

HPC & Parallel Programming

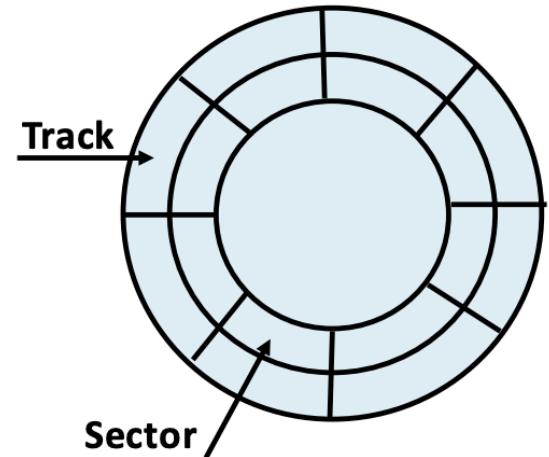
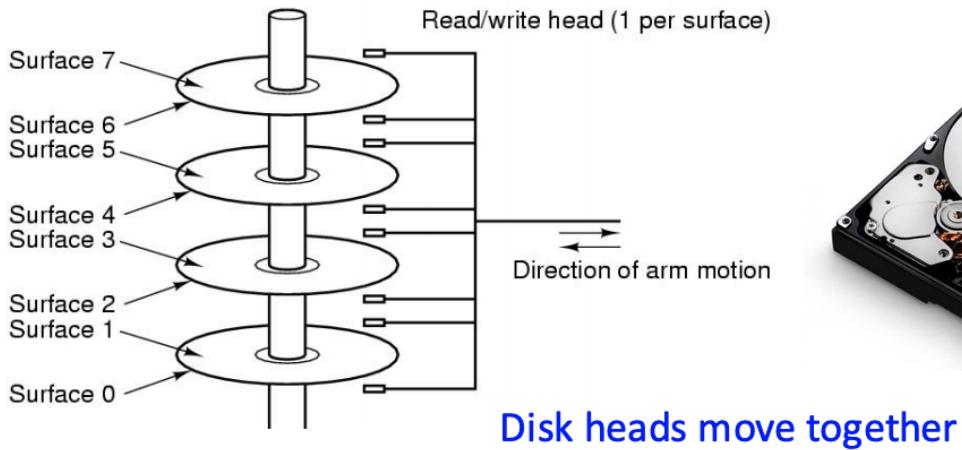
Overview

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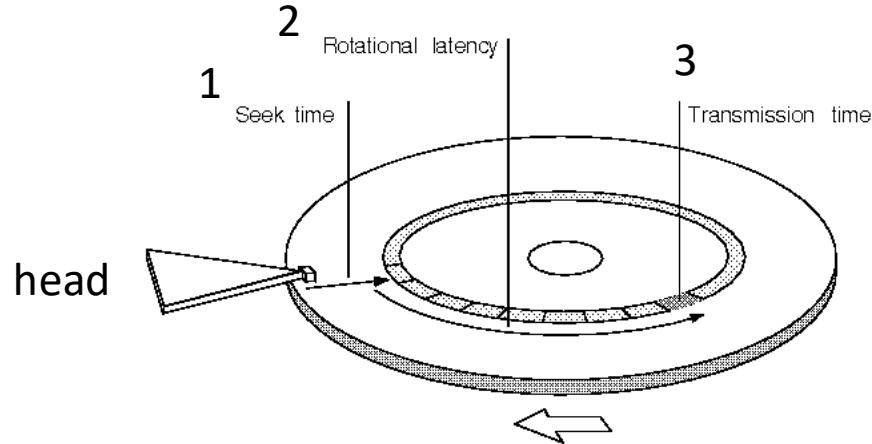
<https://kevinsuo.github.io/>

