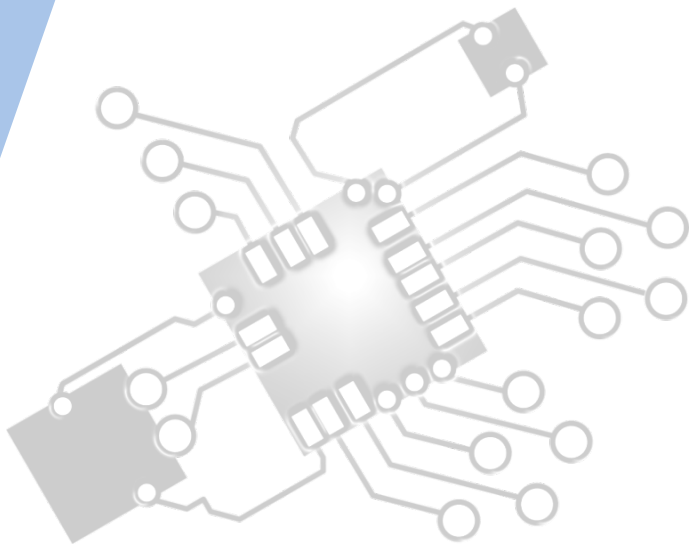
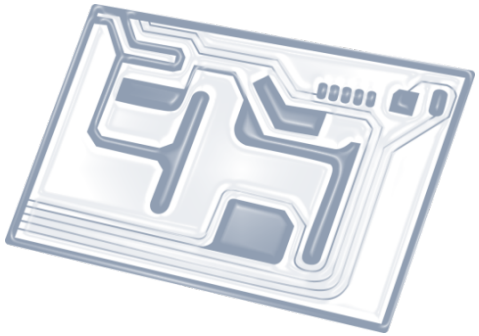
Resource Management

IB Computer Science



Content developed by
Dartford Grammar School
Computer Science Department

HL Topics 1-7, D1-4



1: System design

2: Computer Organisation

3: Networks

4: Computational thinking

5: Abstract data structures

6: Resource management

7: Control

D: OOP

HL only 6 Overview

System resources

6.1.1 Identify the resources that need to be managed within a computer system

6.1.2 Evaluate the resources available in a variety of computer systems

6.1.3 Identify the limitations of a range of resources in a specified computer system

6.1.4 Describe the possible problems resulting from the limitations in the resources in a computer system

Role of the operating system

6.1.5 Explain the role of the operating system in terms of managing memory, peripherals and hardware interfaces

6.1.7 Outline OS resource management techniques: scheduling, policies, multitasking, virtual memory, paging, interrupt, polling

