Power and Speed

bus

front side bus

# of lanes

Chipset

Northbridge

Southbridge

multicore cpu

clockspeed

L1, L2, L3 cache

Virtual Ram (Swap space, Page cache)

HD cache

RPM

Transfer speed

Is the Machine Good Enough?

Processing:

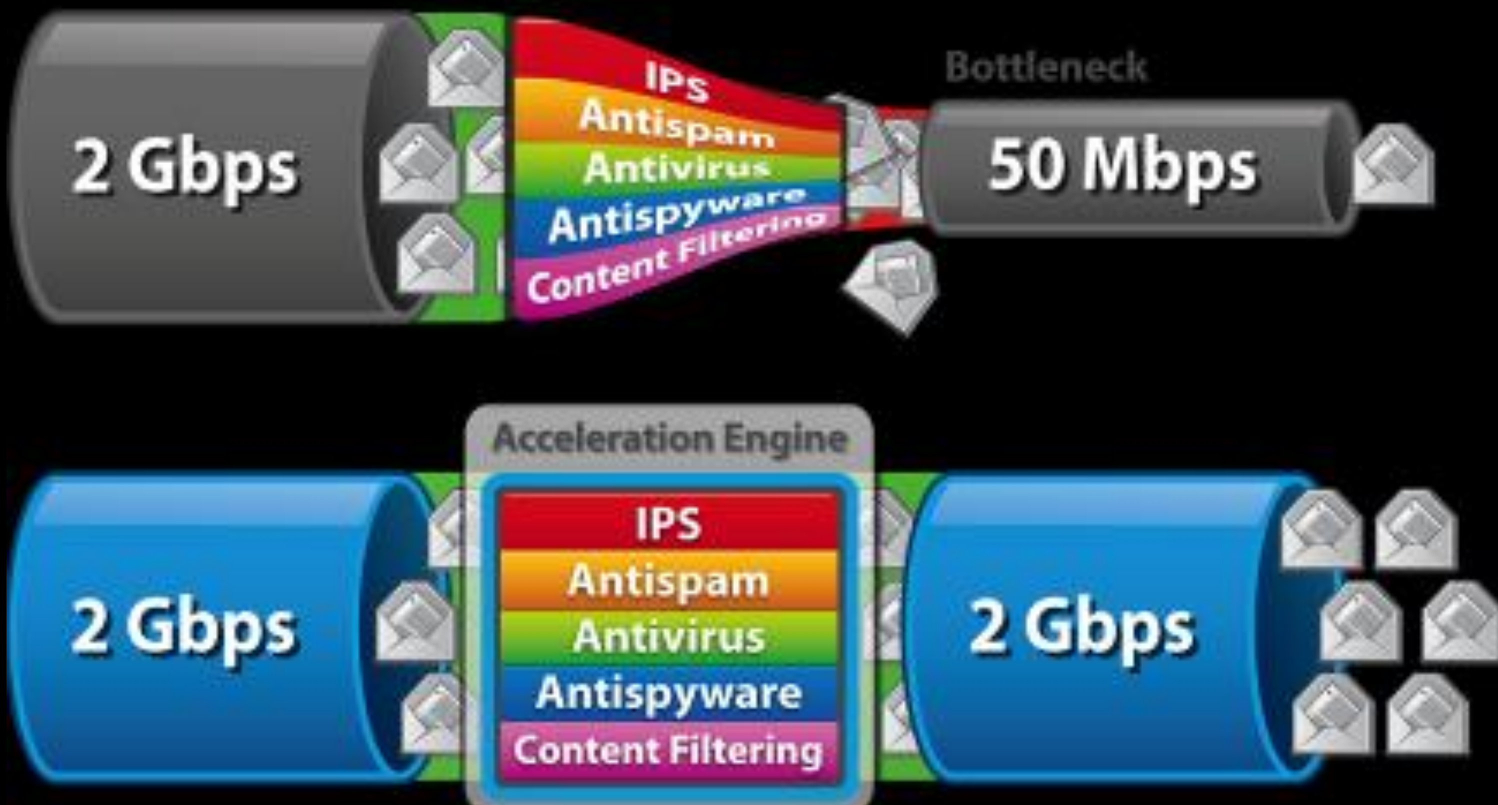
- Does it have enough processing power to run the analyses?