Disk



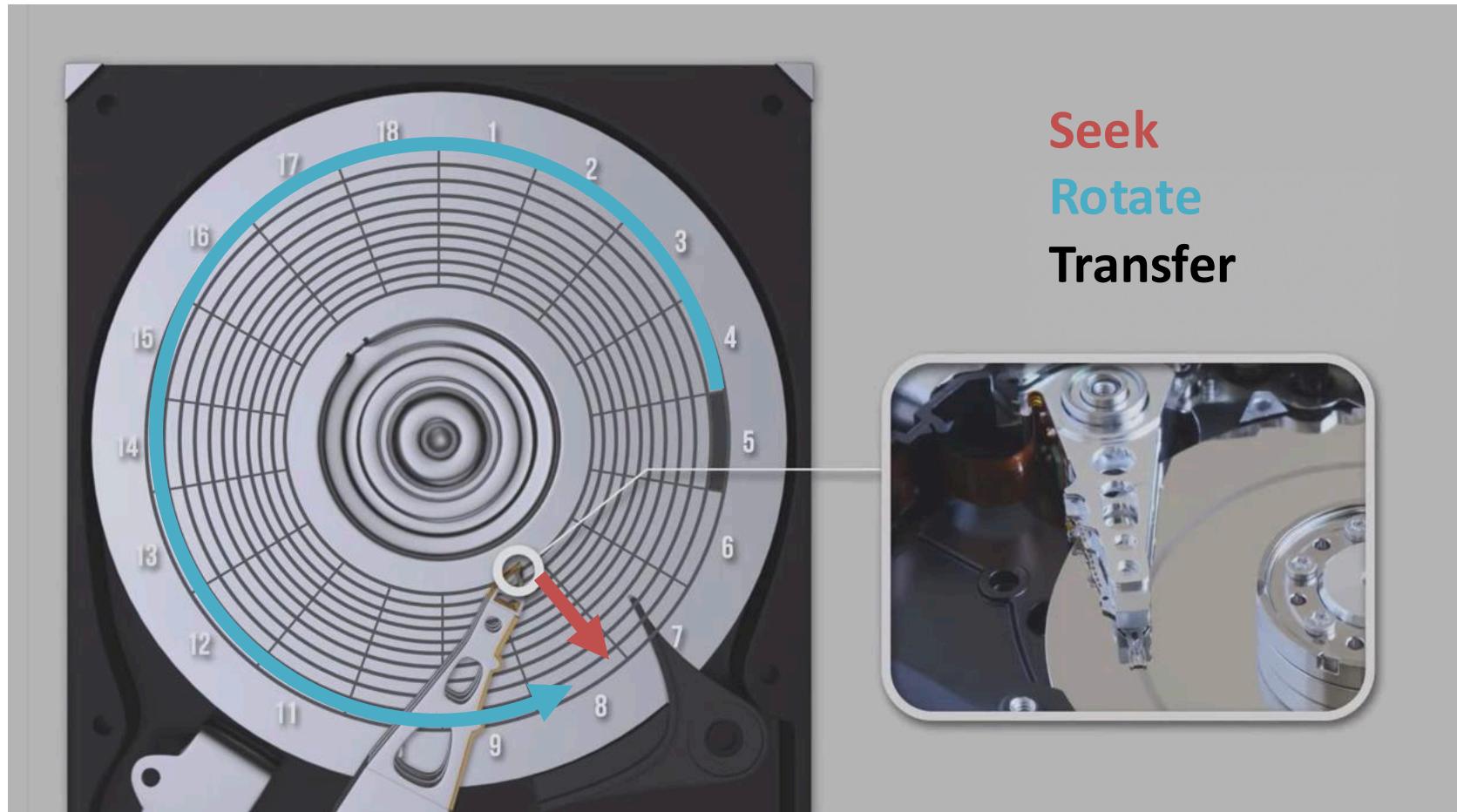
- A stack of platters, a surface with a magnetic coating
- Typical numbers (depending on the disk size):
 - 500 to 2,000 tracks per surface
 - 32 to 128 sectors per track
 - ▶ A sector is the smallest unit that can be read or written
- Originally, all tracks have the same number of sectors

Disk



- Disk head: each side of a platter has separate disk head
- Read/write data is a three-stage process:
 - Seek time: position the arm over the proper track
 - Rotational latency: wait for the desired sector to rotate under the read/write head
 - Transfer time: transfer a block of bits (sector) under the read-write head
- Average seek time as reported by the industry:
 - Typically in the range of 8 ms to 15 ms

Disk



Disk information

- `lsblk`
 - Lists out all the storage blocks, which includes disk partitions and optical drives. Details include the total size of the partition/block and the mount point if any.

```
administrator@ubuntuvm-1604 ~> lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sr0     11:0    1  1.5G  0 rom  /media/administrator/Ubuntu 16.04.5 LTS amd64
sda      8:0    0   40G  0 disk 
└─sda2   8:2    0    1K  0 part 
└─sda5   8:5    0  975M  0 part [SWAP]
└─sda1   8:1    0   39G  0 part /
```