6.1.8 Discuss the advantages of producing a dedicated operating system for a device

6.1.9 Outline how an operating system hides the complexity of the hardware from users and applications


1: System design

2: Computer Organisation



3: Networks

4: Computational thinking


5: Abstract data structures

6: Resource management

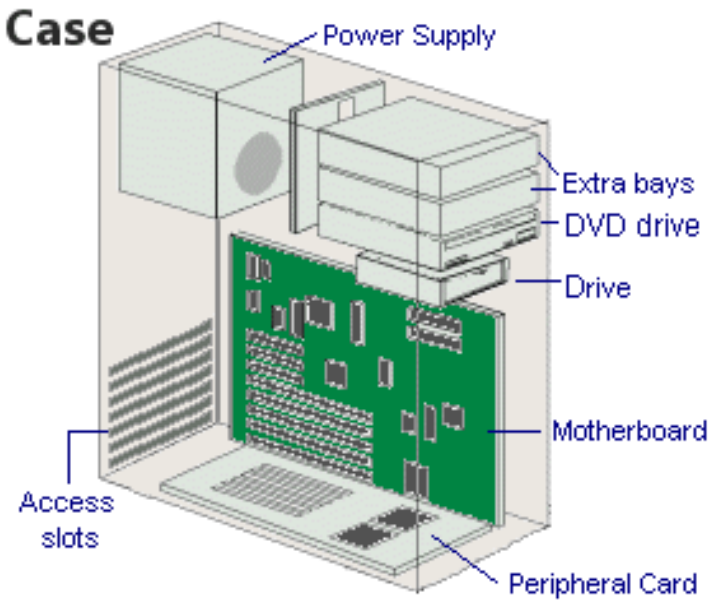


7: Control

D: OOP


Topic 6.1.1

Identify the **resources** that need to be **managed** within a computer system

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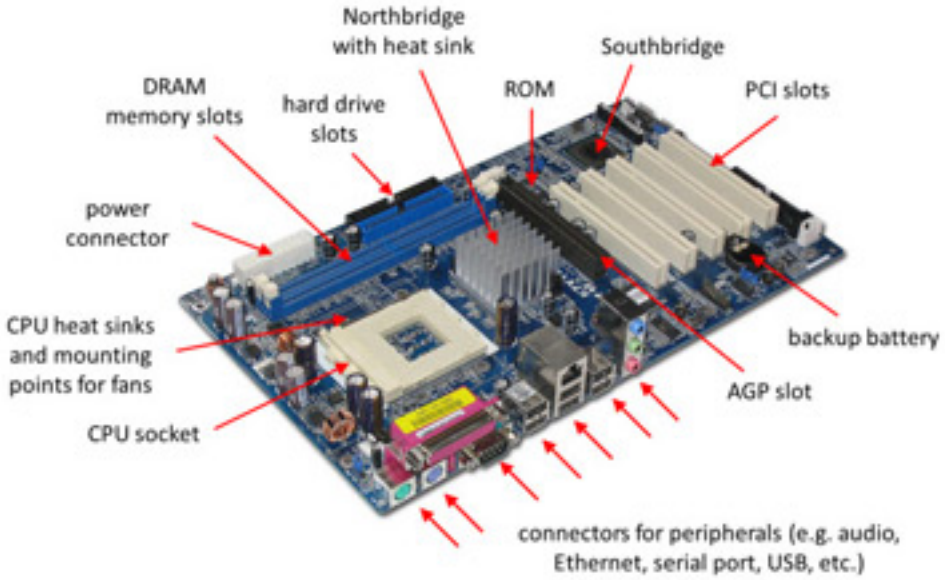
Important resources to manage

- Primary memory (RAM)
- Secondary storage (HDD/SSD/optical drives)
- Processor speed
- Bandwidth
- Screen resolution
- Sound processor
- Graphics processor
- Cache
- Network connectivity



It's all about the money

Ultimately, most computers are **commodities** – items to be sold.

If **profit** is a factor, so will be reducing the costs of manufacturing.

To give users the best possible experience, it is essential to tailor each system's configuration to its **intended purpose**.

Each component in a computer affects its function in a particular way.

Primary Memory (RAM)

What it does:

- Place where all data/programs currently being processed are kept

Common capacities:

- Gigabytes (GB): 1/2/4/8/16

Effect on system if too limited:

- If too little physical memory exists, the system will need to use secondary storage, which is much slower, by means of virtual memory.
- If virtual memory cannot be created or is insufficient, the program/data simply cannot be loaded.
- It influences how many processes can be done silmulataneously.

Secondary Storage (HDD/SSD/Optical)

What it does:

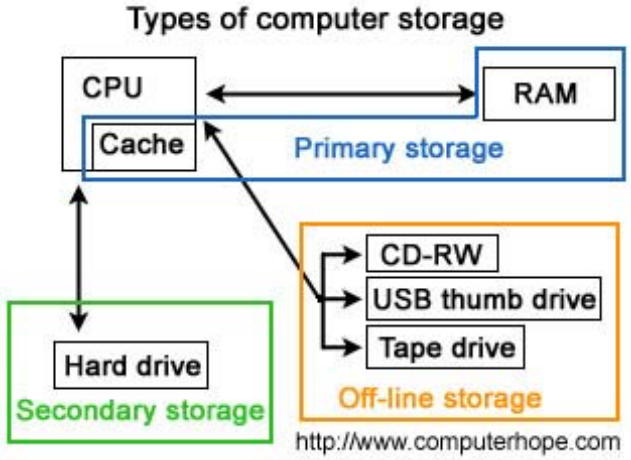
- Place were data/program can be stored if powered is lost (RAM is volatile).

