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# **CPU (Central Processing Unit)**

## Speed (Hastighet)

* A CPU operates at a specific speed, measured in hertz (HZ).
* The speed of CPUs has steadily increased from MHz (Megahertz) to GHz (Gigahertz)
* The speed range for most CPUs today is between 2.5 – 4.5 GHz, with some reaching up to around 5 GHz.

## Overclocking and Throttling

* **Overclocking:** Increasing a CPU’s speed beyond its default to extract maximum performance. This can increase power usage and heat.
* **Throttling:** CPU’s might run at a speed lower than their maximum to conserve power.

## Hyperthreading

* **Simultaneous Multi-Threading (SMT):** A feature allowing each core of a CPU to handle multiple tasks (threads) at the same time.
* **Hyper Threading (HTT):** Intel’s terminology for SMT.
* Threads are like individual “lines of thought” for a computer, accessing RAM and storage.

## Bit Depth

* Refers to the size of data a CPU can handle simultaneously.
* Common Bit Depths:
  + **32-bits:** Can address up to 2^32 or roughly 4GB of memory.
  + **64-bits:** Can address up to 2^64, which equates to about 16 Exabytes (or 17179869184 Gigabytes)

## Cache

* The CPU’s built-in-memory which helps in faster data retrieval.
* **L1 Cache:** Smallest, and each CPU core has its distinct L1 cache.
* **L2 Cache:** Larger than L1 and may be shared among cores.
* **L3 Cache:** Largest and always shared among cores.

## Other Noteworthy Points

Virtualization Support: Modern CPU’s may have built-in support for virtualization. Examples include AMD’s AMD-V and Intel’s VT technologies.

# Et bilde som inneholder kobling, kabel, Strømforsyning Automatisk generert beskrivelse**Cables (Kabler)**

## VGA (Video Graphics Array)

**VGA** has been used in various contexts.

* As a general term for analog video.
* With a resolution of 640 x 480.
* Features a 15-pin analog video D-sub connector.

## DVI (Digital Visual Interface)

Introduced in 1999 to provide digital transmission over longer distances and with better quality than VGA.

Et bilde som inneholder kobling, kabel, Strømforsyning, utendørs

Automatisk generert beskrivelseTypes:

* **DVI-A:** Analog
* **DVI-D:** Digital
* **DVI-I:** Supports both analog and digital.

**Dual link:** Provides increased speed and signal quality.

## Et bilde som inneholder kobling, kabel, Strømforsyning, utendørs Automatisk generert beskrivelseHDMI (High-Definition Multimedia Interface)

* Delivers digital video continually improving quality since its inception in 2002.
* **Latest version:** 2.1 offers a bandwidth of 48Gbps.
* Can also transmit audio, network data, and other information.
* While older cables can be used, they may not support newer features.
* Available in standard, mini, and micro versions.

## Et bilde som inneholder kobling, kabel, Strømforsyning, Dataoverføringskabel Automatisk generert beskrivelseDisplayPort

* Delivers top-quality video.
* Does not have as many features as HDMI but is more power-efficient.

## Honourable mentions

* **eSATA:** External SATA connection for storage devices
* **FireWire/1394:** Once popular for data transfer, especially in multimedia applications.
* **RS232/Seriell:** An older serial communication standard.

## USB (Universal Serial Bus)

* **Plug N Play** technology.
* Speed evolution: Started from 12 Mbps and has reached up to 20Gbps.
* Initially used for devices like keyboards and printers; now ubiquitous.
* Also provides power to connected devices.
* Important distinction: USB-C and USB 3 are NOT the same.
  + **USB 3.2** offers a speed of 20Gbps.

## Et bilde som inneholder kobling, kabel, Strømforsyning, Dataoverføringskabel Automatisk generert beskrivelseThunderbolt

* Starting from its third version, Thunderbolt bolt uses standard USB-C connectors.
* Offers everything USB does but as faster speeds and higher bandwidth.
* Supports PCIe and DisplayPort.
* To identify if a port or device is Thunderbolt enabled, look for a lighting symbol or refer to the manual (RTFM).

# **Data Storage (Non-Volatile data Storage Summary)**

## Hard Disk Drives (HDD)

* Uses magnetism for data storage.
* Mechanical storage on platters.
* Comprises of a controller, hard disk, and a host bus adapter.
* Speeds vary from 5400 to 15000 rpm.
* Common sizes: 3.5” or 2.5”

## Solid State Drives (SSD)

* Stores data on flash memory.
* No moving parts resulting in less power consumption, less heat, and quitter operation.
* Generally, 10X faster reading and 20x faster writing than HDDs.

## Interfaces

* IDE/Parallel Advanced Technology Attachment.
* SATA ranging from SATA 1.O to SATA 6Gb/s (SATA III)

## M2 & NVMe

* Developed for laptops but now also common in Desktops.
* Can be SATA or PCIe based.
* NVMe is an open standard improving SSD performance.

## Optical Storage

* Floppy disks once held 1.44 MB.
* CD-ROMs brought a leap to 600 MB.
* DVDs came next, and now we have Blu-Rays that can store up to 100GB.

## RAID (Redundant Array of Independent / Inexpensive Disks)

Combines multiple disks for enhanced speed, data redundancy, or both.