Disk information

- `df`
 - prints out details about only mounted file systems. The list generated by `df` even includes file systems that are not real disk partitions.

```
administrator@ubuntuvm-1604 ~> df
Filesystem 1K-blocks Used Available Use% Mounted on
udev        4054632   0  4054632  0% /dev
tmpfs       816876  42148  774728  6% /run
/dev/sda1  40168028 7350596 30753972 20% /
tmpfs       4084376  1044  4083332  1% /dev/shm
tmpfs       5120     0    5120  0% /run/lock
tmpfs       4084376   0  4084376  0% /sys/fs/cgroup
/dev/sr0   1610928 1610928      0 100% /media/administrator/Ubuntu 16.04.5 LTS amd64
tmpfs       816876   56  816820  1% /run/user/1000
```



Disk information

- **fdisk**
 - display the partitions and details like file system type

```
administrator@ubuntuvm-1604 ~> sudo fdisk -l
[sudo] password for administrator:
Disk /dev/sda: 40 GiB, 42949672960 bytes, 83886080 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x6e6dc012

Device      Boot   Start     End   Sectors   Size Id Type
/dev/sda1    *      2048 81885183 81883136   39G 83 Linux
/dev/sda2          81887230 83884031 1996802 975M  5 Extended
/dev/sda5          81887232 83884031 1996800 975M 82 Linux swap / Solaris
```



Disk R/W Process



Disk R/W Speed

- \$ sudo hdparm -Tt /dev/sda

Read cache
data size

Read cache
speed

```
administrator@ubuntuvm-104 ~> sudo hdparm -Tt /dev/sda
/dev/sda:
Timing cached reads: 17132 MB in 1.99 seconds = 8599.49 MB/sec
Timing buffered disk reads: 592 MB in 3.04 seconds = 194.58 MB/sec
```

Read disk
data size

Read disk
speed

dd: Disk Write Speed

- \$ dd if=/dev/zero of=/testw.dbf bs=4k count=100000 oflag=direct

/dev/zero: generate null string stream

Write into this file

```
sudo dd if=/dev/zero of=/testw.dbf bs=4k count=100000 oflag=direct
100000+0 records in
100000+0 records out
4096000000 bytes (410 MB, 391 MiB) copied, 25.1254 , 16.3 MB/s
```

Block size 4k

Block number 100000



dd: Disk Read Speed

- `$ dd if=/dev/sdb of=/dev/null bs=4k count=100000`

/dev/zero: the source file

Write into this file (it is an empty file)

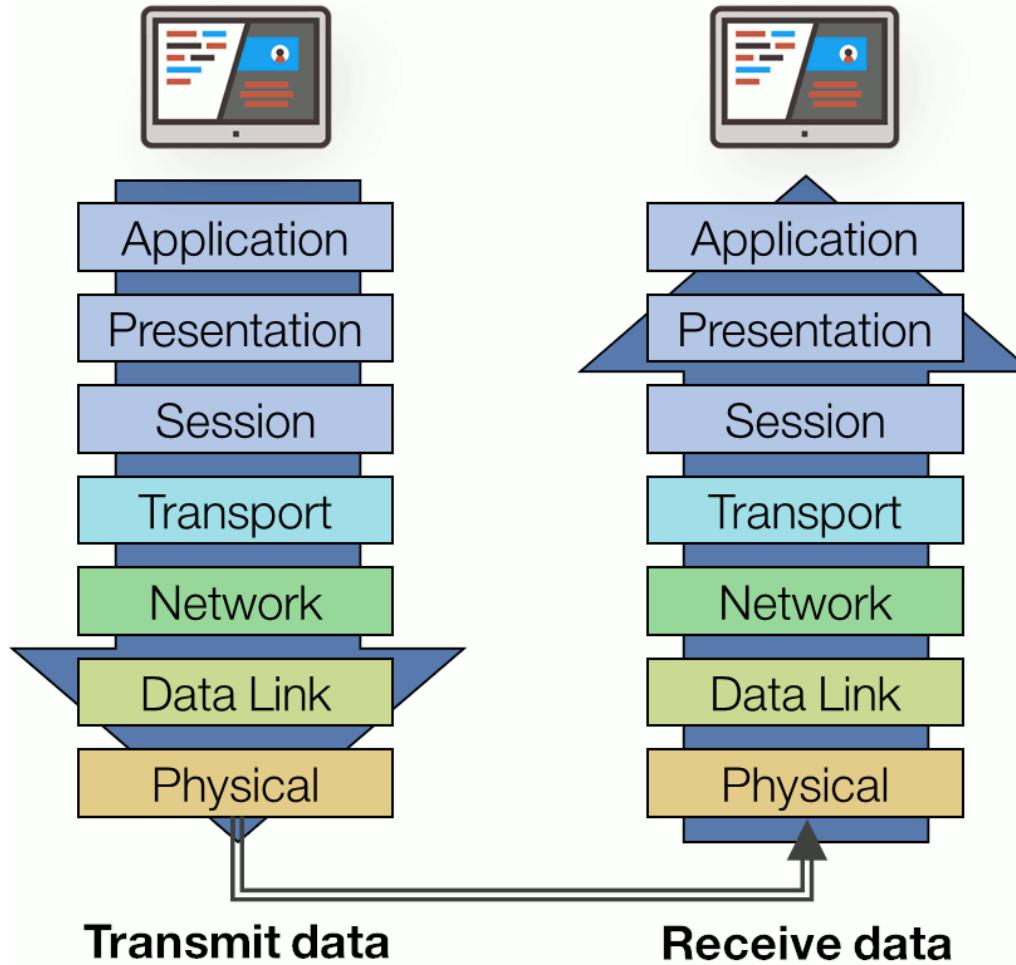
```
administrator@ubuntuvm-1604 ~>
sudo dd if=/dev/sda of=/dev/null bs=4k count=100000
100000+0 records in
100000+0 records out
4096000000 bytes (410 MB, 391 MiB) copied, 2.03887 s, 197 MB/s
```