Common capacities:

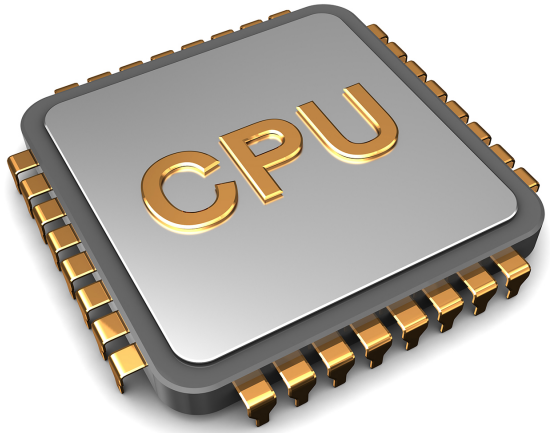
- Gigabytes (GB) / Terabyte (TB):
  - HDD: 500GB / 1TB / 2TB
  - SDD: 256GB / 512GB
  - Optical: CD 650MB / DVD 4.7GB

Effect on system if too limited:

- No place to 'save' work – so data might be lost
- Can also prevent the OS from using storage as virtual memory if RAM fills up
- Limits how much data can be kept



Processor: Speed



What it does:

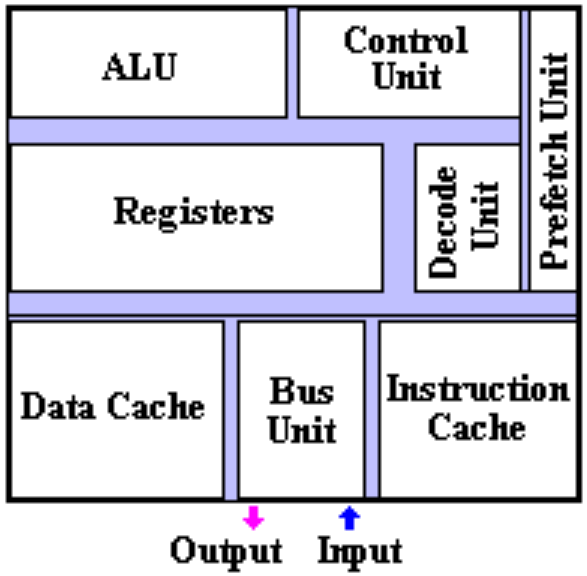
- Processor does all calculations in a computer system.
- Speed is measurement of how many calculations can be done per second (1Ghz = 1 billion calculations per second)

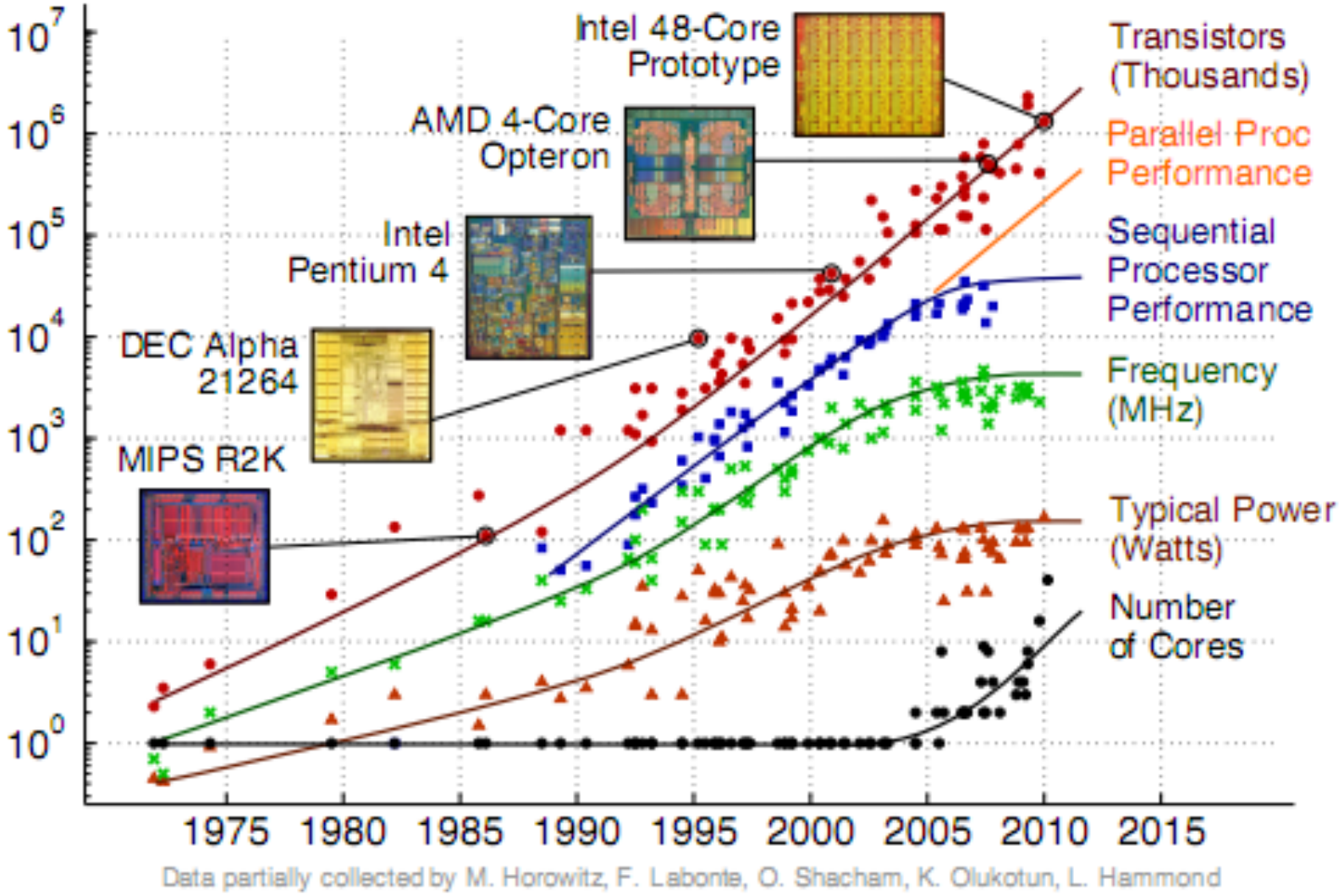
Common speeds:

- Gigahertz (GHz): 1/1.2/2/2.4/3.2

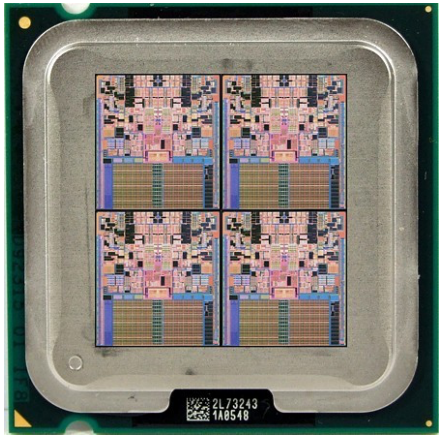
Effect on system if too limited:

- Processor will take longer to perform tasks




Intel 48-Core Prototype
AMD 4-Core Opteron
Intel Pentium 4
DEC Alpha 21264
MIPS R2K
Transistors (Thousands)
Parallel Proc Performance
Sequential Processor Performance
Frequency (MHz)
Typical Power (Watts)
Number of Cores
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1975 1980 1985 1990 1995 2000 2005 2010 2015
Data partially collected by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond

Processor: Cores



What it does:

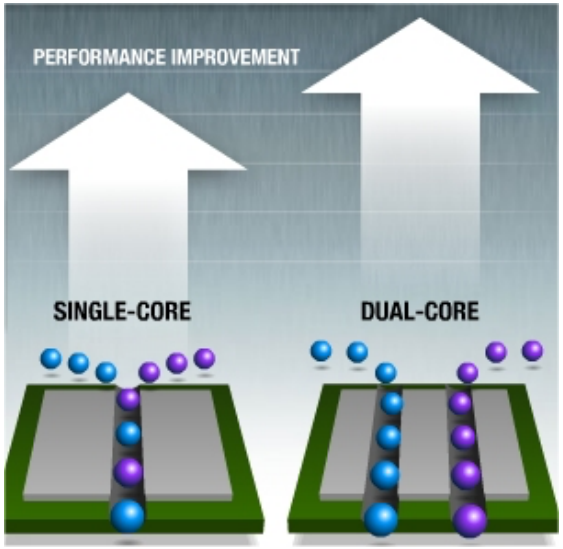
- Each processor has at least 1 ALU or core. If you have 2 ALUs you can do two operations at once, etc.

