

NASA homework2

Network Administration

Iperf3

我是透過在一台裝置當做server，先呼叫 `ifconfig`，得到其IP address，再透過指令 `iperf3 -s` 使其成為 server。而另一台當client，透過 `iperf3 -c <server IP> -n 100M` 即可。

- 兩台連接csie(無線網路)的裝置：

```
Server listening on 5201 (test #1)

Accepted connection from 10.5.3.64, port 57507
[ 5] local 10.5.5.75 port 5201 connected to 10.5.3.64 port 57508
[ ID] Interval          Transfer     Bitrate
[ 5]  0.00-1.00    sec   1.43 MBytes  12.0 Mbits/sec
[ 5]  1.00-2.00    sec   2.35 MBytes  19.8 Mbits/sec
[ 5]  2.00-3.00    sec   1.52 MBytes  12.7 Mbits/sec
[ 5]  3.00-4.00    sec   1.45 MBytes  12.2 Mbits/sec
[ 5]  4.00-5.00    sec   2.13 MBytes  17.9 Mbits/sec
[ 5]  5.00-6.00    sec   1.75 MBytes  14.7 Mbits/sec
[ 5]  6.00-7.00    sec   2.06 MBytes  17.3 Mbits/sec
[ 5]  7.00-8.00    sec   2.46 MBytes  20.7 Mbits/sec
[ 5]  8.00-9.00    sec   2.31 MBytes  19.4 Mbits/sec
[ 5]  9.00-10.00   sec   2.53 MBytes  21.2 Mbits/sec
[ 5] 10.00-11.00   sec   2.29 MBytes  19.2 Mbits/sec
[ 5] 11.00-12.00   sec   2.23 MBytes  18.7 Mbits/sec
[ 5] 12.00-13.00   sec   1.64 MBytes  13.8 Mbits/sec
[ 5] 13.00-14.00   sec   1.06 MBytes  8.85 Mbits/sec
[ 5] 14.00-15.00   sec   1.04 MBytes  8.76 Mbits/sec
[ 5] 15.00-16.01   sec   427 KBytes  3.48 Mbits/sec
[ 5] 16.01-17.00   sec   329 KBytes  2.71 Mbits/sec
[ 5] 17.00-18.00   sec   1.56 MBytes  13.1 Mbits/sec
[ 5] 18.00-19.00   sec   2.24 MBytes  18.8 Mbits/sec
[ 5] 19.00-20.00   sec   2.08 MBytes  17.4 Mbits/sec
[ 5] 20.00-21.00   sec   1.97 MBytes  16.5 Mbits/sec
[ 5] 21.00-22.00   sec   2.61 MBytes  22.0 Mbits/sec
[ 5] 22.00-23.00   sec   1.56 MBytes  13.1 Mbits/sec
[ 5] 23.00-24.00   sec   2.34 MBytes  19.7 Mbits/sec
[ 5] 24.00-25.00   sec   1.90 MBytes  15.9 Mbits/sec
[ 5] 25.00-26.00   sec   1.30 MBytes  10.9 Mbits/sec
[ 5] 26.00-27.00   sec   2.60 MBytes  21.8 Mbits/sec
[ 5] 27.00-28.00   sec   2.28 MBytes  19.1 Mbits/sec
[ 5] 28.00-29.00   sec   1.95 MBytes  16.3 Mbits/sec
[ 5] 29.00-30.00   sec   1.68 MBytes  14.1 Mbits/sec
[ 5] 30.00-31.00   sec   2.32 MBytes  19.5 Mbits/sec
[ 5] 31.00-32.00   sec   2.07 MBytes  17.3 Mbits/sec
[ 5] 32.00-33.00   sec   2.52 MBytes  21.1 Mbits/sec
```

```

[ 5] 33.00-34.00  sec  2.42 MBytes  20.4 Mbits/sec
[ 5] 34.00-35.00  sec  2.07 MBytes  17.3 Mbits/sec
[ 5] 35.00-36.00  sec  2.18 MBytes  18.3 Mbits/sec
[ 5] 36.00-37.00  sec  1.32 MBytes  11.1 Mbits/sec
[ 5] 37.00-38.00  sec  2.59 MBytes  21.7 Mbits/sec
[ 5] 38.00-39.00  sec  2.66 MBytes  22.3 Mbits/sec
[ 5] 39.00-40.00  sec  2.81 MBytes  23.6 Mbits/sec
[ 5] 40.00-41.00  sec  2.61 MBytes  21.9 Mbits/sec
[ 5] 41.00-42.00  sec  3.17 MBytes  26.5 Mbits/sec
[ 5] 42.00-43.00  sec  3.14 MBytes  26.4 Mbits/sec
[ 5] 43.00-44.00  sec  2.48 MBytes  20.8 Mbits/sec
[ 5] 44.00-45.00  sec  2.76 MBytes  23.2 Mbits/sec
[ 5] 45.00-46.00  sec  2.53 MBytes  21.2 Mbits/sec
[ 5] 46.00-47.00  sec  3.14 MBytes  26.3 Mbits/sec
[ 5] 47.00-47.70  sec  1.34 MBytes  16.1 Mbits/sec
-----  

[ ID] Interval          Transfer     Bitrate  

[ 5] 0.00-47.70  sec  99.2 MBytes  17.4 Mbits/sec
                                         receiver

