Homework #2 Solution

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Network Administration

Part 1

1. (10%)

The modern Ethernet networks often use network switches rather than network hubs to connect their links now. Since each link that connects to the switch has its own separate port, it doesn't use share media anymore. Hence CSMA is not necessary. Furthermore, some of the modern network applications even remove this protocol such as 10 Gigabit Ethernet, which is defined by IEEE 802.3ae-2002 standard. It uses full duplex point-to-point links and those links are generally connected by network switches. Full duplex means two sides of a link can send message to each other simultaneously. The most common example is telephone.

2. (15%)

Concept: The **binary exponential backoff** algorithm, which is used in Ethernet as well as in DOCSIS cable network multiple access protocols [DOCSIS 2011], elegantly solves this problem. Specifically, when transmitting a frame that has already experienced n collisions, a node chooses the value of K at random from $\{0, 1, 2, ... 2^n - 1\}$. For Ethernet, the actual amount of time a node waits is K * 512 bit times (i.e., K times the amount of time needed to send 512 bits into the Ethernet). Suppose that a node attempts to transmit a frame for the first time and detects a collision. The node then chooses $K = 0$ with probability 0.5 or chooses $K = 1$ with probability 0.5. If the node chooses $K = 0$, then it immediately begins sensing the channel. If the node chooses $K = 1$, it waits 512 bit times (e.g. 0.01 microseconds for a 100Mbps Ethernet) before beginning the sense-and-transmit-when-idle cycle. After the second collision, K is chosen with equal probability from $\{0, 1, 2, 3\}$.

Calculations: After the 5th collision, the adapter chooses from $\{0, 1, 2, ..., 31\}$. The probability that it chooses 4 is 1/32. Note that the one bit times 10^{-7} seconds ($= 0.1$ μs) for 10Mbps Ethernet. It waits 4 * 512 * 0.1 = 204.8 μs.

3. (25%)

1. Download source code of `iperf-3.1.3` from https://iperf.fr/download/source/iperf-3.1.3-source.tar.gz

2. Build it locally by `./configure --prefix=[directory you want];make;make install`.

3. Do 1. and 2. on both 217 Workstation and your PC.

4. Run `[path_to/]iperf3 -s` on 217 Workstation to set up an `iperf` server.

5. Run `[path_to/]iperf3 -c [IP of 217 Wrokstation] -p [port of 'iperf3 -s' in 4.]` to measure the bandwidth from your PC to 217 Workstation.

6. Take screenshot of result showing on your PC.

   In step 5., it's okay to use parameter `-u` which means using UDP in transmission.

System Administration

```
# in VirtualBox
# following are two examples:
# (boot with bios, type of partition table = msdos (mbr))
# (boot with uefi, type of partition table = gpt)

parted /dev/sda mklabel gpt
(or "parted /dev/sda mklabel msdos"
 Note that this option makes it nearly impossible to get the bonus.)
parted /dev/sda mkpart primary 1mib 513mib
parted /dev/sda mkpart primary 1g 5g
parted /dev/sda mkpart primary 5g 6g
parted /dev/sda mkpart primary 6g 20g

# partition 2 for rootfs
mkfs.ext4 /dev/sda2
mount /dev/sda2 /mnt

# partition 1 for /boot
parted /dev/sda set 1 boot on
mkfs.fat -F32 /dev/sda1
mkdir /mnt/boot
mount /dev/sda1 /mnt/boot

# partition 3 for swap
mkswap /dev/sda3
swapon /dev/sda3

# partition 4 for lvm
pvcreate /dev/sda4
vgcreate vg /dev/sda4
lvcreate -n home-part -L 4g vg
lvcreate -n var-part -L 4g vg
mkfs.ext4 /dev/vg/home-part
mkfs.ext4 /dev/vg/var-part
mkdir /mnt/home
mkdir /mnt/var
mount /dev/vg/home-part /mnt/home
mount /dev/vg/var-part /mnt/var

# for spec 3.
tune2fs -m 10 /dev/vg/var-part

pacstrap /mnt base

# for spec 7.
genfstab -U /mnt >> /mnt/etc/fstab

arch-chroot /mnt
```

```
# remember to set password for root
passwd

# for spec 6 and bonus
pacman -S grub
pacman -S efibootmgr
# if the type of partition table is gpt
    grub-install --target=x86_64-efi \
    --efi-directory=/boot --bootloader-id=boot
    grub-mkconfig -o /boot/grub/grub.cfg
    mv /boot/EFI/boot/grubx64.efi /boot/EFI/boot/bootx64.efi
# if the type of partition table is msdos
    grub-install --target=i386-pc /dev/sda
    grub-mkconfig -o /boot/grub/grub.cfg

exit
shutdown now
(remove the image for installation and then boot)

# for spec 8.
lvresize -r -L +2G /dev/vg/home-part
```