Common capacities:

- 2 core = dual core, 4 = quad, 8 = octa, etc.

Effect on system if too limited:

- If you have only one core, you can only perform one set of operations/calculations at a time. If you have two or more you can do more calculation in the same time frame.
- It affects how many tasks a system can cope with simulataneously.



Bandwidth (network transmissions)

What it does:

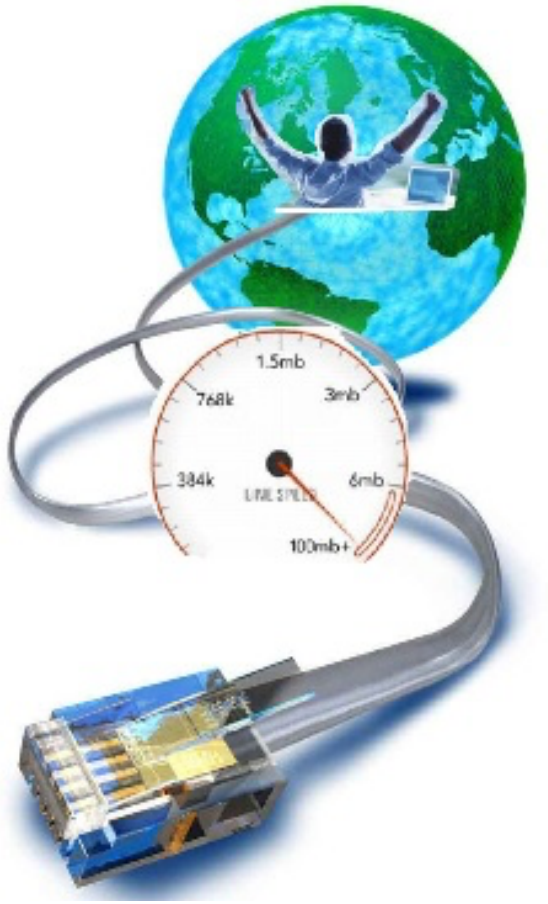
- Measurement of how much data can be sent at same time in a certain time frame (also called bitrate)

Common capacities:

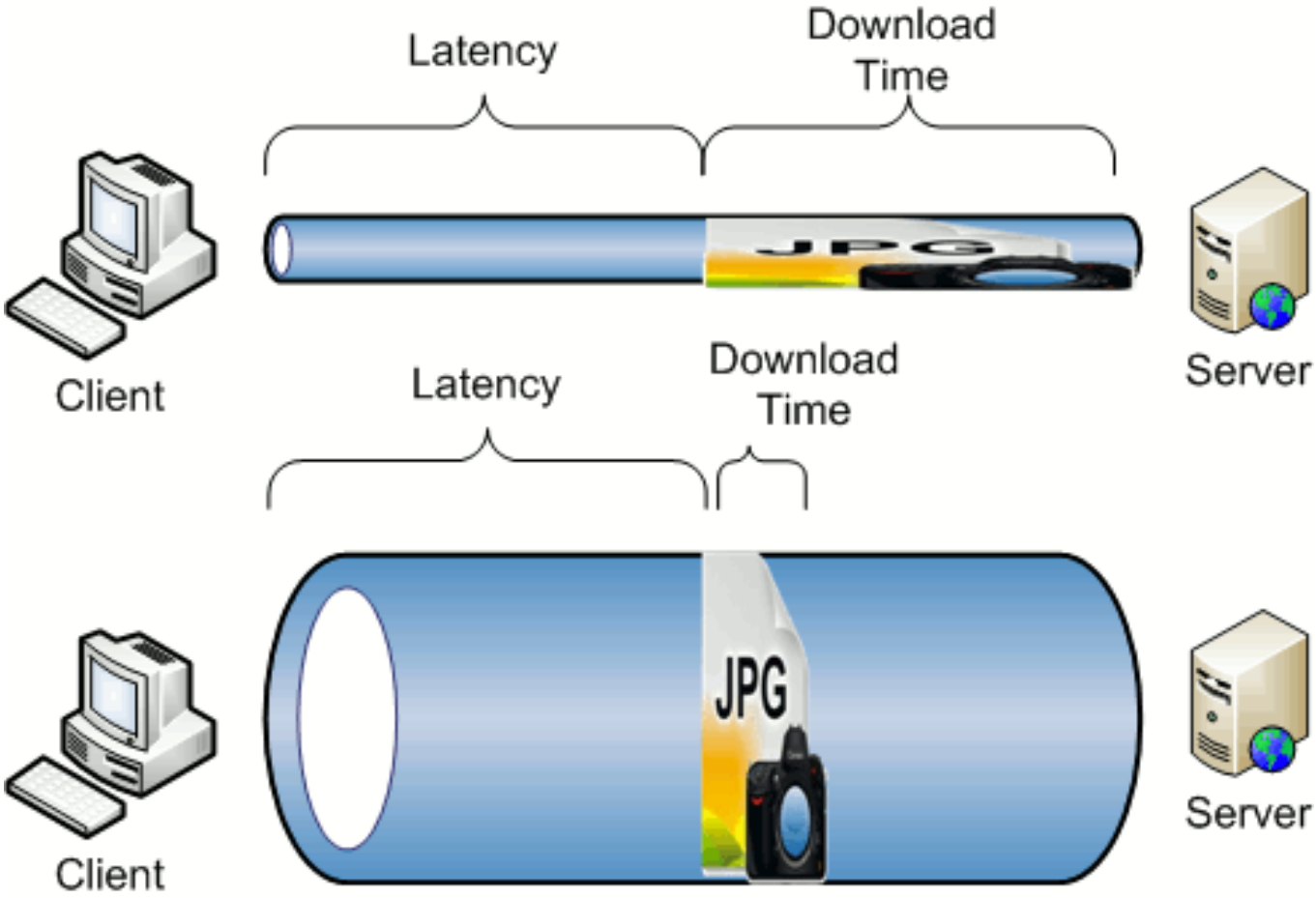
- Measured in bits per second (bps):
  Broadband = 16-100Mbps;
  LAN = up to 1Gbps (note: 1 Gbps = 1/8 GBps)