Speed:

- Is it fast or slow?

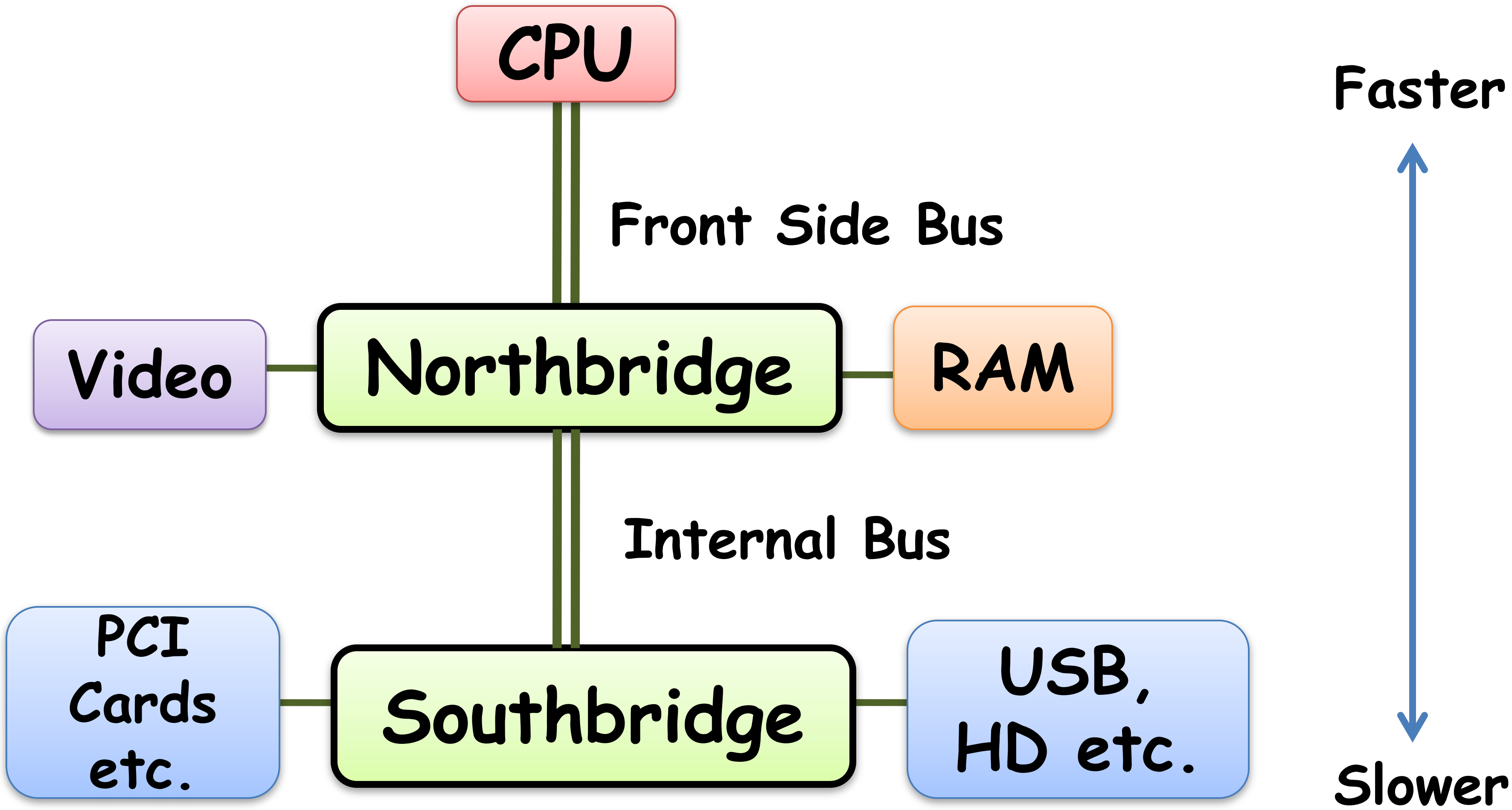
It all depends on unimpeded flow of data through the system.