```

- 一台連接csie(無線網路)與一台連接csie-5G(無線網路)的裝置：

Server listening on 5201 (test #1)

```

Accepted connection from 10.5.3.64, port 57517
[ 5] local 10.5.5.75 port 5201 connected to 10.5.3.64 port 57518
[ ID] Interval          Transfer     Bitrate  

[ 5] 0.00-1.00  sec  4.92 MBytes  41.3 Mbits/sec
[ 5] 1.00-2.00  sec  4.76 MBytes  39.9 Mbits/sec
[ 5] 2.00-3.00  sec  5.71 MBytes  47.9 Mbits/sec
[ 5] 3.00-4.00  sec  5.73 MBytes  48.1 Mbits/sec
[ 5] 4.00-5.00  sec  6.17 MBytes  51.8 Mbits/sec
[ 5] 5.00-6.00  sec  5.34 MBytes  44.8 Mbits/sec
[ 5] 6.00-7.00  sec  7.55 MBytes  63.3 Mbits/sec
[ 5] 7.00-8.00  sec  6.13 MBytes  51.5 Mbits/sec
[ 5] 8.00-9.00  sec  6.49 MBytes  54.5 Mbits/sec
[ 5] 9.00-10.00  sec  4.48 MBytes  37.5 Mbits/sec
[ 5] 10.00-11.00  sec  6.06 MBytes  50.9 Mbits/sec
[ 5] 11.00-12.00  sec  4.92 MBytes  41.1 Mbits/sec
[ 5] 12.00-13.00  sec  4.34 MBytes  36.5 Mbits/sec
[ 5] 13.00-14.00  sec  7.83 MBytes  65.7 Mbits/sec
[ 5] 14.00-15.00  sec  8.27 MBytes  69.4 Mbits/sec
[ 5] 15.00-16.00  sec  8.84 MBytes  74.1 Mbits/sec
[ 5] 16.00-16.17  sec  1.45 MBytes  71.9 Mbits/sec
-----  

[ ID] Interval          Transfer     Bitrate  

[ 5] 0.00-16.17  sec  99.0 MBytes  51.4 Mbits/sec
                                         receiver

```

- 兩台連接csie-5G(無線網路)的裝置：

```
Server listening on 5201 (test #1)

Accepted connection from 10.5.3.64, port 57548
[ 5] local 10.5.5.75 port 5201 connected to 10.5.3.64 port 57549
[ ID] Interval          Transfer     Bitrate
[ 5] 0.00-1.00   sec  2.15 MBytes  18.0 Mbits/sec
[ 5] 1.00-2.00   sec  3.57 MBytes  30.0 Mbits/sec
[ 5] 2.00-3.00   sec  2.76 MBytes  23.2 Mbits/sec
[ 5] 3.00-4.00   sec  5.83 MBytes  48.9 Mbits/sec
[ 5] 4.00-5.00   sec  4.60 MBytes  38.6 Mbits/sec
[ 5] 5.00-6.00   sec  4.68 MBytes  39.2 Mbits/sec
[ 5] 6.00-7.00   sec  4.92 MBytes  41.3 Mbits/sec
[ 5] 7.00-8.00   sec  5.69 MBytes  47.7 Mbits/sec
[ 5] 8.00-9.00   sec  7.34 MBytes  61.7 Mbits/sec
[ 5] 9.00-10.00  sec  8.00 MBytes  67.1 Mbits/sec
[ 5] 10.00-11.00  sec  12.0 MBytes  101 Mbits/sec
[ 5] 11.00-12.00  sec  12.6 MBytes  106 Mbits/sec
[ 5] 12.00-13.00  sec  13.3 MBytes  112 Mbits/sec
[ 5] 13.00-14.00  sec  11.3 MBytes  95.2 Mbits/sec
[ 5] 14.00-14.03  sec   505 KBytes  149 Mbits/sec
-
[ ID] Interval          Transfer     Bitrate
[ 5] 0.00-14.03  sec  99.3 MBytes  59.4 Mbits/sec           receiver
```

(Ref: <https://blog.gtwang.org/useful-tools/iperf-network-bandwidth-testing-tool-tutorial/>)

IPv6

```
[b08902149@oasis1 [~] telnet -6 fe80::5054:ff:fecf:12d9%net0 8888
Trying fe80::5054:ff:fecf:12d9%net0...
Connected to fe80::5054:ff:fecf:12d9%net0.
Escape character is '^]'.

/ FLAG{Q:Is_this_problem_too_easy?A:No... \
\ QQ}                                /



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 \  (oo)\_____
   (__)\       )\/\
     ||----w |
      ||     |

Connection closed by foreign host.
```

