Cairo University
Faculty of Engineering

ECE 403 Fall 2016

Computer Networks Project

Virtual Networks Lab using Linux and the CORE Network Emulator

Introduction Document

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1 Acknowledgements

Brian Linkletter web site http://www.brianlinkletter.com has great tutorials that helped writing this lab and exploring multiple other packages.

2 Overview

The objective of the project is to enhance the skills the ECE department 4th year students in the area of IP networking. Since there is not an actual lab of routers that can accommodate all students to experiment and learn, using virtualization and the CORE open source network emulators, the students will be able to build and configure a network that resembles and behaves exactly like a network of real routers and end nodes. The routers are based on Quagga software that are fully capable of using Cisco routers configuration commands and support OSPF, RIP, BGP, etc. Students will collect results from the network traces and asked to interpret the results in order to gain good understanding of IP networking concepts.

In this lab, students will be exposed to different techniques such as router configuration, traffic generation, TCP protocol performance, OSPF routing, network analysers and tracers. As a side knowledge students will be exposed to using Linux and virtualization tools.

3 Setup Tutorial

3.1 Obtain the Lab Files

1- Get the CUVirtualNetLab.zip from the Internet Lab.

2- Unzip in any folder, you will find three main folders/files:

   a. CUVirtualNetLab_2016.pdf (this file)

   b. CUNetProject_2016.pdf (the actual project)

   c. Vcore4.7 folder

   d. VirtualBox-5.0.14-105127-Win.exe

3- You may also choose to download the latest version of Oracle VirtualBox for your operating system

3.2 Install Virtualbox and setup CORE virtual machine

1- Install VirtualBox on your PC. You can use VMWARE as well or install virtualbox/vmware on Linux if you plan to use Linux to host the virtual lab. However, the process herein assumes virtualbox on windows environment. You are on your own if you want to try other combinations (they should work without problem but the instructor and teaching assistant have no time to help you if you have any problems).

2- Move the folder Vcore4.7.zip to the location of your choice. For example D:\Vbox\/Vcore4.7

3- Now open virtualbox software, select Machine -> Add and browse to D:\Vbox\/Vcore4.7 and select the file vcore-4.7.vbox
A new virtual machine will be added. You can select Machine -> Settings -> System and increase the virtual machine allocated RAM to 1 Gbytes or more for better performance.

4- Start the virtual machine Vcore by selecting it and clicking start. It may ask you few questions about LAN cards, etc, choose default answers.

5- **Important Note**: It is highly likely that the virtual machine may not start complaining about some network card does not exist. If this happens select the virtual machine, right click, select properties -

> network -> and then on adapter 1 attached either choose not attached or choose bridge and then select the network adapter installed on your PC (e.g. some Ethernet or Wifi interface).

3.3 Running Vcore

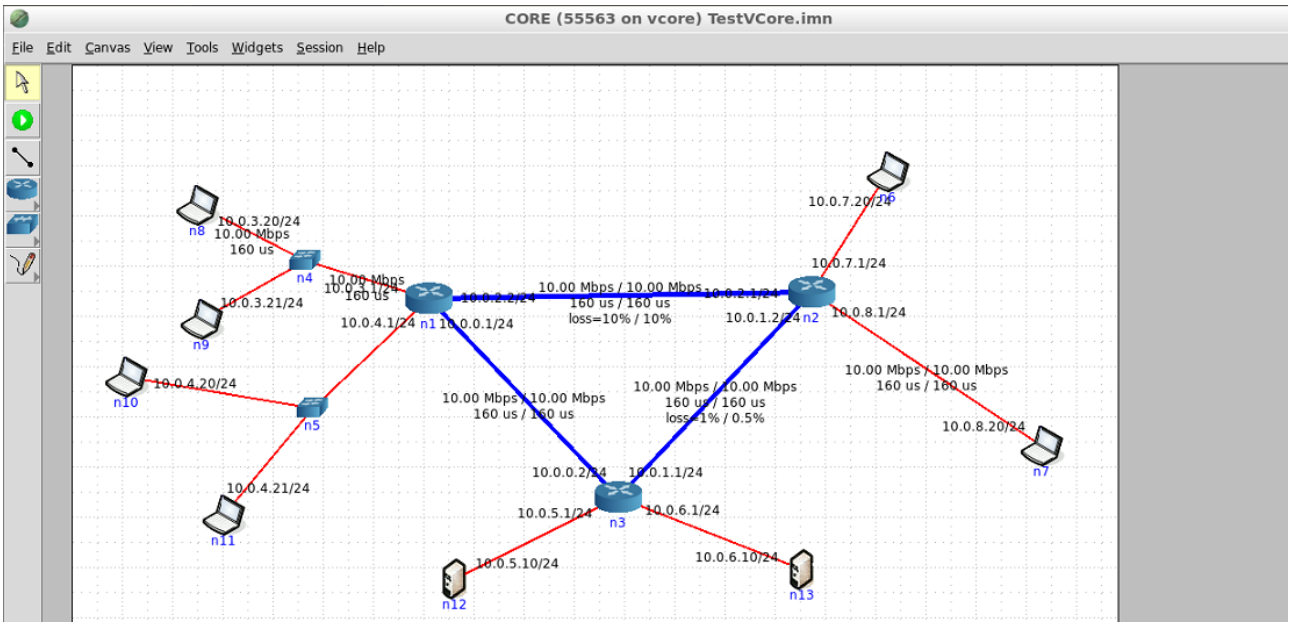
Important Note: Both the user name and password to the Vcore Linux installation are “core”