One bottleneck in the path is like the whole path being slow



You know a little about CPU and RAM,

but what are crucial components of the motherboard?


CPU
Front Side Bus
Video
Northbridge
RAM
Internal Bus
PCI Cards etc.
Southbridge
USB, HD etc.
Faster
Slower

The buses:
(especially the frontside bus)

and the chipset (Northbridge and Southbridge).

A bus is a data path.

- A bus has clock speed and width (or number of lanes) e.g., 8-bit, 16-bit, 32-bit, 64-bit.

e.g., the Front Side Bus is like a freeway between RAM and CPU.

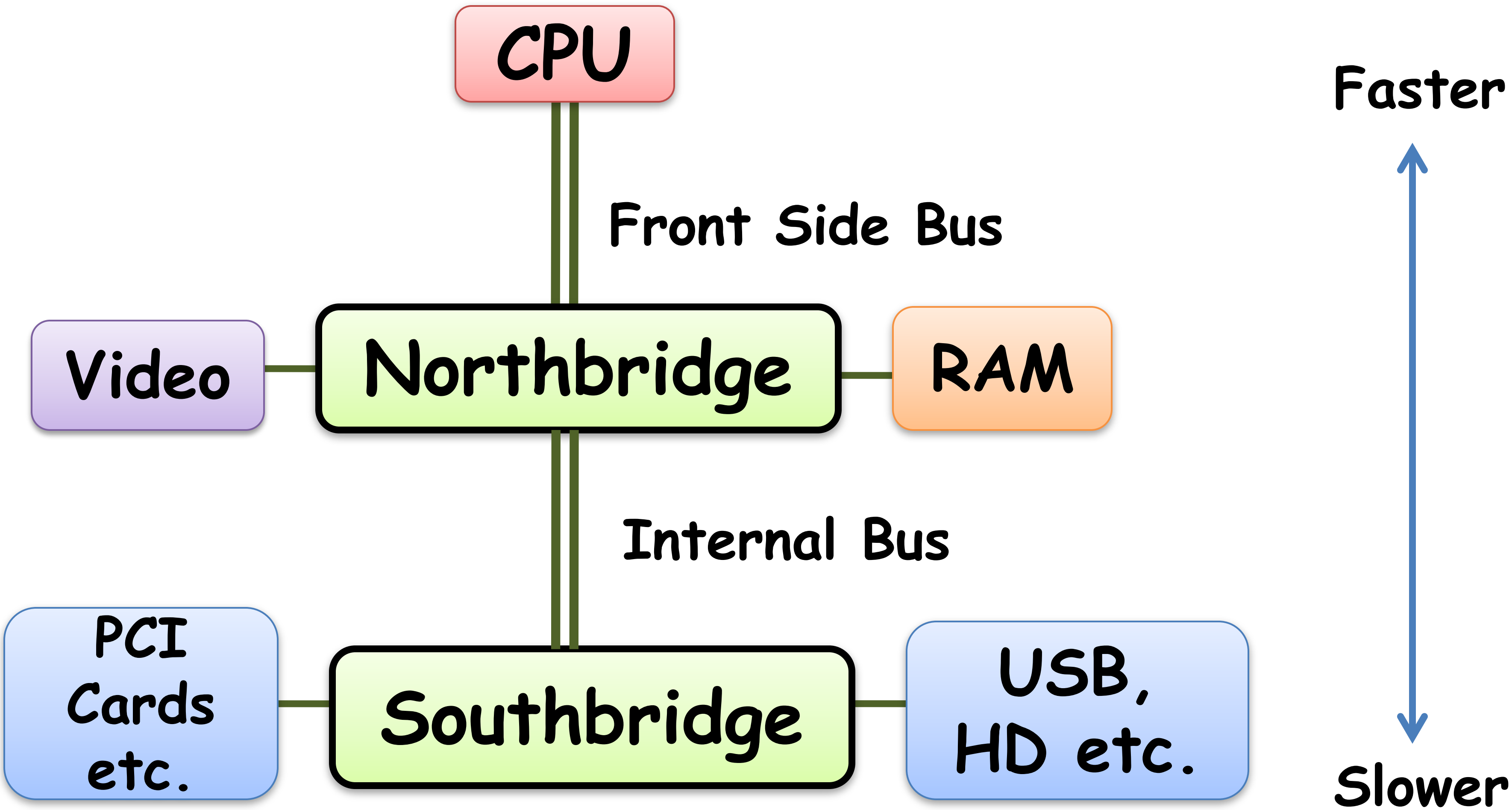
A chipset refers to a specific set of integrated circuits.