- 步驟與指令：

- 先連接到工作站：`ssh b08902149@oasis1.csie.ntu.edu.tw`
- 透過 ifconfig 查看IPv6位址
- 透過 telnet 與port進行connect：`telnet -6 fe80::5054:ff:fecf:12d9%net0 8888`

(IPv6地址的telnet操作 : `telnet <ipv6地址>%<接口序號> <port number>`)

(Ref: <https://zhuanlan.zhihu.com/p/144171272>)

Cisco Switch

1. VLAN, Access, and Trunk

- 因為對 `Gi1/0/5` 而言，`vlan307` 是Native vlan，所以只要沒有tag的封包它也不會幫它上tag，所以看封包的802.1q header是沒有vlan ID的。而對 `Gi1/0/4` 而言，它與另外一台之間沒有定義Native Vlan，所以會替該封包的802.1q header寫上vlan ID為307。對 `Gi1/0/3` 而言，該封包只是在switch內部傳輸，所以也無需上tag，該封包的802.1q header也不會寫上vlan ID。

(Ref: <https://www.jannet.hk/virtual-lan-vlan-zh-hant/>)

- 因為 `Gi1/0/1` 是tagged port並且沒有Native VLAN的設定，因此在通過 `Gi1/0/1` 之前，封包的802.1q header會紀錄著上面的tag為VLAN 424。而封包要離開 `Gi1/0/2` 時，因為 `Gi1/0/2` 是untagged port，此時就會把封包的tag移除，因此在離開 `Gi1/0/2` 之後，封包的802.1q header是沒有tag的。

(Ref: <https://networkdirection.net/articles/network-theory/taggeduntaggedandnativevlans/>)

- 如果有一個封包的VLAN ID與某個port的Native VLAN吻合，該port就會把那個封包的tag移除再傳出。該指令用在有switch-to-switch的communication上面，當兩台switch需要分享connected devices的資訊時，就可以這樣設定，sending switch就不需要決定要選擇使用什麼VLAN來傳遞這個資訊。如果今天我們希望將某個VLAN ID設成Native VLAN，我們就可以在trunk link的兩邊interface透過 `switchport trunk native` 的指令設定相同的Native VLAN。需注意trunk link的兩邊需要設定相同的Native VLAN，不然會造成Native VLAN mismatch的狀況。

(Ref1: <https://networkdirection.net/articles/network-theory/taggeduntaggedandnativevlans/>)

(Ref2: <https://www.jannet.hk/virtual-lan-vlan-zh-hant/>)

2. More on Link Aggregation

- 不可以，因為要做Link Aggregation需要是相同速度的網路線。

(Ref: 上課講義)

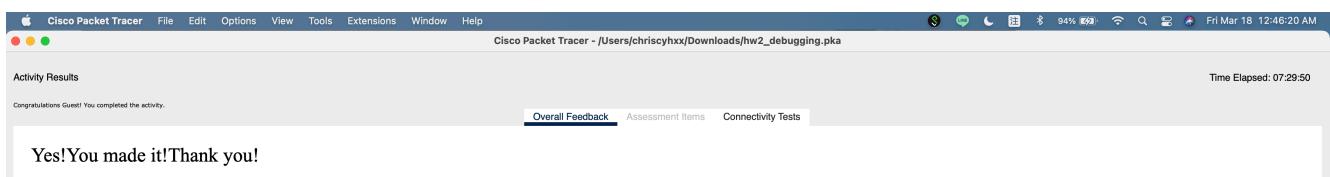
- 錯誤點在於兩邊的 `Gi1/0/1-2` 都設 `channel-group 1 mode passive`。因為兩邊都在等對方主動發出LACP封包來協商，所以就沒辦法建立EtherChannel。應該至少將一邊的 `Gi1/0/1-2` 都設成 `channel-group 1 mode active` 即可。

(Ref: <https://www.jannet.hk/etherchannel-pagp-lacp-zh-hant/>)

3. Network Debugging

- 因為NewUser的privilege是2，他沒有privilege 15的使用者下放 configure 指令給他使用。
(Ref: <https://www.twblogs.net/a/5b96ef292b717750bda788dc>)
- 透過NewUser使用 show run 可以看到admin的password是經過"type 7"的cisco password，而網路上也找得到Decrypt的方法，可以知道admin的密碼是 TopSecret 。
(CISCO Type 7 Password Decrypt : <https://www.firewall.cx/cisco-technical-knowledgebase/cisco-routers/358-cisco-type7-password-crack.html>)
(Ref: <https://blog.xuite.net/towns/hc/553633779>)
- 透過 show run 與 show vlan 可知要把 Gi1/0/3 和 Gi1/0/2 的shutdown解除，並且把 vlan 100 和 vlan 200 啟用。用以下指令即可。

```
Core(config-if)#vlan 100
Core(config-vlan)#vlan 200
Core(config-vlan)#int Gi1/0/3
Core(config-if)#no shutdown
Core(config-vlan)#int Gi1/0/3
Core(config-if)#no shutdown
```