Block size 4k

Block number 100000



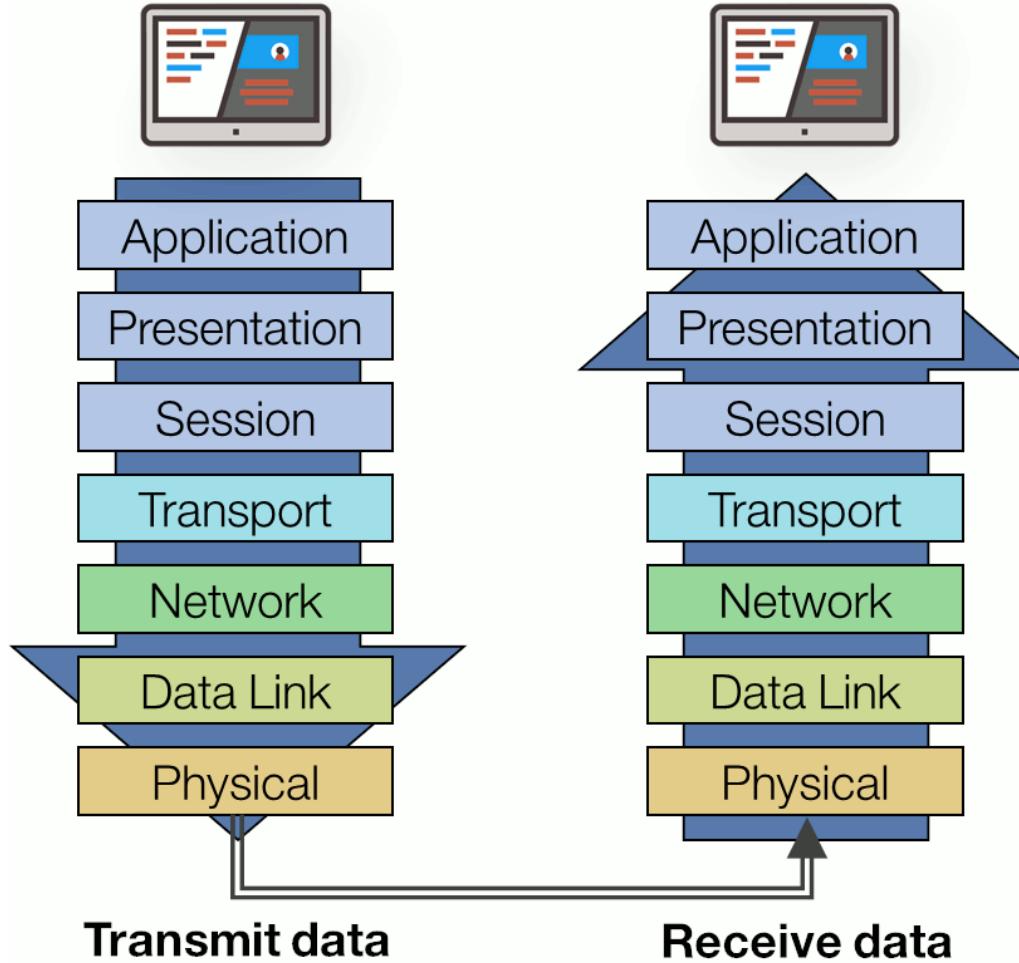
Networking



- Physical: represents the electrical and physical representation of the system
- Data link: provides node-to-node data transfer and handles error correction
- Network: router function, packet forwarding, etc.