Effect on system if too limited:

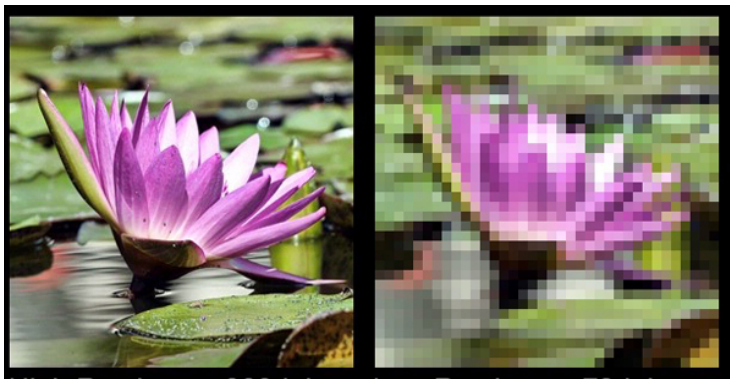
- Limiting the bandwidth means data will take longer to move between two points.
- It affects how long it takes before data can be processed in its entirety.



Low vs High bandwidth



Screen resolution

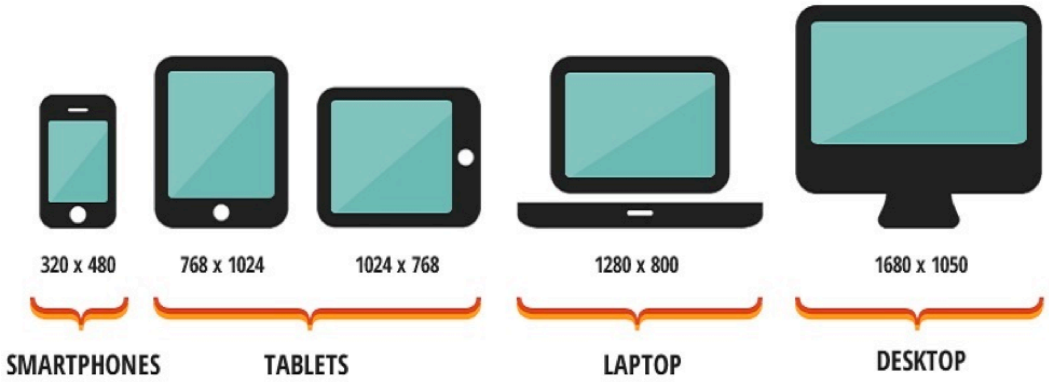


What it is:

- Measurement of number of pixels in height x width of display

Common capacities:

- 1024×768 (XGA)
- 1366×768 (HD 720p)
- 1920x1080 (HD 1080p)
- 4096x2304 (4K)



Effect on system if too limited:

- If resolution is too limited, the number of pixles that can be displayed is less – display might be pixelated (blocky)
- Lower resolutions = smaller file size but poorer quality images

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

Sound processor

What it does:

- Sound reproduction is done by a separate processor, freeing up the CPU to do other calculations.
- Can also contain a bank of 'sampled' sounds to reproduce better quality music/audio

Commonly seen in:

- Home theatre systems
- Cinemas

Effect on system if too limited:

- CPU is taxed with having to processes sounds, slows down system overall.
- Overall quality is not as high as in a system with a dedicated sound processor.

Graphics processor (GPU)

What it does:

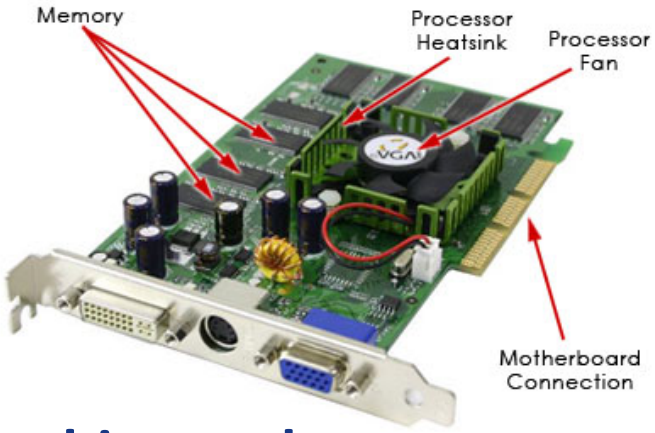
- Does complex graphic processing (like 3D rendering)

Commonly seen as:

- Nvidia graphics card
- ATI graphics card

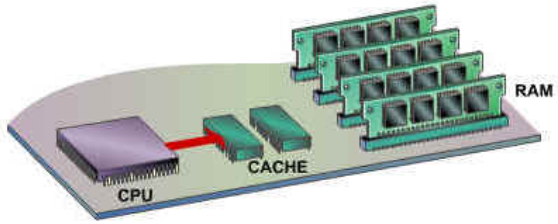
Effect on system if too limited:

- If CPU has to do graphics processing, it will take longer or be limited.



Note: SoC vs 'on board' vs GPU vs Graphics card

Cache (physical cache)



What it does:

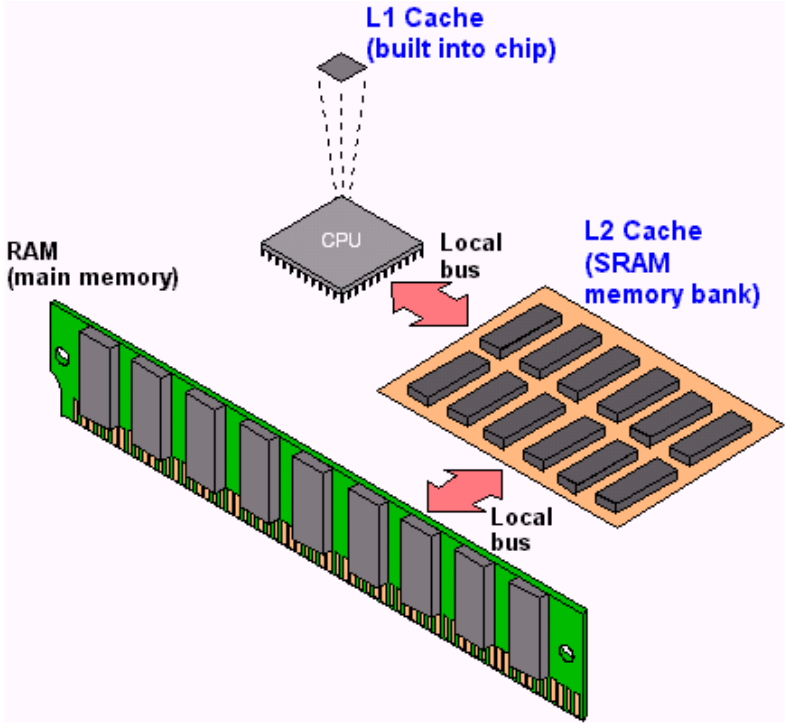
- Contains the instruction/data the CPU is likely to request next from RAM – it massively speeds up processing as the CPU does not have to 'wait' for instructions to arrive from RAM.