(討論對象：b05504066 李旻翰)

System Administration

(SA討論對象：b09505014王聖文)

1. 與其他作業系統共用檔案

先以下列指令建立file system並且mount到 /mnt/usbdisk

```
sudo mkfs -t ntfs /dev/sdi1
sudo mount -t ntfs3 /dev/sdi1 /mnt/usbdisk
```

再透過 `ls -lh /dev/disk/by-uuid` 查詢到 `UUID=6737F20A06B9B0C3` 後，在 `/etc/fstab` 裡加上：

`UUID=6737F20A06B9B0C3 /mnt/usbdisk ntfs defaults 1 2` 即可在開機時自動掛載。

```
[nasa@nasahw2 ~]$ lsblk; df -hT
NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
sda        8:0    0   5G  0 disk 
|---sda1   8:1    0 128M 0 part /boot
`---sda2   8:2    0  4.9G 0 part /
sdb        8:16   0   1G  0 disk 
`---sdb1   8:17   0 1023M 0 part
  `---NasaHW2-course 254:0  0 500M 0 lvm  /home/nasa/course
sdc        8:32   0   1G  0 disk 
`---sdc1   8:33   0 1023M 0 part
sdd        8:48   0   1G  0 disk 
`---sdd1   8:49   0 1023M 0 part
sde        8:64   0   1G  0 disk 
sdf        8:80   0   1G  0 disk 
sdg        8:96   0   1G  0 disk 
sdh        8:112  0   1G  0 disk 
sdi        8:128  0   8G  0 disk 
`---sdi1   8:129  0   8G  0 part /mnt/usbdisk
Filesystem           Type  Size  Used Avail Use% Mounted on
dev                 devtmpfs 2.0G  0  2.0G  0% /dev
run                tmpfs   2.0G  724K 2.0G  1% /run
/dev/sda2            ext4   4.8G  1.8G 2.8G  39% /
tmpfs              tmpfs   2.0G  0  2.0G  0% /dev/shm
tmpfs              tmpfs   2.0G  0  2.0G  0% /tmp
/dev/sda1            vfat  128M  51M  78M  40% /boot
/dev/mapper/NasaHW2-course ext4  459M  538K 429M  1% /home/nasa/course
tmpfs              tmpfs   100K  0  100K  0% /var/lib/lxd/shmounts
tmpfs              tmpfs   100K  0  100K  0% /var/lib/lxd/devlxd
tmpfs              tmpfs   392M  0  392M  0% /run/user/1000
/dev/sdi1            ntfs3  8.0G  42M  8.0G  1% /mnt/usbdisk
```

(Ref: <https://wiki.archlinux.org/title/NTFS>)

2. 記憶體不足？

```
sudo fallocate -l 1GiB /myswap # Create a file that will be used for swap  
sudo chmod 600 /myswap  
sudo mkswap /myswap           # Set up the file as Linux swap area  
sudo swapon /myswap          # Enable the swap
```

最後在 `/etc/fstab` 多加上：`/myswap swap swap defaults 0 0` 即可完成。

```
[nasa@nasahw2 /]$ free -h  
              total        used        free      shared  buff/cache   available  
Mem:       3.8Gi     148Mi     3.5Gi      2.0Mi     205Mi    3.5Gi  
Swap:      1.0Gi        0B     1.0Gi
```

(Ref: <https://linuxize.com/post/create-a-linux-swap-file/>)

3. 空間不足

```
sudo lvresize -L 1GiB /dev/NasaHW2/course
sudo resize2fs /dev/mapper/NasaHW2-course
```

```
[nasa@nasahw2 /]$ lsblk; df -hT
NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
sda            8:0    0   5G  0 disk
`-sda1         8:1    0  128M 0 part /boot
`-sda2         8:2    0  4.9G 0 part /
sdb            8:16   0   1G  0 disk
`-sdb1         8:17   0 1023M 0 part
  `--NasaHW2-course 254:0  0   1G  0 lvm  /home/nasa/course
sdc            8:32   0   1G  0 disk
`-sdc1         8:33   0 1023M 0 part
  `--NasaHW2-course 254:0  0   1G  0 lvm  /home/nasa/course
sdd            8:48   0   1G  0 disk
`-sdd1         8:49   0 1023M 0 part
sde            8:64   0   1G  0 disk
sdf            8:80   0   1G  0 disk
sdg            8:96   0   1G  0 disk
sdh            8:112  0   1G  0 disk
sdi            8:128  0   8G  0 disk
`-sdi1         8:129  0   8G  0 part /mnt/usbdisk
Filesystem      Type  Size  Used Avail Use% Mounted on
dev             devtmpfs 2.0G  0  2.0G  0% /dev
run             tmpfs   2.0G 724K 2.0G  1% /run
/dev/sda2       ext4   4.8G 2.8G 1.8G 62% /
tmpfs           tmpfs   2.0G  0  2.0G  0% /dev/shm
tmpfs           tmpfs   2.0G  0  2.0G  0% /tmp
/dev/sda1       vfat   128M 51M  78M 40% /boot
/dev/mapper/NasaHW2-course ext4  953M 3.3M 900M 1% /home/nasa/course
tmpfs           tmpfs   100K  0  100K  0% /var/lib/lxd/shmounts
tmpfs           tmpfs   100K  0  100K  0% /var/lib/lxd/devlxd
tmpfs           tmpfs   392M  0  392M  0% /run/user/1000
/dev/sdi1       ntfs3  8.0G 42M  8.0G 1% /mnt/usbdisk
```