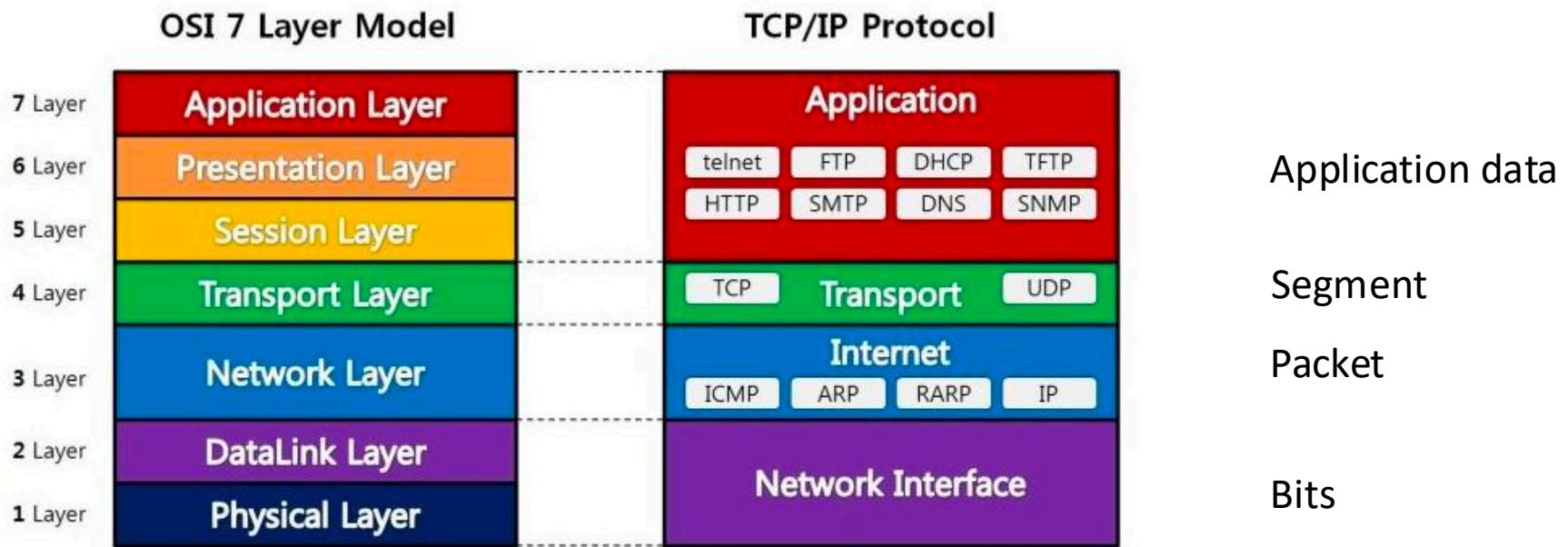


Networking



- Transport: coordination of the data transfer between end systems and hosts. How much data to send, at what rate, where it goes, etc.
- Session/Presentation/Application: interaction with the user level application

Networking



Networking connection: ping

- Ping is a computer network administration software utility used to test the reachability of a host on an Internet Protocol network.

```
administrator@ubuntuvm-1604 ~> ping www.google.com
PING www.google.com (216.58.194.228) 56(84) bytes of data.
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=1 ttl=116 time=2.70 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=2 ttl=116 time=3.11 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=3 ttl=116 time=2.81 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=4 ttl=116 time=3.14 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=5 ttl=116 time=3.01 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=6 ttl=116 time=3.07 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=7 ttl=116 time=3.03 ms
^C
```



Networking throughput: speedtest-cli

- \$ wget https://github.com/sivel/speedtest-cli/archive/master.zip
- \$ unzip master.zip
- \$ cd speedtest-cli-master/
- ./speedtest.py

```
administrator@ubuntu1804vm ~/speedtest-cli-master> ./speedtest.py
Retrieving speedtest.net configuration...
Testing from PeachNet (168.28.186.189)...
Retrieving speedtest.net server list...
Selecting best server based on ping...
Hosted by Nitel (Atlanta, GA) [27.97 km]: 5.091 ms
Testing download speed...
Download: 1596.49 Mbit/s
Testing upload speed...
Upload: 1035.54 Mbit/s
```



An interesting video introducing hardware

Computer Parts!