These are generally two “bridges”.

The **Northbridge** is for the fast components.

The **Southbridge** is for the slower components.

Bridges are connected by buses.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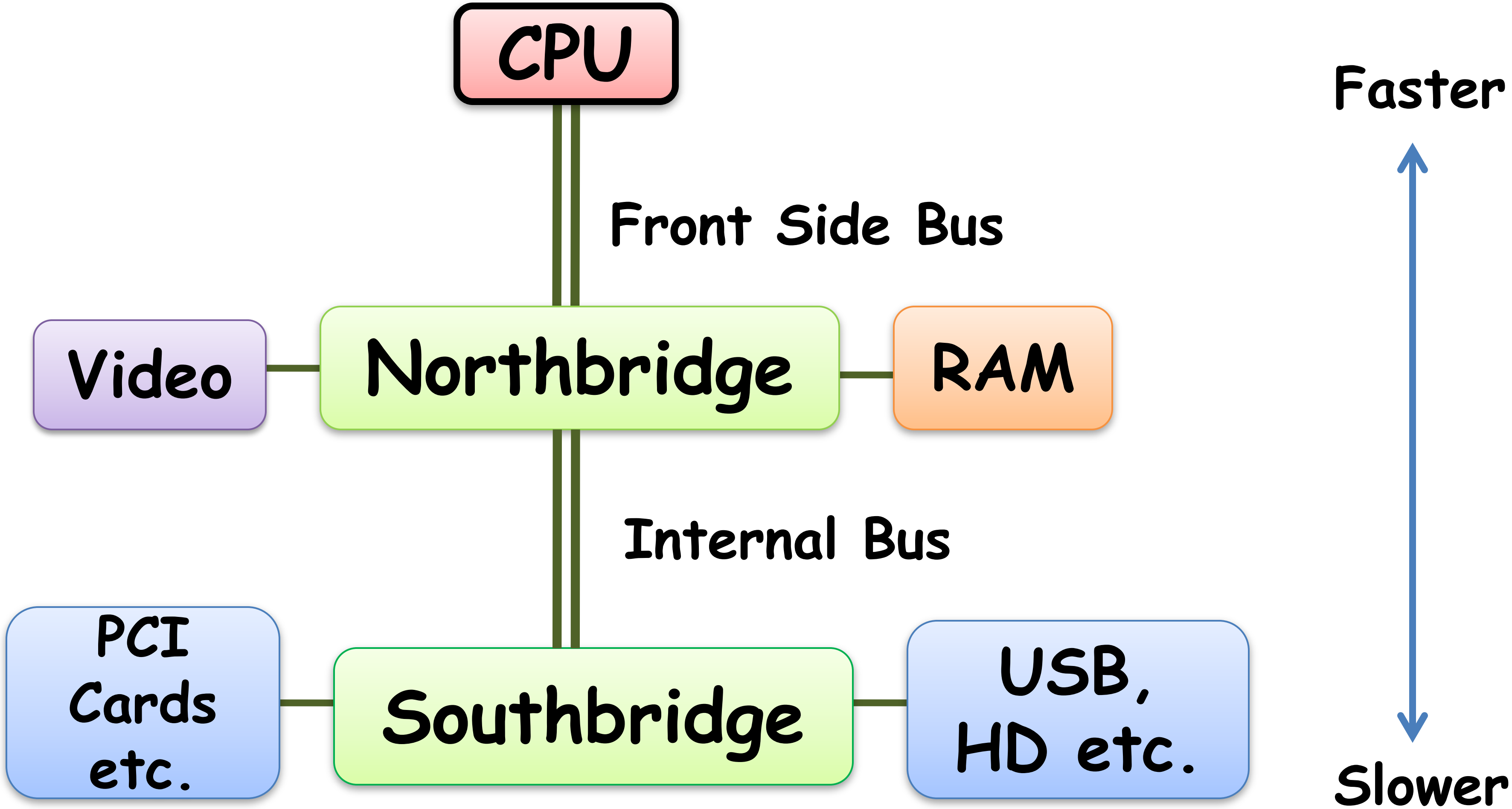
So, machine efficiency depends on unimpeded flow of data through the system.