(Ref: <https://www.linuxtechi.com/extend-lvm-partitions/>)

4. 建立加密分割區

```
sudo lvcreate -L 800MiB -n NasaHW2-homework /dev/NasaHW2
sudo shred -v --iterations=1 /dev/NasaHW2/NasaHW2-homework
sudo cryptsetup luksFormat /dev/NasaHW2/NasaHW2-homework
sudo cryptsetup luksAddKey /dev/NasaHW2/NasaHW2-homework /home/nasa/lvm_key
sudo cryptsetup luksDump /dev/NasaHW2/NasaHW2-homework
sudo cryptsetup luksOpen /dev/NasaHW2/NasaHW2-homework homework
sudo mkfs -t ext4 /dev/mapper/homework
sudo mount /dev/mapper/homework /home/nasa/homework/
```

在 /etc/crypttab 加上 : `homework /dev/NasaHW2/NasaHW2-homework /home/nasa/lvm_key luks` ,
並且在 /etc/fstab 加上 : `/dev/mapper/homework /home/nasa/homework ext4 defaults 0 0` 即可。

```
[nasa@nasahw2 ~]$ lsblk;df -hT
NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
sda            8:0    0   5G  0 disk
|---sda1        8:1    0 128M 0 part /boot
`---sda2        8:2    0 4.9G 0 part /
sdb            8:16   0   1G  0 disk
`---sdb1        8:17   0 1023M 0 part
   `---NasaHW2-course 254:0    0   1G  0 lvm  /home/nasa/course
sdc            8:32   0   1G  0 disk
`---sdc1        8:33   0 1023M 0 part
   |---NasaHW2-course 254:0    0   1G  0 lvm  /home/nasa/course
   `---NasaHW2-NasaHW2--homework 254:1    0 800M 0 lvm
     `---homework      254:2    0 784M 0 crypt /home/nasa/homework
sdd            8:48   0   1G  0 disk
`---sdd1        8:49   0 1023M 0 part
sde            8:64   0   1G  0 disk
sdf            8:80   0   1G  0 disk
sdg            8:96   0   1G  0 disk
sdh            8:112  0   1G  0 disk
sdi            8:128  0   8G  0 disk
`---sdi1        8:129  0   8G  0 part /mnt/usbdisk
Filesystem      Type  Size Used Avail Use% Mounted on
dev            devtmpfs 2.0G  0  2.0G  0% /dev
run            tmpfs   2.0G 732K 2.0G  1% /run
/dev/sda2       ext4   4.8G 2.8G 1.8G 62% /
tmpfs          tmpfs   2.0G  0  2.0G  0% /dev/shm
tmpfs          tmpfs   2.0G  0  2.0G  0% /tmp
/dev/sda1       vfat   128M 51M  78M 40% /boot
/dev/mapper/NasaHW2-course ext4   953M 3.3M 900M 1% /home/nasa/course
tmpfs          tmpfs   100K  0  100K  0% /var/lib/lxd/shmounts
tmpfs          tmpfs   100K  0  100K  0% /var/lib/lxd/devlxd
tmpfs          tmpfs   392M  0  392M  0% /run/user/1000
/dev/sdi1       ntfs3  8.0G 42M  8.0G 1% /mnt/usbdisk
/dev/mapper/homework_ ext4   755M 24K 700M 1% /home/nasa/homework
```

(Ref: <https://www.cyberciti.biz/hardware/cryptsetup-add-enable-luks-disk-encryption-keyfile-linux/>)

5. Extend then Snapshot

```
sudo pvcreate /dev/sdd1
sudo vgextend NasaHW2 /dev/sdd1
sudo lvcreate -L 1GiB -s -n NasaHW2-backup /dev/NasaHW2/course
sudo mkdir /mnt/backup
sudo mount /dev/NasaHW2/NasaHW2-backup /mnt/backup
```