<https://www.youtube.com/watch?v=ExxFxD4OSZ0>



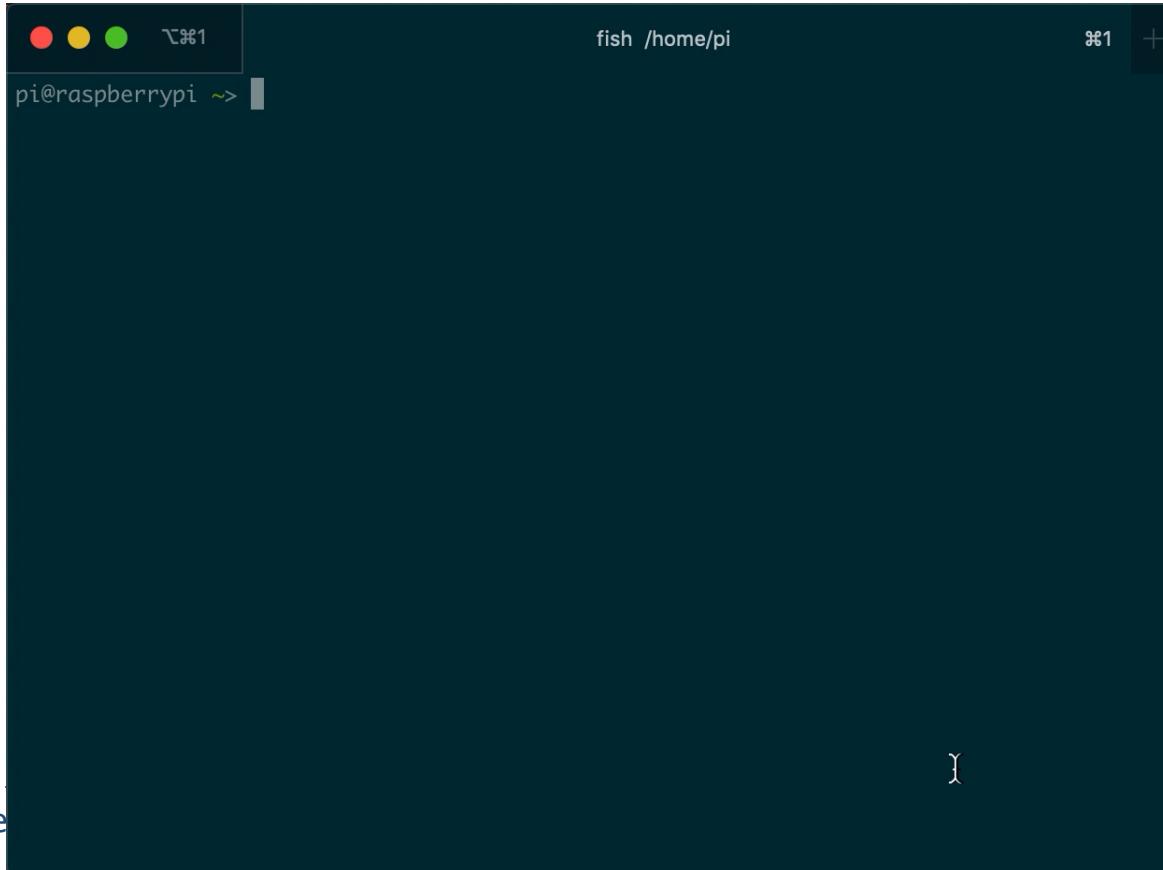
Test: Your VM hardware specs?

- CPU? → How many cores? Frequency? Topology?
- Cache? → Size?
- Memory? → Size? Speed?
- Disk? → Size?
- Network? → Latency? Bandwidth?



How to get my machine spec?

