Networking Labs

ECE

ING4 (SI)

2018/2019

Network Virtualization With VirtualBox

Lab 2

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Session Requirements:

- Please work in pairs!
- Each group shall submit one single report. **Same groups shall be maintained during the semester.**
- The report shall be submitted on the campus page ONLY.
- **Only PDF format is accepted** (3 points penalty for other formats)
- Answer all the numbered questions (in bold)
- **Late reports are not allowed! This is a hard deadline!**
- The deadline for submitting the reports is
    - **27 January 2019 by midnight**

Network virtualization with VirtualBox

The objective of the lab is to understand how to configure virtual networks, machines and routers. You will learn also to configure a router, an HTTP server, an FTP server and a DHCP server on a Linux machine. Finally, you shall understand the HTTP protocol by analyzing an exchange with Wireshark. For this purpose, you will create 4 virtual machines and you will use the host machine on one of the virtual networks.

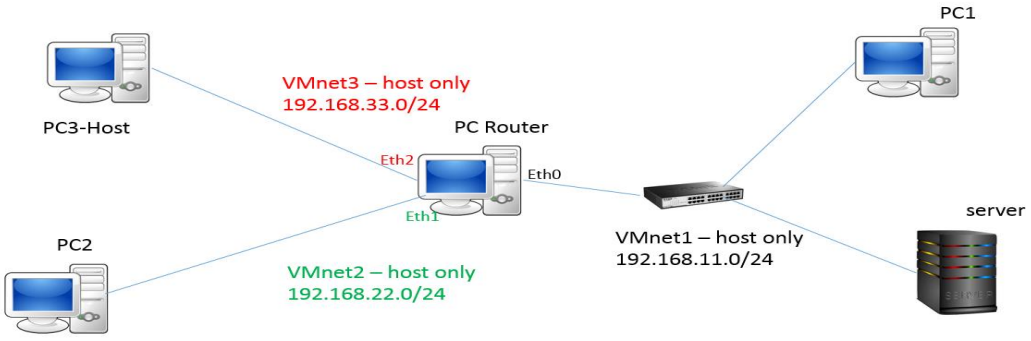
Before starting the lab, let's learn about the basic network administration commands in a Linux environment from this page:

https://fr.wikibooks.org/wiki/Administration_r%C3%A9seau_sous_Linux/Configuration_r%C3%A9seau

Start now:

Create and install a virtual machine with the following settings:

1. Operating system: debian 8.3 or later version (link:
   https://www.debian.org/CD/http-ftp/#stable
   http://www.osboxes.org/vmware-images/
2. Disk space: 12 GB
3. Memory: 256 MB



Once the first VM is created, create a full clone (3 times). Now you have 4 VMs. Please call the machines **PC1, PC2, PC Router, Server.**

The PC router shall have three network interfaces eth0 (or whatever name), eth1and eth2 (You need to add two additional interfaces, by default each machine has only network interface).

Realize the network configuration as given the previous figure:

- PC1, Server and the PC Router (on the first Ethernet interface) are connected to the first virtual network in "Host Only" mode. **Do not forget to disconnect the host machine from this network.** By default, it is connected on all the virtual networks.

  You can set statically the IP addresses on this network. Configurations shall be done in the file /etc/network/interfaces. You have also to disable the DHCP Server of VirtualBox.

  PC Router: 192.168.11.1/24
  PC1: 192.168.11.10/24 (GW: 192.168.11.1)
  Server: 192.168.11.2/24 (GW: 192.168.11.1)

- PC2 and the PC Router (second network interface) are connected to the second virtual network "VMnet2". (**You need to disconnect the host machine from this network**.

  You can set statically the IP addresses on this network. Configurations shall be done in the file /etc/network/interfaces. You have also to disable the DHCP Server of VirtualBox.

  PC Router: 192.168.22.1/24
  PC2: 192.168.22.10/24 (GW: 192.168.22.1)

- PC3-Host (the host machine) and the PC Router (interface eth1) are connected to the third virtual network "VMnet3".

  You can set statically the IP addresses on this network (in the file /etc/network/interfaces). You have also to disable the DHCP Server of VirtualBox.

