

NASA HW2

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NA

Short Answer

1. In CSMA/CD & CSMA/CA, CD stands for collision detection, CA stands for collision avoidance. CSMA/CD monitors for collision during transmission, and terminate as soon as a collision is detected, while CSMA/CA determines if others are transmitting or not beforehand.

CSMA/CD is not possible for wireless networks, due to wireless transmitters typically can not sense for collisions while transmitting.

https://en.wikipedia.org/wiki/Carrier-sense_multiple_access_with_collision_detection

https://en.wikipedia.org/wiki/Carrier-sense_multiple_access_with_collision_avoidance

2. Collision domain is where transmissions from multiple devices can collide with one another, broadcast domain is a range of devices where every device can reach each other with a broadcast message.

(a) Hubs can not split collision domain nor broadcast domain, since all it does is just forwarding all input signals to all connected devices.

(b) Switches can split collision domain, since it can actually choose which device to send packets to, thus every port is in a different collision domain. However, it can not split broadcast domain, since when a switch receives a broadcast message, it still send it to everyone.

(c) Routers can split both collision and broadcast domain. It connects between local networks and the internet, and only direct the data between them to each other, it never broadcast message to everyone, thus separates different broadcast and collision domain.

https://en.wikipedia.org/wiki/Broadcast_domain

https://en.wikipedia.org/wiki/Collision_domain

3. Broadcast storm is when switches in a LAN are connected with redundant links, which creates a loop, causing broadcast messages loop around and use up most of the bandwidth, making it unable to transport normal traffic.

The STP solves this problem by cataloguing redundant links on the network, and block some of the redundant links so that the network forms a spanning tree with a selected switch as the root. When one of the links broke, it will re-enable one of the blocked redundant links so the network can continue without problem.

http://en.wikipedia.org/wiki/Spanning_Tree_Protocol

Iperf

References: [iperf manual page](#)

- Testing steps

On one side, use `iperf -s` to listen.

On the other side, use `iperf -c <ip of the server> -p 5001 -i 5 -t 60` to test every 5 sec for 1 min.

- 204 PC - Workstation

```
student@204-04: /mnt/c/Users/ x + v
After this operation, 213 kB of additional disk space will be used.
Get:1 http://free.nhch.org.tw/ubuntu/ubuntu focal/universe amd64 iperf amd64 2.0.13+dfsg1-1build1 [76.5 kB]
Fetched 76.5 kB in 0s (1199 kB/s)
Selecting previously unselected package iperf.
(Reading database ... 40750 files and directories currently installed.)
Preparing to unpack ../iperf_2.0.13+dfsg1-1build1_amd64.deb ...
Unpacking iperf (2.0.13+dfsg1-1build1) ...
Setting up iperf (2.0.13+dfsg1-1build1) ...
Processing triggers for man-db (2.9.1-1) ...
student@204-04:/mnt/c/Users/student/desktop$ iperf -c 140.112.30.42 -p 5001 -i 5 -t 60
-----
Client connecting to 140.112.30.42, TCP port 5001
TCP window size: 512 KByte (default)
-----
[ 3] local 192.168.204.130 port 49939 connected with 140.112.30.42 port 5001
[ ID] Interval      Transfer    Bandwidth
[ 3] 0.0- 5.0 sec  435 MBytes  730 Mbits/sec
[ 3] 5.0-10.0 sec  416 MBytes  698 Mbits/sec
[ 3] 10.0-15.0 sec  415 MBytes  696 Mbits/sec
[ 3] 15.0-20.0 sec  405 MBytes  680 Mbits/sec
[ 3] 20.0-25.0 sec  438 MBytes  734 Mbits/sec
[ 3] 25.0-30.0 sec  431 MBytes  722 Mbits/sec
[ 3] 30.0-35.0 sec  374 MBytes  627 Mbits/sec
[ 3] 35.0-40.0 sec  382 MBytes  642 Mbits/sec
[ 3] 40.0-45.0 sec  390 MBytes  654 Mbits/sec
[ 3] 45.0-50.0 sec  416 MBytes  698 Mbits/sec
[ 3] 50.0-55.0 sec  420 MBytes  704 Mbits/sec
[ 3] 55.0-60.0 sec  404 MBytes  677 Mbits/sec
[ 3] 0.0-60.0 sec  4.81 GBytes  688 Mbits/sec
student@204-04:/mnt/c/Users/student/desktop$
```