Common capacities:

- Megabytes (MB): 1 to 128

Effect on system if too limited:

- CPU will have to 'wait' for instructions/data to be fetched from RAM – slowing down system. User experiences 'sluggish' system.



Network connectivity (NIC/WNIC/Bluetooth)

What it is:

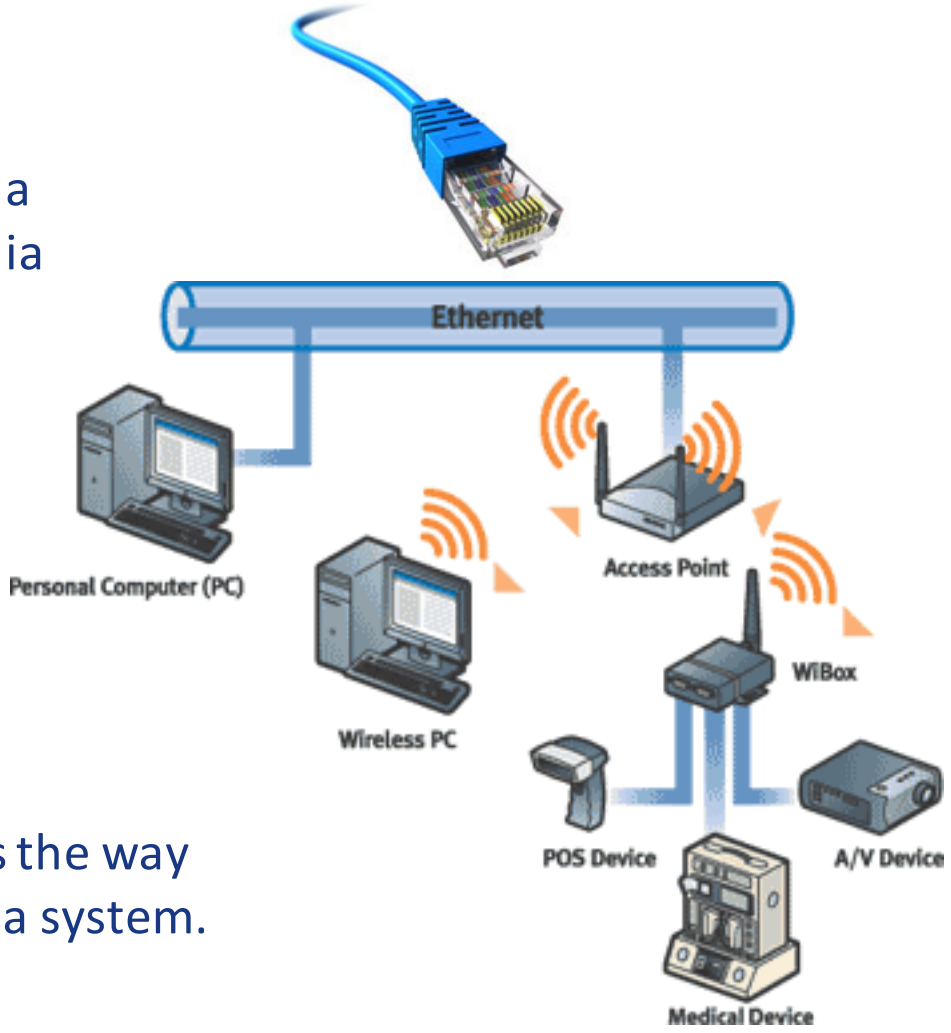
- Each network card connects to a particular type of network media (cable/wireless signal)

Commonly found as:

- NIC = LAN/ethernet cables
- WNIC = WiFi signals
- Bluetooth = Bluetooth signals
- 3G radio = cellular signals

Effect on system if limited:

- Limited connection types limits the way data can be sent or received in a system.
- Speed can also be a factor.



Connectivity (in general)