The motherboard connects components together, by providing buses, bridges and slots.

The buses are like freeways. They have speed limits, and a limited number of lanes.

Bridges are like smart intersections that handle traffic from the buses.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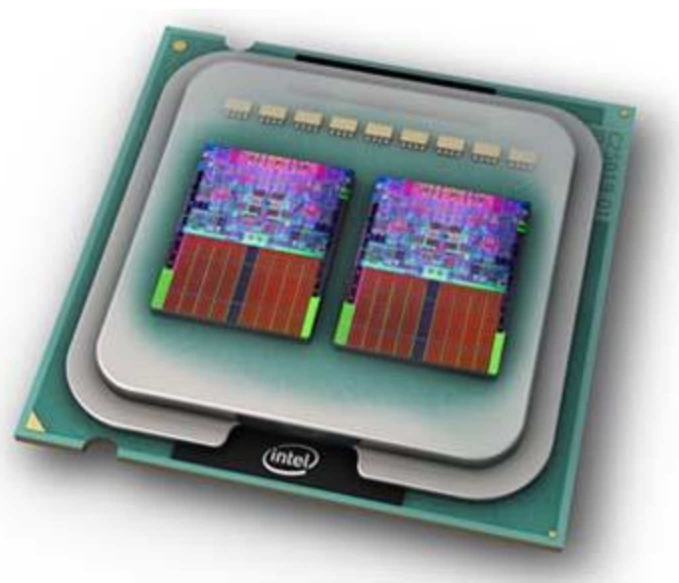
CPU


E5193788CC
A4
A80502-100
SX963/SSS
iPP


intel
Core™2 Extreme
quad-core


intel

CPU

Usually the fastest part of the system, everything else is trying to keep up.

CPUs max out
~3 GHz (clock rate),
because of heat
dissipation problems.

So, how can we continue to improve them?

By increasing the # of cpus in each machine.
"multicore"

But # of cores doesn't affect the speed of a single computation unless the computation is rewritten so it can be shared by the cpus.

So, # of cpus predicts # of simultaneous tasks until software engineers write programs that are multi-threaded (run processes in parallel)

What is Cache?

An extra copy of information that would normally be stored somewhere else (like RAM).