[nasa@nasahw2 ~]\$ lsblk

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINTS
sda	8:0	0	5G	0	disk	
-sda1	8:1	0	128M	0	part	/boot
`-sda2	8:2	0	4.9G	0	part	/
sdb	8:16	0	1G	0	disk	
`-sdb1	8:17	0	1023M	0	part	
`-NasaHW2-course-real	254:3	0	1G	0	lvm	
-NasaHW2-course	254:0	0	1G	0	lvm	/home/nasa/course
`-NasaHW2-NasaHW2--backup	254:5	0	1G	0	lvm	/mnt/backup
sdc	8:32	0	1G	0	disk	
`-sdc1	8:33	0	1023M	0	part	
-NasaHW2-NasaHW2--homework	254:1	0	800M	0	lvm	
`-homework	254:2	0	784M	0	crypt	/home/nasa/homework
-NasaHW2-course-real	254:3	0	1G	0	lvm	
-NasaHW2-course	254:0	0	1G	0	lvm	/home/nasa/course
`-NasaHW2-NasaHW2--backup	254:5	0	1G	0	lvm	/mnt/backup
`-NasaHW2-NasaHW2--backup-cow	254:4	0	1G	0	lvm	
`-NasaHW2-NasaHW2--backup	254:5	0	1G	0	lvm	/mnt/backup
sdd	8:48	0	1G	0	disk	
`-sdd1	8:49	0	1023M	0	part	
`-NasaHW2-NasaHW2--backup-cow	254:4	0	1G	0	lvm	
`-NasaHW2-NasaHW2--backup	254:5	0	1G	0	lvm	/mnt/backup
sde	8:64	0	1G	0	disk	
sdf	8:80	0	1G	0	disk	
sdg	8:96	0	1G	0	disk	
sdh	8:112	0	1G	0	disk	
sdi	8:128	0	8G	0	disk	
`-sdi1	8:129	0	8G	0	part	/mnt/usbdisk

```
sudo tar cvf /home/nasa/backup.tar.zst /mnt/backup
sudo umount /mnt/backup
sudo lvremove /dev/NasaHW2/NasaHW2-backup
```

(Ref: <https://ithelp.ithome.com.tw/articles/10081811>)

6. Now, Start using ZFS

```
sudo zpool create b08902149 raidz sde sdf sdg sdh
sudo mkdir /mnt/zfs
sudo zfs set mountpoint=/mnt/zfs b08902149
```

```
[nasa@nasahw2 ~]$ sudo zpool status; df -h
pool: b08902149
  state: ONLINE
config:

  NAME        STATE      READ WRITE CKSUM
  b08902149   ONLINE       0     0     0
    raidz1-0   ONLINE       0     0     0
      sde      ONLINE       0     0     0
      sdf      ONLINE       0     0     0
      sdg      ONLINE       0     0     0
      sdh      ONLINE       0     0     0

errors: No known data errors

Filesystem              Size  Used Avail Use% Mounted on
dev                    2.0G   0    2.0G  0% /dev
run                    2.0G  764K  2.0G  1% /run
/dev/sda2              4.8G  2.8G  1.8G  62% /
tmpfs                  2.0G   0    2.0G  0% /dev/shm
tmpfs                  2.0G   0    2.0G  0% /tmp
/dev/sda1              128M  51M   78M  40% /boot
/dev/mapper/NasaHW2-course 953M  3.3M  900M  1% /home/nasa/course
tmpfs                  100K   0   100K  0% /var/lib/lxd/shmounts
tmpfs                  100K   0   100K  0% /var/lib/lxd/devlxd
tmpfs                  392M   0   392M  0% /run/user/1000
/dev/sdi1              8.0G  42M   8.0G  1% /mnt/usbdisk
/dev/mapper/homework    755M  24K   700M  1% /home/nasa/homework
b08902149             2.7G 128K  2.7G  1% /mnt/zfs
```

(Ref1: <https://blog.ruanbekker.com/blog/2017/08/24/create-a-zfs-raidz1-volume-pool-on-ubuntu-16/>)

(Ref2: <https://askubuntu.com/questions/123126/how-do-i-mount-a-zfs-pool>)

7. Create ZFS Dataset

首先執行下列指令：

```
sudo zfs create -o encryption=on -o keyformat=raw -o  
keylocation=file:///home/nasa/zfs_key b08902149/httpcat  
sudo zfs set quota=500MiB b08902149/httpcat  
sudo zfs set copies=2 b08902149/httpcat  
sudo touch /etc/systemd/system/zfs-load-key@b08902149-httpcat.service
```

接著在 `/etc/systemd/system/zfs-load-key@b08902149-httpcat.service` 加上以下這段：

```
[Unit]  
Description=Load %I encryption keys  
Before=systemd-user-sessions.service  
After=zfs-import.target  
Before=zfs-mount.service  
  
[Service]  
Type=oneshot  
RemainAfterExit=yes  
ExecStart=/usr/bin/bash -c 'until (systemd-ask-password "Encrypted ZFS password for %I"  
--no-tty | zfs load-key %I); do echo "Try again!"; done'  
  
[Install]  
WantedBy=zfs-mount.service
```