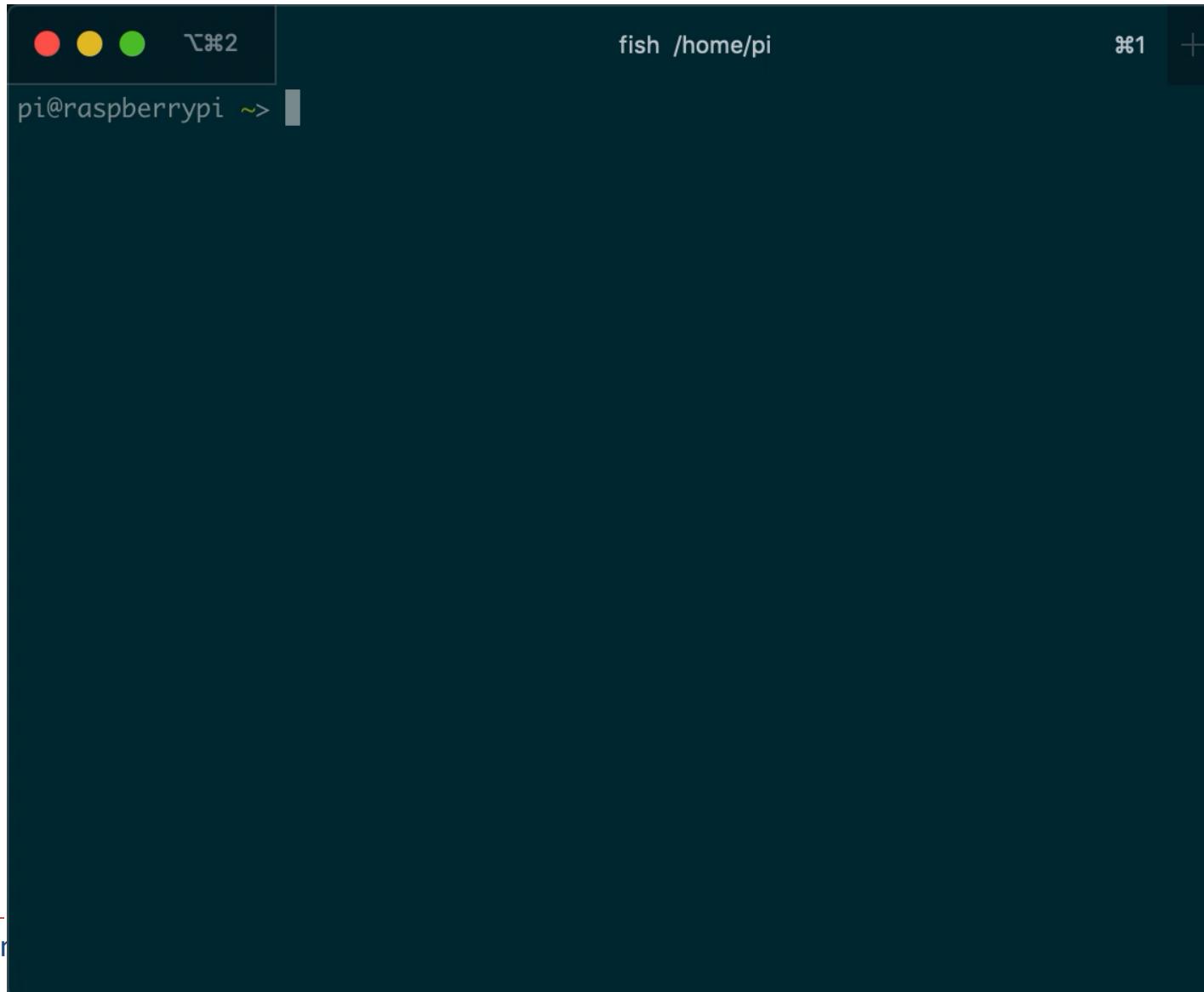
- Inxi: <https://www.tecmint.com/inxi-command-to-find-linux-system-information/>



A screenshot of a terminal window on a Raspberry Pi. The window title is 'fish /home/pi'. The terminal prompt is 'pi@raspberrypi ~>'. The window has a dark background with light-colored text. The Inxi command output is completely redacted (blurred) in the screenshot.