L1, L2, L3 Cache

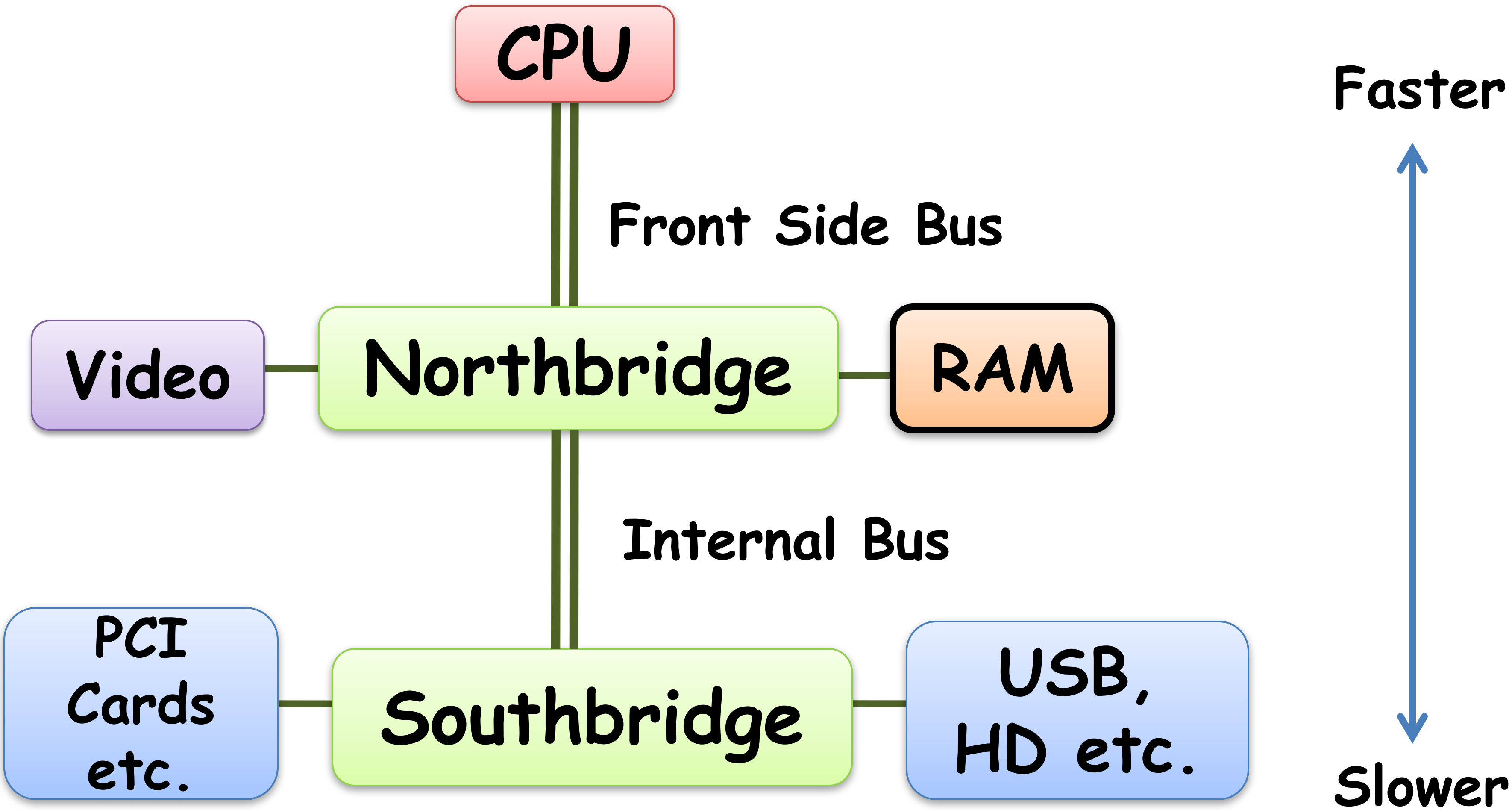
(Level 1 Cache, Level 2 cache, etc.)

Very fast memory caches on/near cpu
(big ones are helpful)

L1, L2, L3 Cache

- L1 Cache is usually the fastest and smallest
- L2 Cache is bigger than L1 cache, so it is slower, and not quite as central.
- L3 cache…well you get the idea.
- Caches help reduce the bottleneck between RAM and CPU(s).
- Manufacturers are always fooling around with different designs.