- 204 PC - Wifi device

```
student@204-04: /mnt/c/Users/ x + v
[ 3] 20.0-25.0 sec  438 MBytes  734 Mbits/sec
[ 3] 25.0-30.0 sec  431 MBytes  722 Mbits/sec
[ 3] 30.0-35.0 sec  374 MBytes  627 Mbits/sec
[ 3] 35.0-40.0 sec  382 MBytes  642 Mbits/sec
[ 3] 40.0-45.0 sec  390 MBytes  654 Mbits/sec
[ 3] 45.0-50.0 sec  416 MBytes  698 Mbits/sec
[ 3] 50.0-55.0 sec  420 MBytes  704 Mbits/sec
[ 3] 55.0-60.0 sec  404 MBytes  677 Mbits/sec
[ 3] 0.0-60.0 sec  4.81 GBytes  688 Mbits/sec
student@204-04:/mnt/c/Users/student/desktop$ iperf -c 10.5.6.200 -p 5001 -i 5 -t 60
-----
Client connecting to 10.5.6.200, TCP port 5001
TCP window size: 512 KByte (default)
-----
[ 3] local 192.168.204.130 port 49957 connected with 10.5.6.200 port 5001
[ ID] Interval      Transfer    Bandwidth
[ 3] 0.0- 5.0 sec   94.2 MBytes  158 Mbits/sec
[ 3] 5.0-10.0 sec   124 MBytes  209 Mbits/sec
[ 3] 10.0-15.0 sec   128 MBytes  215 Mbits/sec
[ 3] 15.0-20.0 sec   130 MBytes  218 Mbits/sec
[ 3] 20.0-25.0 sec   124 MBytes  207 Mbits/sec
[ 3] 25.0-30.0 sec   131 MBytes  219 Mbits/sec
[ 3] 30.0-35.0 sec   129 MBytes  216 Mbits/sec
[ 3] 35.0-40.0 sec   124 MBytes  208 Mbits/sec
[ 3] 40.0-45.0 sec   122 MBytes  205 Mbits/sec
[ 3] 45.0-50.0 sec   126 MBytes  212 Mbits/sec
[ 3] 50.0-55.0 sec   121 MBytes  203 Mbits/sec
[ 3] 55.0-60.0 sec   121 MBytes  202 Mbits/sec
[ 3] 0.0-60.0 sec   1.44 GBytes  206 Mbits/sec
student@204-04:/mnt/c/Users/student/desktop$
```

- Wifi device - Wifi device

```

> ./iperf -c 10.5.7.85 -p 5001 -i 5 -t 60
-----
Client connecting to 10.5.7.85, TCP port 5001
TCP window size: 129 KByte (default)
-----
[ 4] local 10.5.6.200 port 58438 connected with 10.5.7.85 port 5001
[ ID] Interval      Transfer    Bandwidth
[ 4]  0.0- 5.0 sec  16.9 MBytes 28.3 Mbits/sec
[ 4]  5.0-10.0 sec  32.0 MBytes 53.7 Mbits/sec
[ 4] 10.0-15.0 sec  17.9 MBytes 30.0 Mbits/sec
[ 4] 15.0-20.0 sec  31.6 MBytes 53.1 Mbits/sec
[ 4] 20.0-25.0 sec  27.2 MBytes 45.7 Mbits/sec
[ 4] 25.0-30.0 sec  17.8 MBytes 29.8 Mbits/sec
[ 4] 30.0-35.0 sec  29.9 MBytes 50.1 Mbits/sec
[ 4] 35.0-40.0 sec  24.4 MBytes 40.9 Mbits/sec
[ 4] 40.0-45.0 sec  30.6 MBytes 51.4 Mbits/sec
[ 4] 45.0-50.0 sec  22.6 MBytes 38.0 Mbits/sec
[ 4] 50.0-55.0 sec  21.6 MBytes 36.3 Mbits/sec
[ 4] 55.0-60.0 sec  28.1 MBytes 47.2 Mbits/sec
[ 4]  0.0-60.1 sec  301 MBytes 42.1 Mbits/sec
-----
/Volumes/Transcend/NTU/iperf-2.0.5-macos-x86_64 ..... 1m 0s / 15:44:50

```

204 - Workstation: It's a wired connection, so naturally it's super fast.

