Homework #2

Due Time: 2019/3/24 (Sun.) 22:00
Contact TAs: `vegetable@csie.ntu.edu.tw`

Submission

- Put all answers **in one single PDF file**, in the same order as the problem sheet. Do not repeat problem descriptions, just organize them by problem number in a tidy manner.

- Submit on NTU COOL (`https://cool.ntu.edu.tw`).

Instructions and Announcements

- Discussions with others are encouraged. However, you should write down your solutions **in your own words**. In addition, for **each and every** problem you have to specify the references (the URL of the web page you consulted or the people you discussed with) on the first page of your solution to that problem.

- Problems below will be related to the materials taught in the class and may be far beyond that. Try to search for additional information on the Internet and give a reasonable answer.

- Some problems below may not have standard solutions. We will give you the points if your answer is followed by reasonable explanations.

- **NO LATE SUBMISSION OR PLAGIARISM IS ALLOWED.**

Network Administration

1. CSMA/CD

In class, we've learned about CSMA/CD. However, switches, instead of hubs, are used more often in modern Ethernet networks, leading to the lack of use in CSMA/CD. Please explain the reason why CSMA/CD is rarely used when we choose switches instead of hubs. Nevertheless, we still use CSMA/CD in some corners. Please give an example in which CSMA/CD is used alongside switch (instead of hub).

2. Look Foward to being Fowarder

In Lab2, we created a `socks` proxy through SSH tunnel; there are, in fact, more things we can do with `ssh`. Sometimes, we have some machines holding private IPs inside an NAT network that is inaccessible to external network. There are two ways to access these machines: either a machine with both public and NATed interface is used as a proxy, or the NATed machine initiates a special SSH connection with a machine with public interface. The special connection exposes a port on the public-facing machine and forwards all traffic to the port back to the NATed machine. In this part, we will explore the second method.

a. Download the VM and start SSH server

Download the *Zeus's Laptop* virtual machine we provide in SA section. Then, install and start the SSH server as followed:

```
$ sudo yum install -y openssh-server
$ sudo systemctl enable sshd; sudo systemctl start sshd
```

b. Forward the port

Configure *Zeus's Laptop* to access public network by NAT.

Make *Zeus's Laptop* accessiable to the world by using `nasa-hw0.csie.ntu.edu.tw` (a public-facing machine) as a forwarder.

c. Try to ssh

Use the following command for testing:

```
ssh zeus@nasa-hw0.csie.ntu.edu.tw -p [your port]
```

This command will teleport you to *Zeus's Laptop*, **wherever you are**. You might possibly connect to other people's computer, so double-check **it is your *Zeus's Laptop***.

Notes

- If you forget your password for homework 0, contact TAs.

- Use any (and only) port between 8000~8999 in `nasa-hw0.csie.ntu.edu.tw`. If somebody has used your port, use another.

- Check again whether you ssh to **your** machine correctly. You might possibly connect to others' machines.

- Explain what you've done thoroughly and screenshot the last step.

3. IPerf Everywhere

Use `iperf` to measure the bandwidth between corners in CSIE department.

Required combinations of corners:

1. Two devices connected to our WiFi (SSID: `CSIE` or `CSIE-5G`) in the Dirtien building.

    - You can cooperate with one of your friends, just mention him/her in your report.

2. A 204 PC and one device connected to WiFi (`CSIE` or `CSIE-5G`)

3. *The CSIE Public Workstation* and one device connected to WiFi (`CSIE` or `CSIE-5G`)

4. *The CSIE Public Workstation* and a 204 PC.

Note: non-CSIE student without a CSIE account shall use `nasa-hw0.csie.ntu.edu.tw` as a replacement for *the CSIE Public Workstation.*

Required analysis:

1. Thoroughly explain what you have done and screenshot the resulting bandwidth in all four parts.

2. Try to analyze the differences between the four resulting bandwidth and give a reasonable explanation.

Hint: build `iperf` from source or download a static binary built by one of the TAs: here[1].

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[1] https://github.com/yunchih/static-binaries

System Administration

Zeus's Laptop

It is said that *Technology always comes from human nature.*

After graduating from senior high school, Zeus owned his first Windows laptop. However, things got worse day after day. His `D://` drive was occupied with many *Academic Videos* and there was no more free space in the directory!!!

In his second semester at CSIE, Zeus takes the NASA course and learns some knowledge about Linux, including partition, file-system and Linux kernel. After that, Zeus decides to re-install his laptop to a Linux distribution called *CentOS 7* and try to solve the problem he faces.