1- The Linux virtual machine will start and you will see on the desktop a green icon named CORE as in the picture

6- Double click on CORE icon, the CORE emulator starts

7- Select File -> Open and browse to /home/core/.core/configs/TestVCore.imn
You should see a network topology as shown below.

8- Click on the Green start button on the left panel in VCore window



9- In the above topology, the nodes n1, n2, and n3 are full-fledged routers based on Quagga software. This software is an open source implementation of routing protocols supporting RIP, OSPF, BGP-4. It has a configuration interface almost identical to Cisco IoS-based routers.

10- Nodes n4 and n5 are Ethernet switches, whereas the rest of the nodes n6 through n13 are Linux hosts. They support all Linux commands available on the Vcore Linux installation.

11- Wait till all nodes have a green square around them. Right Click on node 7, select shell window and then bash. Repeat for node 8. You now have full control over these two nodes via the bash shell script (Linux equivalent to DOS prompt).

12- On node n7 ping and tracroute the path to n8 by issuing the commands

   a. ping 10.0.3.20

   b. traceroute 10.0.3.20

13- Change link parameters on the path between n8 and n7 like delay, loss, capacity, and watch how ping performance behaves. Note that links are not symmetric and you may need to configure both directions.

14- Run iperf3 performance tool to generate traffic and measure throughput/delays. More about iperf3 will be provided later. For now, do the following:

   a. On n8 run an iperf3 server, issue the command: iper3 –s –D
   This means as follows: –s run as server, –D run as daemon (process in the background)

   b. On n7 run an iperf3 tcp client, issue the command
   iperf3 –c 10.0.3.20 –t 1000 –i 10 –w 4k
   This means as follows: –c client, 10.0.3.20 is address of node n8 at which iperf3 server executes, –t 1000 run for duration of 1000 seconds, –i 10 report results every 10 seconds, –w 4k use TCP window size of 4 kbytes.

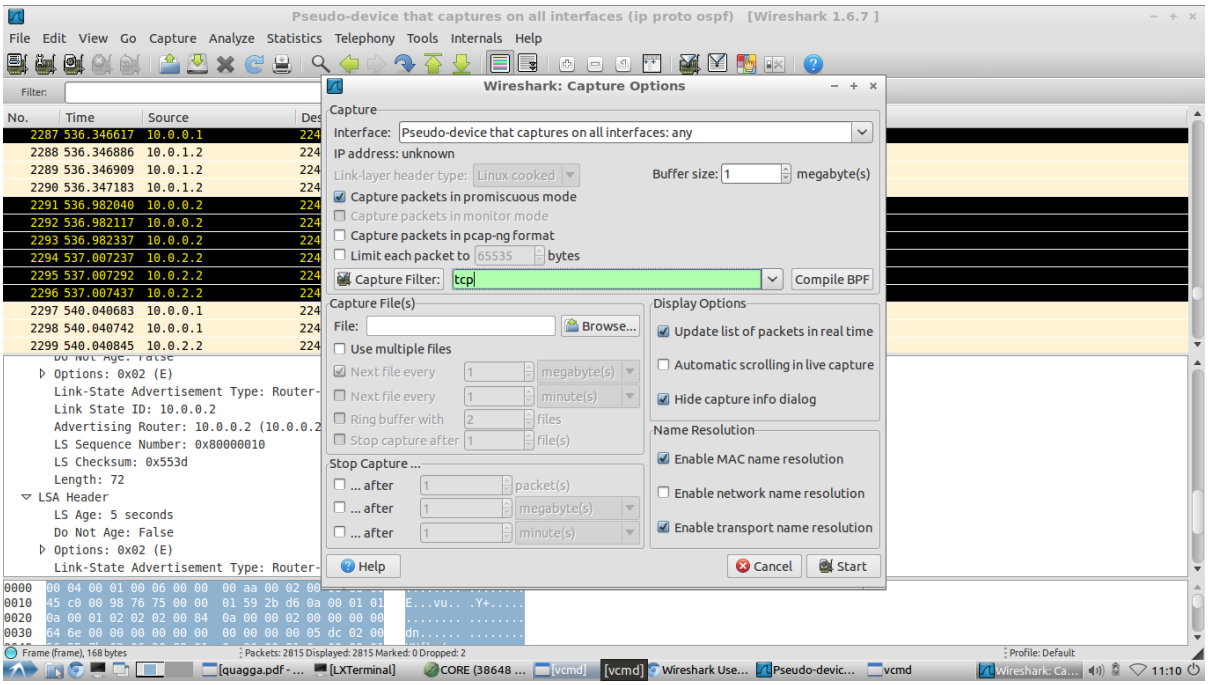
   c. More information on iperf3 can be found at
   https://fasterdata.es.net/performance-testing/network-troubleshooting-tools/iperf-and-iperf3/

15- Now you are ready to explore more. Go to the web site:
http://www.brianlinkletter.com/core-network-emulator-test-drive/
Try all the steps there with traffic generation etc.

