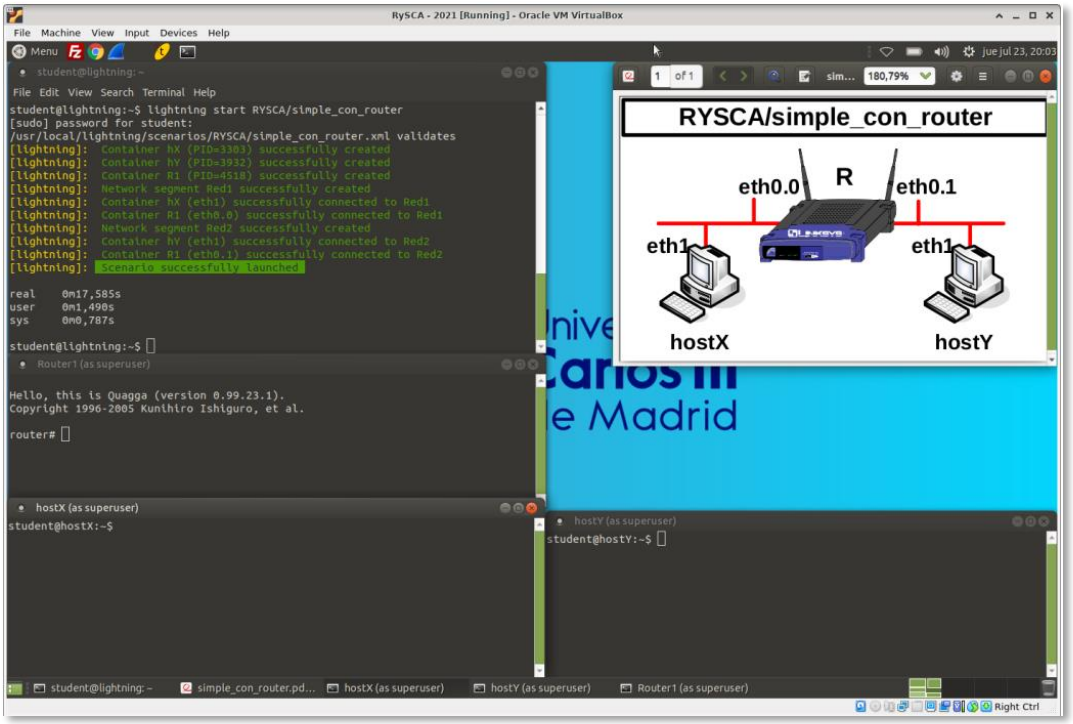
5. LAB_IT VM: CORE

- Open VirtualBox and launch the “LAB_IT” Virtual Machine (labit VM)
- Double click on the CORE icon on the VM desktop to start the application

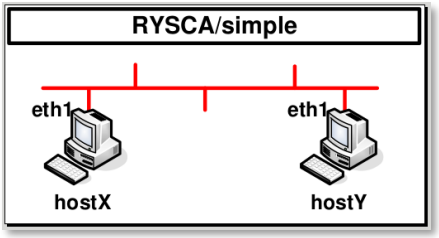


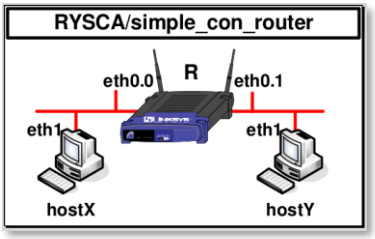
6. LAB_UC3M VM: Lightning

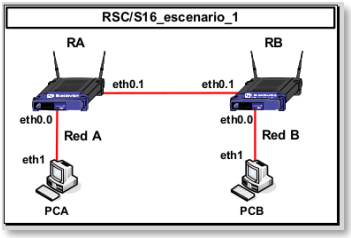
- Open VirtualBox and launch the "LAB_UC3M" Virtual Machine (RySCA – 2021 version for instance)
- It is very convenient whenever you use this VM that you update it by opening a Terminal and running 'lightning update' TWICE (you need to be connected to the Internet)
- You can now start the different scenarios by typing: 'lightning start [SCENARIO_NAME]' (e.g. 'lightning start RYSCA/simple_con_router')
  a. You can locate the xml files with more scenarios in '/usr/local/lightning/scenarios/RSC' and '/usr/local/lightning/scenarios/RYSCA'
- You will be able to see the picture of the created scenario and a different console per network device in the picture (routers or hosts)

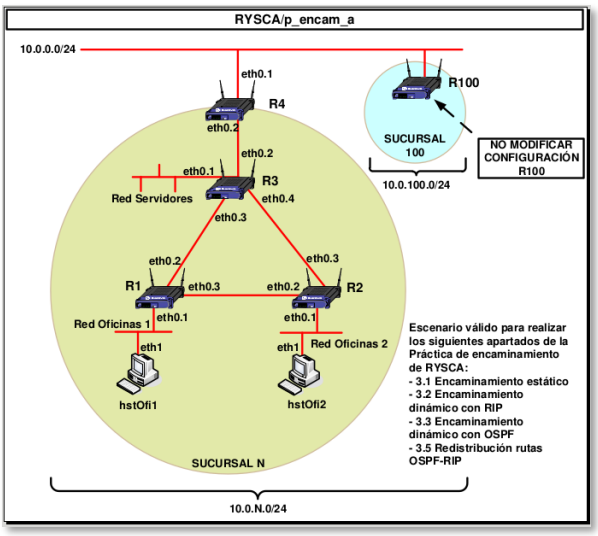


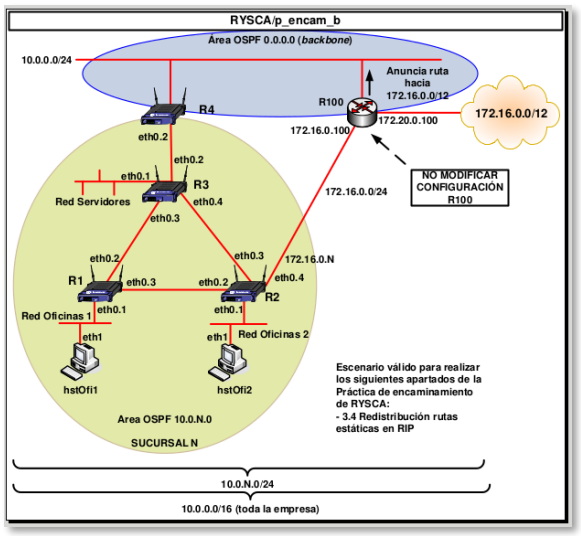
- Now you are ready to work with the topology as if you had it set up in the laboratory with the physical equipment (PCs and Linksys WRT54GS routers).
- If you want to stop the created scenario just execute 'lightning stop' and wait for the terminals to be closed (the picture must be closed manually).
- If you don't want to lose your work progress when you leave, do not power off the virtual machine, just click on the "Save the machine state" button when closing the VM window.
- Scenarios:











- Remote desktop:
  a. The VM includes the Google Remote Desktop feature (allowing the student to share its environment with the teacher).
  b. Click on the 'Chrome Remote Desktop' icon in your desktop and select 'Remote support'. You must initiate a Google session with your university account in case you have not done so yet.
     i. Language will probably change to Spanish in your browser now
  c. Select 'Recibir asistencia' to generate the assistance code that you will provide to your teacher (the code expires after 5 min, so do not generate it until you are instructed to do so).