Please download Zeus's Laptop before you start.

- Download from either sites:

    - CSIE workstation: http://linux4.csie.org:59487/Zeus_Laptop.ova
    - google drive: http://bit.ly/2F0cHXi

- MD5 checksum : `3722d4b4265d920de3b37f64ebf6664c`

- account:

    - username : zeus (with root permission)
    - password : zeus

- Use *Virtualbox* or *VMWare* to open the `.ova` file.

1. More space (15 pts)

Zeus always puts all *Academic Videos* under `/home/zeus/course`. However, there is no free space now QwQ. Therefore, he wants to enlarge it.

1. Create a new partition, `/dev/sdaX`, with size 3GB ($X \in \mathbb{N}$).

2. Create a LVM physical volume on `/dev/sdaX` and use this to extend the original volume group (Zeus) from 9G to 12G.

3. Enlarge `/home/zeus/course` file-system from 1G to 2G without rebooting the machine. (Make sure to extend your file-system as well as the partition)

4. Capture the output of the following command with a screenshot: "`lsblk; df -h;`".

Hints:

- The MBR partition table supports up to four primary partitions.

- `/dev/sda` will be further partitioned in other tasks ...

- Shall `/dev/sdaX` be primary or extended partition?

2. New Video (5 pts)

After enlarging the file-system, Zeus finally has additional space to put new videos! Every week, Zeus shares some new videos with his classmates. Can you copy the latest video to `/home/zeus/course`?

1. Mount the partition `/dev/sda3` to `/mnt/media`.

2. Copy `new_video.mp4` from `/mnt/media` to `/home/zeus/course`.

   Hints: Read-only?

3. Encrypted Homework (15pts)

With great dilligence, Zeus has watched all *Academic Videos* and thus he always gets high grades on homework and exams. Therefore, some of his classmates plan to steal his homework from his laptop. After knowing that, Zeus would like to encrypt all datas in `/home`.

1. Use LUKS to encrypt the logical volume that holds `/home`.

2. Make the encrypted logical volume mounted on boot.

   - User will be prompted for password as a part of booting process.
   - Do not accomplish this by running a script on user login.

3. Take the screenshot of password prompt during booting (see here[2] for an example).

4. Take another screenshot of the output of the following command: "`lsblk; df -h`" (Make sure to mount `/home/zeus/course` back).

   Hints:

   - Make sure you backup the data in `home` (to somewhere else) before creating the LUKS, and recover when you are done.

   - Use `yum` to install the package: *cryptsetup*

4. Backup (10pts)

Zeus is taught the possibility of disk failure and the importance of data backup in the NASA course. To protect his *cherished videos*, Zeus decides to backup them regularly.

1. Use LVM commands to create a snapshot (1 GB logical volume named `backup`) for `/dev/mapper/Zeus-video`.

2. Then, `tar` all files in the snapshot to `/home/backup-video.tar`.

3. Capture the output of the following command with a screenshot: "`lsblk`".

4. Then, use LVM commands to drop (remove) the snapshot logical volume.

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[2]`https://i.imgur.com/ETRdGhA.png`

5. Experiment (5pts)

Knowing that there is some additional unused disk space on the laptop, Zeus wants to try some brand new technology on it, such as software RAID and *btrfs*.

- Short answer:

    1. List at least one difference between *ext4* and *btrfs* file-system.
    2. Briefly describe what RAID 0, RAID 1 and RAID 5 are.

- **Bonus (5pts)**:

    1. Make two additional partitions on `/dev/sda` with size of 2GB and 2GB, respectively.
    2. Then, format the two partitions into *btrfs*, implement software RAID 1 and mount it at `/btrfsdisk`.
    3. Capture the output of the following command with a screenshot: "`lsblk; btrfs filesystem show;`".

Further reminders

- You can install any package on the VM if needed. However, **do not re-install** the machine and **do not remove files** on the machine without our instruction. You should finish all tasks using the VM provided by us.

- You should write down what you do step by step, and explain what you are doing to get full credit.

- The process is as important as the result. Therefore, if you do things in some incorrect or nasty ways (such as writing a script that mounts a file-system during user login), you will not get full credit.

- *Absolute power corrupts absolutely*: type commands with great care. **You are a root** and blindly copy-paste a command from *stackoverflow.com* and its friends could lead to devastating damage. Check **reliable** documentation, e.g `man`, and think twice.