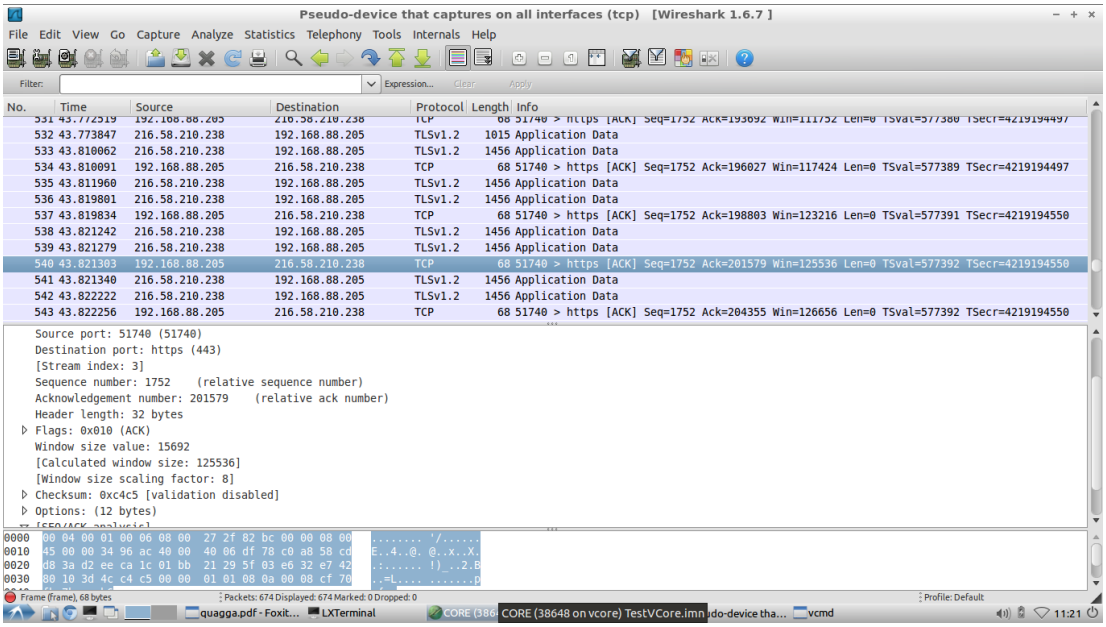
16- Move the mouse to any node in the vcore window and Right Click on the node and select Wireshark and then select any of the network interfaces.

17- Wireshark (a network packet analyser) will start and report some error message, ignore it.

18- Start a wireshark capture, select **psedu-device that captures all interfaces** as shown in the image.



19- From wireshark menu select capture, you will get a dialog as in the above picture. Go to the capture filter and write tcp (or udp). Start a traffic session using iperf3 and make sure you observe packets in the wireshark window (see picture below). Click on a packet and have a look at the headers of the different layers, TCP, IP, Ethernet.



20- Open File Manager on Linux and get familiar with browsing and opening files etc. You can find a folder called /home/core/Documents where some important documents to be used in the assignment can be found.

21- Optionally, get familiar with basic Linux commands like ls, cp, mv, gedit. Type man ls, man cp, man mv, man gedit to know more information.

22- Learn how to switch back and forth between Linux and Windows. Pressing the right control key (Host key) + F puts Linux into full screen mode, and Host+C puts it in a scaled mode where it appears as another program in Windows.

23- Try also capturing USB device in Linux by selecting Devices->USB from the virtualbox host window and select your USB drive to be able to move files between Linux and Windows. Do the reverse (unselect) to be able to see the USB drive back in Windows.

24- When you are done and want to leave, move the mouse to the bottom of the Linux screen (if working in full screen mode) some menu will pop up among which there is a menu item called File.
Select it and select Close -> Save the machine state. This will enable you to come back where you left off.
Alternatively, select Machine -> ACPI Shutdown and choose Hibernate so that you come back to the Linux virtual machine.
Now you are back to windows. Go back to Linux virtual machine by starting it again and do some other exploring of Linux commands and file browsing or even use chromium browser to browse the Internet.

25- Goto step 1 (of section 3.3) and do the above a couple of 2-3 times to get ready for the actual lab/experiment.