Choose large cache (L1,L2,L3) when you are choosing a CPU.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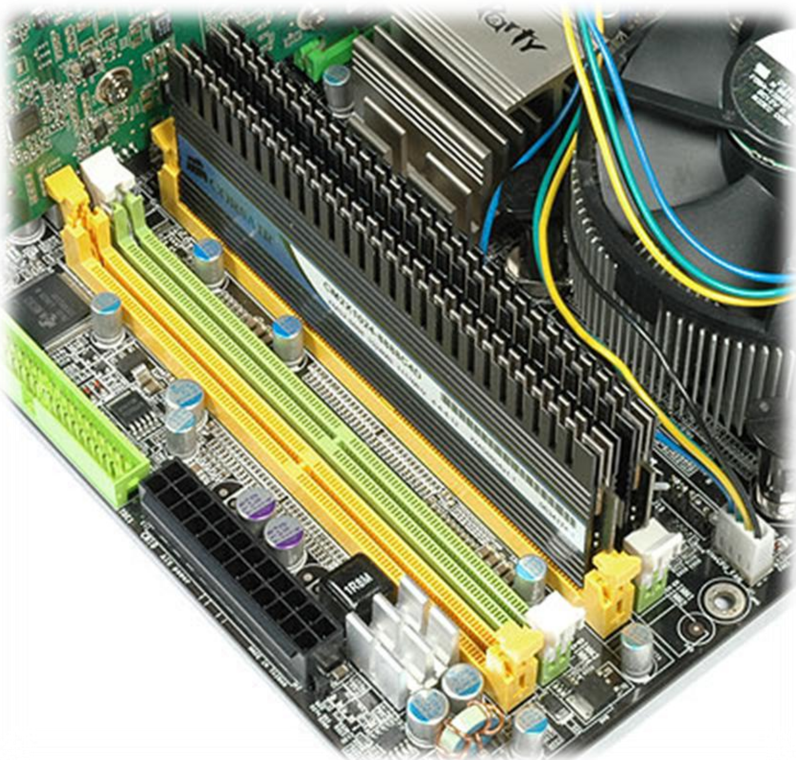
RAM



RAM is pretty fast, but not as fast as the L1 and L2 cache or CPU.

So, RAM can cause a bottleneck.

What can we do?

Buy fast RAM

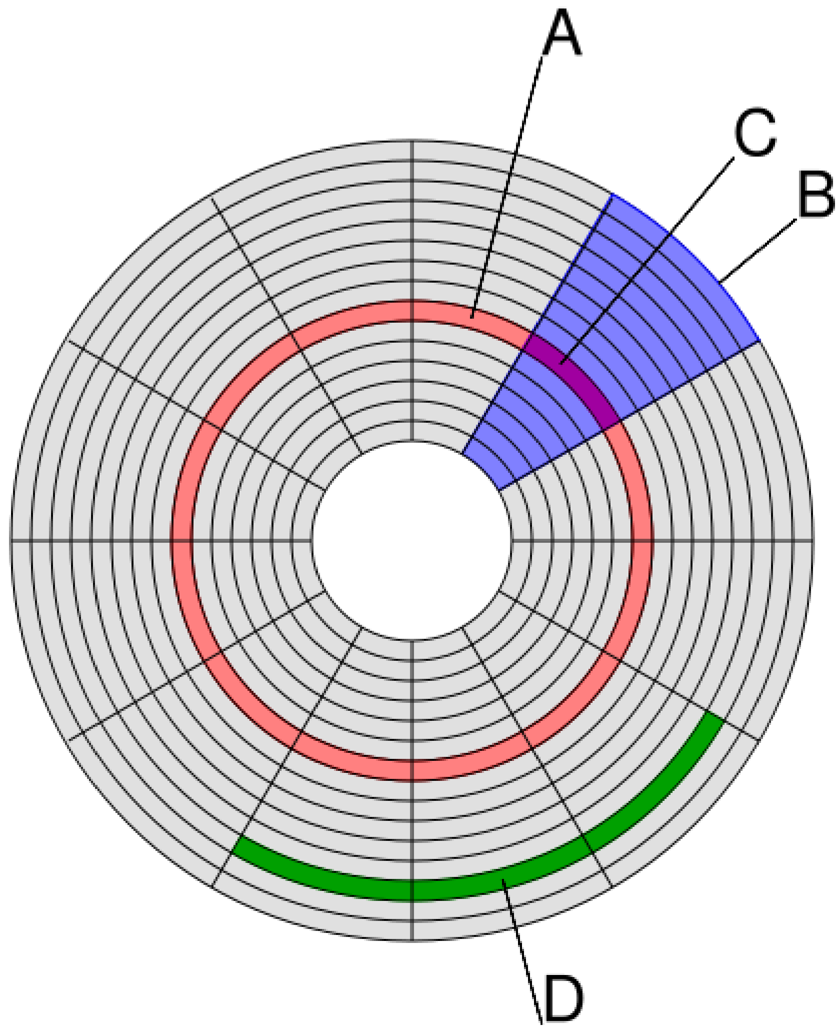
(i.e., high clock speed in MHz)