然後繼續下列指令即可完成：

```
sudo systemctl enable zfs-load-key@b08902149-httpcat.service  
sudo systemctl enable zfs-mount.service  
sudo zfs set mountpoint=/home/nasa/httpcat b08902149/httpcat  
sudo zfs mount -a  
sudo cp /home/nasa/imgs/http_cat/* /home/nasa/httpcat -R  
sudo reboot
```

重新啟動後執行 `ls -l /home/nasa/httpcat; df -h` 的結果：

```
[nasa@nasahw2 ~]$ ls -l /home/nasa/httpcat; df -h
total 824
-rw-r--r-- 1 root root 27012 Mar 20 00:28 http_cat_200.jpg
-rw-r--r-- 1 root root 43124 Mar 20 00:28 http_cat_301.jpg
-rw-r--r-- 1 root root 43408 Mar 20 00:28 http_cat_302.jpg
-rw-r--r-- 1 root root 62251 Mar 20 00:28 http_cat_304.jpg
-rw-r--r-- 1 root root 79163 Mar 20 00:28 http_cat_404.jpg
-rw-r--r-- 1 root root 30814 Mar 20 00:28 http_cat_405.jpg
-rw-r--r-- 1 root root 26913 Mar 20 00:28 http_cat_418.jpg
-rw-r--r-- 1 root root 46496 Mar 20 00:28 http_cat_500.jpg
-rw-r--r-- 1 root root 55606 Mar 20 00:28 http_cat_504.jpg
Filesystem          Size  Used Avail Use% Mounted on
dev                  2.0G   0    2.0G  0% /dev
run                 2.0G  788K  2.0G  1% /run
/dev/sda2             4.8G  2.8G  1.8G  62% /
tmpfs                2.0G   0    2.0G  0% /dev/shm
tmpfs                2.0G   0    2.0G  0% /tmp
/dev/sda1            128M   51M   78M  40% /boot
/dev/mapper/NasaHW2-course 983M   34M  900M  4% /home/nasa/course
/dev/sdi1              8.0G  42M  8.0G  1% /mnt/usbdisk
/dev/mapper/homework      755M   24K  700M  1% /home/nasa/homework
tmpfs                100K   0   100K  0% /var/lib/lxd/shmounts
tmpfs                100K   0   100K  0% /var/lib/lxd/devlxd
b08902149             2.7G  128K  2.7G  1% /mnt/zfs
b08902149/httpcat       500M  1.0M  499M  1% /home/nasa/httpcat
tmpfs                392M   0   392M  0% /run/user/1000
```

(Ref1: <https://docs.freebsd.org/zh-tw/books/handbook/zfs/>)

(Ref2: https://docs.oracle.com/cd/E23824_01/html/821-1448/gkkih.html)

(Ref3: <https://wiki.archlinux.org/title/ZFS>)

8. Create ext4 on ZFS?

```
sudo zfs create -V 250MiB b08902149/test
sudo zfs set compression=lz4 b08902149/test
sudo fdisk /dev/b08902149/test      # create a partition
sudo mkfs -t ext4 /dev/zd0p1
sudo mkdir /home/nasa/test
sudo mount /dev/zd0p1 /home/nasa/test
```

Filesystem	Size	Used	Avail	Use%	Mounted on
dev	2.0G	0	2.0G	0%	/dev
run	2.0G	800K	2.0G	1%	/run
/dev/sda2	4.8G	2.8G	1.8G	62%	/
tmpfs	2.0G	0	2.0G	0%	/dev/shm
tmpfs	2.0G	0	2.0G	0%	/tmp
/dev/sda1	128M	51M	78M	40%	/boot
/dev/mapper/NasaHW2-course	983M	34M	900M	4%	/home/nasa/course
/dev/sdi1	8.0G	42M	8.0G	1%	/mnt/usbdisk
/dev/mapper/homework	755M	24K	700M	1%	/home/nasa/homework
tmpfs	100K	0	100K	0%	/var/lib/1xd/shmounts
tmpfs	100K	0	100K	0%	/var/lib/1xd/devlxd
b08902149	2.5G	128K	2.5G	1%	/mnt/zfs
b08902149/httpcat	500M	1.0M	499M	1%	/home/nasa/httpcat
tmpfs	392M	0	392M	0%	/run/user/1000
/dev/zd0p1	228M	14K	211M	1%	/home/nasa/test

這個虛擬的block device是ZVOL。它可以充當virtual disk，當我們建立了一個ZVOL，這樣的操作就好像插入了一個空的disk，你可以在上面建立檔案系統。一個實際的應用是用於virtual machine，VM可以在ZVOL上面建立partition table。

(Ref1: <https://pthree.org/2012/12/21/zfs-administration-part-xiv-zvols/>)

(Ref2: <https://pthree.org/2012/12/18/zfs-administration-part-xi-compression-and-deduplication/>)

(Ref3: https://www.reddit.com/r/freenas/comments/itgwlz/what_do_you_use_a_zvol_for/)