204 (upload) - Wifi device (download): Choke point is wifi download speed.

Wifi device (upload) - Wifi device (download): Choke point is wifi upload speed.

Therefore in terms of bandwidth, (1) > (2) > (3).

IPv6

On `oasis1.csie.ntu.edu.tw`, we can use `netstat -tupln` to find the server is running at `fe80::5054:ff:fecf:12d9`.

The `fe80` makes it so we must connect from within the network, and specify the network interface.

```
-----
      ^ ^
      (oo)\_____
      ( _)\       )\/\
           ||----w |
           ||     ||

b09902011@linux11 [~] nc fe80::5054:ff:fecf:12d9%net0 8453
Error: Couldn't resolve host "fe80::5054:ff:fecf:12d9%net0"
b09902011@linux11 [~] nc -6 fe80::5054:ff:fecf:12d9%net0 8453
nc:???? -- '6'
Try `nc --help' for more information.
b09902011@linux11 [~] nc fe80::5054:00ff:fecf:12d9%net0 9453
Error: Couldn't resolve host "fe80::5054:00ff:fecf:12d9%net0"
b09902011@linux11 [~] nc6 fe80::5054:ff:fecf:12d9%net0 9453
-bash: nc6: 指令找不到
b09902011@linux11 [~] nccat6 fe80::5054:ff:fecf:12d9%net0 9453
-bash: nccat6: 指令找不到
b09902011@linux11 [~] ncat6 fe80::5054:ff:fecf:12d9%net0 9453
-bash: ncat6: 指令找不到
b09902011@linux11 [~] ncat fe80::5054:ff:fecf:12d9%net0 9453
Please enter your student ID: (first letter should be lowercase) b09902011
You have successfully connect me using IPv6!
Please write the follow message in your homework:
151bca1247a44e0012a53ce492275e10
```

Here you go: 151bca1247a44e0012a53ce492275e10

SA

References for this section: https://btrfs.wiki.kernel.org/index.php/Main_Page

Discussed with 郭懷元、林弘毅

1

```
su
umount /dev/sda3
e2fsck -f /dev/sda3
resize2fs /dev/sda3 5G
gdisk: d 3, n 3(+5G), n 4(all), t 0700(microsoft basic data), w
mkfs.exfat /dev/sda4
vim /etc/fstab
# change "UUID=..." to /dev/sda3
# add line "/dev/sda4 /home/nasa/share exfat defaults 0 0"
reboot
```

```
[root@nasahw2 nasa]# lsblk; df -hT
```

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
sda	8:0	0	20G	0	disk	
l-sda1	8:1	0	256M	0	part	/boot
l-sda2	8:2	0	9.1G	0	part	/
l-sda3	8:3	0	5G	0	part	/home/nasa/documents
`-sda4	8:4	0	5.7G	0	part	/home/nasa/share
sdb	8:16	0	16G	0	disk	
sdc	8:32	0	16G	0	disk	
sdd	8:48	0	16G	0	disk	
sde	8:64	0	8G	0	disk	
`-sde1	8:65	0	8G	0	part	/home/nasa/backup

Filesystem	Type	Size	Used	Avail	Use%	Mounted on
dev	devtmpfs	2.0G	0	2.0G	0%	/dev
run	tmpfs	2.0G	664K	2.0G	1%	/run
/dev/sda2	ext4	8.8G	3.1G	5.3G	37%	/
tmpfs	tmpfs	2.0G	0	2.0G	0%	/dev/shm
tmpfs	tmpfs	4.0M	0	4.0M	0%	/sys/fs/cgroup
tmpfs	tmpfs	2.0G	0	2.0G	0%	/tmp
/dev/sde1	btrfs	8.0G	3.6M	7.5G	1%	/home/nasa/backup
/dev/sda4	exfat	5.7G	96K	5.7G	1%	/home/nasa/share
/dev/sda3	ext4	4.9G	33M	4.6G	1%	/home/nasa/documents
/dev/sda1	vfat	256M	46M	211M	18%	/boot
tmpfs	tmpfs	392M	0	392M	0%	/run/user/1000

```
[root@nasahw2 nasa]#
```