Hard Drive Speed (disk access time)

Hard drive (Inside) Platter and Read head

As you may recall, data are organized on the platter(s):

Disk structure:
(A) track
(B) geometrical sector
(C) track sector
(D) cluster



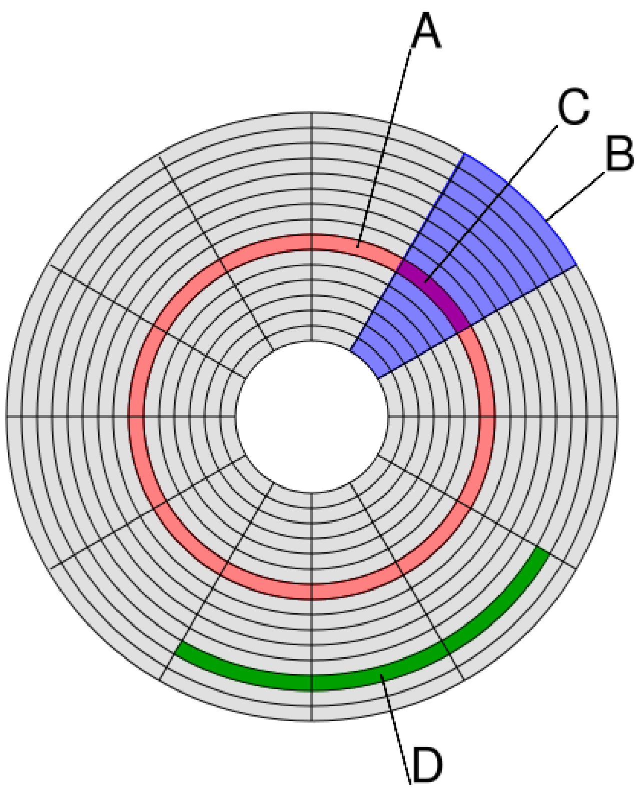
Disk access time is a function of:

Spin-up time - time to accelerate disk to operating speed.

Leave a drive spinning to improve access time,

Spin down drives to reduce energy use or noise.

Seek time - is the time for the read head to reach the desired disk track on the platter.



Rotational delay: time to access the required disk sector with the read head.

Depends on rotational speed: Revolutions Per Minute (RPM).

Low speeds (e.g., 4800 rpms) take less power, but are slower.

High speeds (e.g., 15000 rpms) take more power, but are fast.

Transfer time - time during which data is actually read or written to medium, with a certain throughput (MB/sec)

Disk Buffer/Disk Cache/Cache Buffer

Bottlenecks result from speed differences between:

- rotational delay
- seek time
- transfer time

The disk buffer is memory embedded in the hard drive that tries to compensate for the speed differences and make everything more efficient.

Interface	MBs/sec
USB Full speed (USB 1.x)	1.5 MB/s
USB High speed (USB 2.0)	35-60 MB/s
Firewire 400 (IEEE 1394)	50 MB/s
Firewire 800 (IEEE 1394b)	100 MB/s
CD-ROM, 1x	0.15 MB/s
CD-ROM, 52x	7.8 MB/s
DVD-ROM, 1x	1.3 MB/s
DVD-ROM, 16x	21.1 MB/s
BD-ROM, 1x	4.5 MB/s
PATA	33-133 MB/s
SATA I	150 MB/s
SATA II	300 MB/s
PCIe, 1x	250 MB/s

Summary

An efficient computer allows data flow through the whole system without significant bottlenecks.

For example, bottlenecks occur between CPU and RAM.

Fast RAM helps with this.
L1 and L2 Cache can help with this.

Bottlenecks also occur between RAM and Hard Drive.

Fast Hard Drives help (Drives with High RPM and good transfer speed).

Lots of RAM helps even more.

If you want to run lots of separate processes at once, or your software is multi threaded, multiple cpus help.

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