  PC Router: 192.168.33.2/24
  PC3-Host: 192.168.33.1/24

1. **Launch the 4 machines and fill in the following table**

Ping	Status (OK/Fail)
PC1 → PC-Router	
PC2 → PC-Router	
PC3-Host → PC-Router	
Server → PC2	
PC3-Host → PC1	

2. **Comment on the failed pings!**
3. **Add the necessary configurations on PC1, PC2, Server and PC-Router so that these 4 PCs can ping each other (provide the basic commands, configurations done)**
4. **Do (and provide) the necessary configurations so that PC3-Host can ping the server and PC2**

DHCP Server

Disable the DHCP server on VMNet1 and VMNet2.

Install a DHCP server ("dhcp3-server" or "isc-dhcp-server") on the PC-Router to configure dynamically IP addresses on VMNet1 and VMNet2**. Configure the DHCP server as follows:** (refer to the following page to learn more about the DHCP configuration: https://wiki.debian.org/fr/DHCP_Server)

- The network address for VMNet1 is 192.168.1.0/24.
- The network address for VMNet2 is 192.168.2.0/24.
- Attribute manually the first available address on each subnet to the gateway (PC-Router).
- Reserve a fixed address for the server on VMNet1 (192.168.1.2)

5. **Show the basic DHCP server configuration file and the PC router configuration on each interface (provide screenshot).**

6. **Mention the basic steps needed to ensure the correct startup of the DHCP service (provide the basic Linux commands you used for setting up, configuring and launching the DHCP server. Indicate also the files you need to configure for this purpose).**
7. **Ping PC1 from PC2 and vice versa (show screenshots).**

HTTP Server

Install an HTTP server 'apache2' on the server (if it is not installed yet) (Remember that you need to switch the interface to the bridged/NAT mode to install apache2, when installation is finished, you have to switch the network interface back to VMNet1)

Copy (using ssh) a web page (create a simple one displaying your full name and that of your pair) from the PC-Host to the server

8. **Provide the ssh command you used to copy the page**

With an HTTP client (Browser) installed on PC-Host, retrieve a webpage from the HTTP server on the Server.

9. **Capture and analyze with Wireshark an HTTP traffic on PC-Host (Provide a screen shot showing the browser getting the page and a sequence diagram that shows the basic HTTP exchanges between the client and the server)**

FTP Server

Install an FTP server on PC1. Create also a text file (size > 1 MB) on this VM (you can use any existing file). Download this file on the host machine (PC3 Host) using a client FTP (Filezilla for example). You must capture this transfer with Wireshark for analyzing and understanding TCP and FTP.

TCP Understanding

Use a filter that displays only the frames that correspond to the file transfer.

10. **Identify the connection establishment and connection release of this file transfer.**
    - Capture and analyze the segments used for this purpose.
    - Identify the important flags, sequence and ACK numbers of these segments.
    - Give the IP and MAC addresses and TCP port numbers on both sides
    - Use a sequence diagram to illustrate the connection establishment and release

11. **Identify the sequence numbers of the first 10 data segments sent.**
12. **Identify the segments that acknowledge the reception of these segments.**
13. **Are there any re-transmissions? How can you know?**
14. **Study and analyze the impact of the receiver's buffer space on the sender (based on window size advertisement). Display the window scaling graph.**
15. **Display throughput graphs in both connection directions. Analyze.**

FTP Understanding

16. **How many TCP connections are used to accomplish this data transfer (provide screenshots)? Give the source and destination port numbers for each connection**
17. **Create 3 text files on the FTP server. Start a new Wire shark capture. Let the FTP client download these files at the same time. How many TCP connections are used for the transfer of these 3 files? Give the source and destination port numbers for each connection.**
18. **Are you able to read the content of the files with Wireshark? If it is the case, is it secure? Comment.**
19. **With a sequence diagram, explain a file transfer with FTP:**
    a. **Show all the messages (commands and/or codes) exchanged for establishing connection with FTP server, authentication, listing and changing directories, requesting transfer (GET or PUT)**
    b. **Data transfer**
    c. **Connection release**

Appendix A: DHCP server installation

To install and configure dhcp3-server (or isc-dhcp-server), follow the instructions in the following page:

http://doc.ubuntu-fr.org/dhcp3-server

https://wiki.debian.org/fr/DHCP_Server

Appendix B: HTTP server installation

To install dhcp3-server, follow the instructions in the following page:

http://doc.ubuntu-fr.org/apache2

Appendix C:

To force Wire shark to display information of TCP rather than FTP do the following:

- Click on ***Analyze***
- Select ***Enable protocols***
- Uncheck ***FTP***
- Click **OK**