2

```
su
dd if=/dev/zero of=/myswap bs=1G count=2
mkswap /myswap
swapon /myswap
```

```
[root@nasahw2 nasa]# free -h
```

	total	used	free	shared	buff/cache	available
Mem:	3.8Gi	91Mi	1.6Gi	1.0Mi	2.1Gi	3.5Gi
Swap:	2.0Gi	0B	2.0Gi			

```
[root@nasahw2 nasa]# _
```

3

```
su
mkfs.btrfs -d raid1 -m raid1 -f /dev/sdb /dev/sdc
mount /dev/sdb /home/nasa/mnt
```

```
[root@nasahw2 nasal# sudo btrfs filesystem show /home/nasa/mnt
Label: none  uuid: 56216ed3-9f47-4cc6-9c9a-a7eceb57e166
    Total devices 2 FS bytes used 448.00KiB
    devid    1 size 16.00GiB used 1.26GiB path /dev/sdb
    devid    2 size 16.00GiB used 1.26GiB path /dev/sdc

[root@nasahw2 nasal# sudo btrfs filesystem df /home/nasa/mnt
Data, RAID1: total=1.00GiB, used=320.00KiB
System, RAID1: total=8.00MiB, used=16.00KiB
Metadata, RAID1: total=256.00MiB, used=112.00KiB
GlobalReserve, single: total=3.25MiB, used=0.00B
[root@nasahw2 nasal#
```

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```
su
btrfs subvolume create /home/nasa/mnt/@
btrfs subvolume create /home/nasa/mnt/@videos
btrfs subvolume create /home/nasa/mnt/@documents
mkdir /home/nasa/courses/videos
mkdir /home/nasa/courses/documents
vim /etc/fstab
# add lines:
# /dev/sdb /home/nasa/courses btrfs subvol=@ 0 0
# /dev/sdb /home/nasa/courses/videos btrfs subvol=@videos 0 0
# /dev/sdb /home/nasa/courses/documents btrfs subvol=@documents 0 0
reboot
```

```
[root@nasahw2 nasal# btrfs subvolume list -p /home/nasa/courses
ID 258 gen 12 parent 5 top level 5 path @
ID 259 gen 9 parent 5 top level 5 path @videos
ID 260 gen 10 parent 5 top level 5 path @documents
[root@nasahw2 nasal# cat /etc/fstab
# /dev/sda2 UUID=ade68796-6e1e-4a05-b443-fdc6be933014
PARTUUID=f80310f1-f90e-0144-b5b0-7a8ba789d8b7 / ext4 rw,relatime 0 1
tracefs /sys/kernel/tracing tracefs rw,nosuid,nodev,noexec 0 0
# /dev/sda3 UUID=3a8af8d5-7777-42e3-ba36-0266467029d5
/dev/sda3 /home/nasa/documents ext4 rw,relatime 0 2
# /dev/sda1 UUID=2177-52A4
PARTUUID=e1ca0f4c-a859-ab49-96b5-ed154009fbd4 /boot ufat rw,relatime,fmask=0022,dmask=0022,codepage=437,i
ocharset=ascii,shortname=mixed,utf8,errors=remount-ro 0 2
# /dev/sdd1 UUID=b2d6670d-b2bb-4af3-ab47-7500a8e1520b LABEL=backup
PARTUUID=dfa995af-b842-ad4f-a3a4-c7ca47c83bb8 /home/nasa/backup btrfs rw,relatime,space_cache,subvolid=5,subvo
l=/ 0 0
/dev/sda4 /home/nasa/share exfat defaults 0 0
/dev/sdb /home/nasa/courses btrfs subvol=@ 0 0
/dev/sdb /home/nasa/courses/videos btrfs subvol=@videos 0 0
/dev/sdb /home/nasa/courses/documents btrfs subvol=@documents 0 0
[root@nasahw2 nasal#
```

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```
su
btrfs subvolume snapshot -r /home/nasa/courses/documents
/home/nasa/courses/documents_backup
```