9. ZFS Snapshot

```
sudo zfs snapshot b08902149/httpcat@before
sudo curl https://http.cat/202.jpg -o /home/nasa/httpcat/202.jpg
sudo zfs snapshot b08902149/httpcat@after
```

NAME	USED	AVAIL	REFER	MOUNTPOINT
b08902149/httpcat	1.16M	499M	1.06M	/home/nasa/httpcat
b08902149/httpcat@before	100K	-	966K	-
b08902149/httpcat@after	0B	-	1.06M	-
+ /home/nasa/httpcat/202.jpg				
M /home/nasa/httpcat/				

(Ref: <https://docs.oracle.com/cd/E19253-01/819-5461/gbcya/index.html>)

10. Rollback Snapshot

```
sudo zfs rollback -r b08902149/httpcat@before
```

```
[nasa@nasahw2 ~]$ sudo zfs list -rt all b08902149/httpcat ; ls -l /home/nasa/httpcat
NAME          USED  AVAIL   REFER  MOUNTPOINT
b08902149/httpcat    966K  499M    966K  /home/nasa/httpcat
b08902149/httpcat@Before     0B      -    966K  -
total 824
-rw-r--r-- 1 root root 27012 Mar 20 00:28 http_cat_200.jpg
-rw-r--r-- 1 root root 43124 Mar 20 00:28 http_cat_301.jpg
-rw-r--r-- 1 root root 43408 Mar 20 00:28 http_cat_302.jpg
-rw-r--r-- 1 root root 62251 Mar 20 00:28 http_cat_304.jpg
-rw-r--r-- 1 root root 79163 Mar 20 00:28 http_cat_404.jpg
-rw-r--r-- 1 root root 30814 Mar 20 00:28 http_cat_405.jpg
-rw-r--r-- 1 root root 26913 Mar 20 00:28 http_cat_418.jpg
-rw-r--r-- 1 root root 46496 Mar 20 00:28 http_cat_500.jpg
-rw-r--r-- 1 root root 55606 Mar 20 00:28 http_cat_504.jpg
```

(Ref: <https://docs.oracle.com/cd/E19253-01/819-5461/gbcxk/index.html>)

11. Short Answer

1. **ext**是Linux在1992創建的file system，而ext4是對於舊版本的更新。因為他是基於對1990年代初期開發的技術的革新，對於管理modern data的附載能力有限，且它的journaling system也隨著所存資料量增加變得不再有用；但它可以支援不超過18TB的文件大小，對於data driven的數據公司是很適合的。**zfs**有著LVM和filesystem特性的檔案系統，可以對有檔案備份、壓縮等功能；相較於ext4，它對硬體的要求較高。

(Ref: <https://nascompares.com/2021/07/21/zfs-vs-ext4-for-nas-what-is-the-difference-in-your-file-system/>)

2. **Raid0**：透過兩個硬碟將檔案拆分（將同一筆檔案部分存在一個硬碟，另一部分存在另一個），實現讀寫速度的翻倍。缺點在於當其中一台硬碟壞掉，整個Raid0就無法運作，相較其他Raid，故障機率與資料損毀的風險較高。

(Ref1: 上課講義)

(Ref2: <https://www.linwei.com.tw/forum-detail/13/>)

Raid1：由兩台硬碟機體組成，透過mirror的功能把資料複製成兩份，同時存在兩個硬碟中，實現自動備份的功能。且當只一台硬碟損壞，Raid1仍可正常運作。缺點是，雖然有兩台硬碟，但實際可以拿來儲存的空間卻只有一台硬碟的容量。

(Ref1: 上課講義)

(Ref2: <https://www.linwei.com.tw/forum-detail/12/>)

Raid5：每個Raid5會用至少三個硬碟，每個硬碟至多只有2/3的空間可以實際拿來存資料，剩下的部分要拿來存parity，也就是另外兩個硬碟中所存的實際資料做xor運算後的結果。好處是當其中一台硬碟壞掉，可以透過另外兩台來復原資料，儲存的方式很經濟。

(Ref: 上課講義)

Raid10：至少需要四台硬碟。先以Raid0的方式分割資料成兩組之後，每組再將資料以Raid1的方式以兩個硬碟做鏡像複製儲存。是屬於較安全的資料儲存方式，但同時價格也會較昂貴。

(Ref: <https://zh.wikipedia.org/zh-tw/RAID>)

3. FUSE是一種類UNIX電腦的作業系統之軟體介面，允許非特權用戶創建自己想要用的file system，而不需重新

編譯kernel，zfs就是以FUSE實現。在user space實現file system的優點是可以大幅提升生產率，簡化了為作業系統提供新的檔案系統的工作量，缺點是在會有在kernel mode和user mode切換所帶來的開銷，對效能有一定程度的影響。

(Ref1: <https://zh.wikipedia.org/zh-tw/FUSE>)

(Ref2: <https://www.twblogs.net/a/5b904bec2b7177672218c470>)