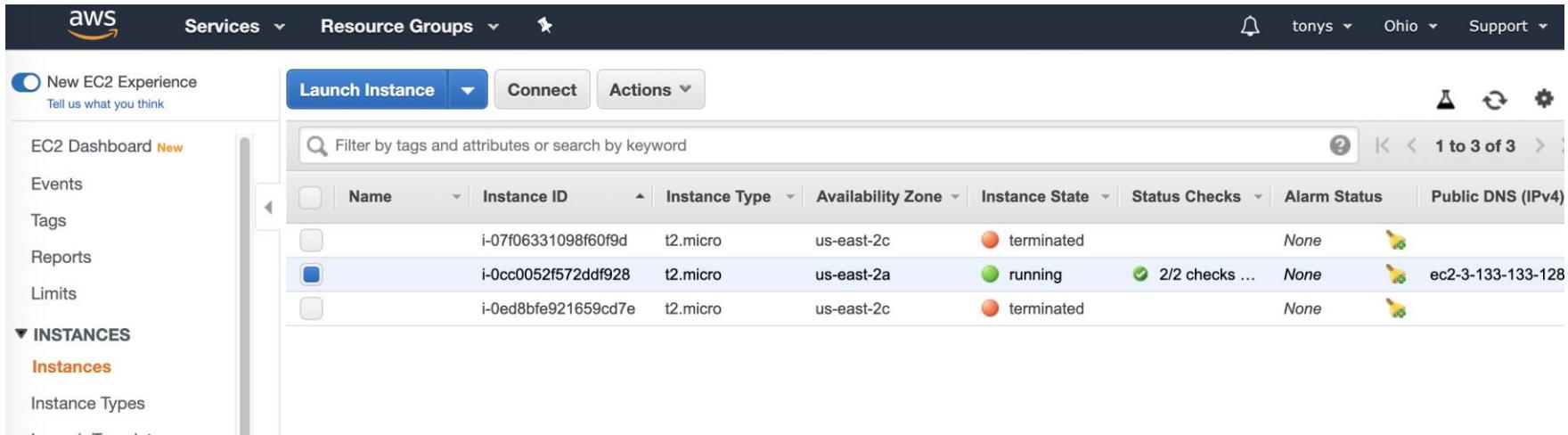
How to get my machine spec? One command for All!



A screenshot of a terminal window on a Raspberry Pi. The window has a dark background and a light blue header bar. In the top-left corner of the header bar, there are three colored dots (red, yellow, green) and a small icon. The top-right corner shows the text "fish /home/pi" and "⌘1" followed by a plus sign. The main area of the terminal is dark and empty, with the text "pi@raspberrypi ~>" visible in the top-left corner. The bottom-left corner of the slide features a red triangle pointing right and the word "Cont" in blue.

Test 1: Amazon Web Service VM

- ssh -i "osclass.pem" ubuntu@ec2-3-133-133-128.us-east-2.compute.amazonaws.com



The screenshot shows the AWS EC2 Dashboard. The left sidebar has links for New EC2 Experience, EC2 Dashboard, Events, Tags, Reports, Limits, and INSTANCES (with sub-links for Instances and Instance Types). The main area has tabs for Launch Instance, Connect, and Actions. A search bar says "Filter by tags and attributes or search by keyword". Below is a table with columns: Name, Instance ID, Instance Type, Availability Zone, Instance State, Status Checks, Alarm Status, and Public DNS (IPv4). The table shows three rows:

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)
		i-07f06331098f60f9d	t2.micro	us-east-2c	terminated		None	
		i-0cc0052f572ddf928	t2.micro	us-east-2a	running	2/2 checks ...	None	ec2-3-133-133-128
		i-0ed8bfe921659cd7e	t2.micro	us-east-2c	terminated		None	



Test 2: Microsoft Azure VM

- ssh ksuo@13.90.101.24

Microsoft Azure

Search resources, services, and docs (G+)

Home > All resources > test

test Virtual machine

Resource group (change) : test

Status : Running

Location : East US

Subscription (change) : Azure subscription 1

Subscription ID : dd8ac868-cf63-4b5d-9abf-edcb82209bb5

Computer name : test

Operating system : Linux (ubuntu 16.04)

Size : Standard B1s (1 vcpus, 1 GiB memory)

Tags (change) : Click here to add tags

Public IP address

Private IP address

Public IP address

Private IP address

Virtual network

DNS name

Scale Set

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Networking

Disks

Size

Security

Extensions

Continuous delivery (Preview)

Availability + scaling

Configuration

Identity

Properties

Connect Start Restart Stop Capture Delete Refresh

Connect to virtual machine

test

To improve security, enable just-in-time access on this VM.

RDP SSH BASTION

To connect to your virtual machine via SSH, select an IP address, optionally change the port number, and use one of the following commands:

IP address *

Public IP address (13.90.101.24)

Port number *

22

Login using VM local account

ssh ksuo@13.90.101.24

Having trouble connecting to this VM?

- Diagnose and solve problems
- Troubleshoot connection
- Serial console
- Reset password

1 hour 6 hours 12 hours 1 day 7 days 30 days

CPU (average)

Network (total)

6% 5% 4% 3% 2%

4MB 3MB 2MB