6

```
su
mv /home/nasa/videos/* /home/nasa/courses/videos
btrfs subvolume snapshot -r /home/nasa/courses/videos
/home/nasa/courses/videos_backup
btrfs send /home/nasa/courses/videos_backup | btrfs receive /home/nasa/backup
```

```
[root@nasahw2 courses]# btrfs subvolume list -p /home/nasa/backup
ID 257 gen 18 parent 5 top level 5 path videos_backup
[root@nasahw2 courses]#
```

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```
su
btrfs add device /dev/sdd /home/nasa/courses
btrfs balance start -dconvert=raid5 -mconvert=raid5 /home/nasa/courses
```

```
[root@nasahw2 courses]# btrfs filesystem df /home/nasa/courses; btrfs filesystem show /home/nasa/courses
Data, RAID5: total=2.00GiB, used=54.73MiB
System, RAID5: total=128.00MiB, used=16.00KiB
Metadata, RAID5: total=512.00MiB, used=272.00KiB
GlobalReserve, single: total=3.25MiB, used=0.00B
Label: none uuid: 56216ed3-9f47-4cc6-9c9a-a7eceb57e166
    Total devices 3 FS bytes used 55.02MiB
    devid    1 size 16.00GiB used 1.31GiB path /dev/sdb
    devid    2 size 16.00GiB used 1.31GiB path /dev/sdc
    devid    3 size 16.00GiB used 1.31GiB path /dev/sdd
[root@nasahw2 courses]# _
```

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```
sudo btrfs device delete /dev/sdc /home/nasa/courses
btrfs balance start -dconvert=raid1 -mconvert=raid1 /home/nasa/courses
```

```
[root@nasahw2 courses]# btrfs filesystem df /home/nasa/courses; btrfs filesystem show /home/nasa/courses
Data, RAID1: total=2.00GiB, used=54.48MiB
System, RAID1: total=64.00MiB, used=16.00KiB
Metadata, RAID1: total=256.00MiB, used=256.00KiB
GlobalReserve, single: total=3.25MiB, used=0.00B
Label: none uuid: 56216ed3-9f47-4cc6-9c9a-a7eceb57e166
    Total devices 2 FS bytes used 54.75MiB
    devid    1 size 16.00GiB used 2.31GiB path /dev/sdb
    devid    3 size 16.00GiB used 2.31GiB path /dev/sdd
[root@nasahw2 courses]# _
```

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1. Ext4 v.s btrfs:

	Ext4	btrfs
Max. File size	16TB	16EB
Max. File number	2^{32}	2^{64}
Snapshots	No	Yes
RAID	No	Yes

<https://linuxhint.com/btrfs-vs-ext4-filesystems-comparison/>

1. RAID

- RAID 0: Combining multiple drives' space to make a BIG drive.
- RAID 1: Mirror everything on all drives, to get a drive with the size of the smallest among its components.
- RAID 5: Uses one drive as checksum, and distribute data evenly to all remaining drives. When any one of the drives is broken, its data can be recovered from the rest. Require at least 3 drives.
- RAID 10: Divide the drives to 2 groups, use RAID 1 to make each group into a drive, then make these 2 drives as a RAID 0 drive.

<https://en.wikipedia.org/wiki/RAID>

2. FUSE

FUSE, or filesystem in userspace, is a framework allowing non-privileged users to mount and create their own filesystem. This is very helpful, however its somewhat slower, and has to be loaded from somewhere else to boot.

<https://unix.stackexchange.com/questions/4146/what-are-the-benefits-and-downsides-to-use-fusefs-filesystems>

3. ZFS & Hardware RAID

ZFS is a 128 bit filesystem with integrated software RAID features, with supports for many unix-like OSes. Hardware RAID uses extra hardware to assist various RAID operations, which makes it faster and also won't take up CPU resources.

Personally I would choose ZFS, just because it's more modern and hardware RAID is just too expensive.

<https://en.wikipedia.org/wiki/ZFS#Summary>