* **RAID 0:** Stripes data across at least two disks for increased speed but offers no redundancy.
* **RAID 1**: Disk mirroring. Creates an exact clone for redundancy.
* **RAID 5:** Uses striping with parity. Can tolerate a single disk failure.
* **RAID 6:** Like RAID 5 but with dual parity, allowing for two disk failures.
* **RAID10 (1+0):** A combination of RAID 1 & RAID 0.

## RAID (Redundant Array of Independent Disks) – Part 2

RAID is a technology used primarily in storage solutions to combine multiple hard drives into a single unit, referred to as an array. This combination serves several purposes:

1. **Performance Enhancement:** By spreading out data, the IO operations can be balanced which, in many cases, can increase performance.
2. **Data redundancy:** By copying data across drives, redundancy ensures data remains accessible even if one (or more, depending on RAID type) drives fail.
3. **Capacity augmentation:** Combining drives effectively pools their storage capacities.

Different RAID levels provide a balance between these purposes based on the user’s specific needs. Here are some common RAID types:

RAID 0 (Striping)

## Tape Backup

* Still used as backup for the backup.
* High capacity, portable, compact, resilient to ransomware, and energy efficient.

## Removable Storage Devices

Devices like USB drives, SD cards, etc. that can be easily removed and ported.

# **MEMORY**

## Memory Corruption

Data stored in RAM can get corrupted in various ways. Mechanisms are therefore needed to identify and rectify these errors.

## Parity Checking and ECC

* **Parity Checking:** Checks for errors by maintaining a count of each bit in byte.
* **Error-Correcting Code (ECC):** Memory controllers store an additional bit for each byte and check for consistency during reads. It can correct single bit errors and report multi-bit errors.

## Speed

RAM operates at the speed of the system clock. However, DDR RAM doubles this speed. DRR2 doubles the speed of DDR, and the pattern continues. Currently, DDR5 operates around 5GHz.

## RAM Channels

RAM can operate in single, dual, triple, or quad channels. This indicates the number of matching memory modules required to fully utilize the motherboard’s capacity.

## Memory types

* **SDRAM (Synchronous Dynamic Random Access Memory):** Requires periodic refreshing and synchronizes with the motherboard’s clock speed.
* **SRAM (Static Random Access Memory):** Faster and more expensive, often used as CPU cache.
* **ROM (Read-only-memory):** Stable memory that does not change much.
* **DIMM/SIMM:** Indicates whether memory modules are present on one or both sides of the chip.

# **Motherboard**

## Form factor

Types: E-ATX, ATX, micro ATX, mini ITX Differences pertain to size and application. Various types are needed for diverse system configurations. Crucial to consider when purchasing a motherboard, case (kabinett), and Power Supply Unit (PSU) separately.

## Components – Bus

The signal pathways on the motherboard.

* Evolution: Serial ---- > Parallel ---- > Serial.
* Higher bus speed leads to faster component performance.

## Chipset

* Chips or circuits that work in conjunction with the CPU.
* Determines the types of supported components.
* Two main groups:
  + Northbridge: Handles high-speed components like PCIe and communicates with the CPU through the Front-side bus (FSB)
  + Southbridge: Manages components that do not follow FSB (slower components) such as USB, PCI, (S)-ATA, LAN, Audio, etc.

Note: The Northbridge’s relevance diminished as of 2022.

## Expansion Slots

* PCI (Peripheral Component Interconnect): Old, operating at 33MHz or 66 MHz, and uses parallel communication.
* PCI Express: Replaced PCI and AGP. Comes in different versions (x1 – x32 lanes and v1.1 – V5.0). It employs serial communication.

## RAM Slots

* Various types have existed over time.
* Notables: SIMM (Single in-line memory module), DIMM (Dual in-line memory module).
* Modern systems predominantly use DDR SDRAM.
* SO-DIMM is used in laptops (Small Outline)
* DDR1-5 are not interchangeable.

## CPU Sockets

* Predominantly types today:
  + **LGA (Land Grid Array):** E.g., 12th Gen Intel (Alder Lake) uses LGA1700.
  + **PGA (Pin Grid Array):** E.g., AMD's socket AM4 uses SOCKET 1331.

## BIOS (Basic Input/Output System)

* Governs booting and the communication between hardware and the operating system.
* UEFI is a modern version emphasizing extensibility.
* Conducts a Power-On Self-Test.

# **Displays and printers.**

## Pixels

* Smallest component in a digital image.
* Measured as Dots Per Inches (DPI) for printers.
* Colour depth depends on bits per pixel (e.g., 24 bpp = 16, 777, 216 colours)

## Display metrics

* **Contrast radio:** Difference between the brightest and darkest point on a screen.
* **Response time**: Time taken for a screen pixel to change from black to white and back.
* **Frame Rate:** Usually expressed in HZ (e.g., films often use 24 FPS)

## Printers

* Speed often measured in mm/s or Pages Per Minute (PPM)
* Consider cost per page and technology fit for the intended use.

## Fun facts

XEROX, and American Company, was pivotal in the development of GUI, mouse, ethernet. Personal computers.

## Printer technologies

* **Daisywheel:** Impact printer from the 1970s, slow and noisy.
* **Dot-Matrix:** Uses dots to form fonts/graphics, outdated but still exists.
* **Inkjet:** Expensive ink, especially good for images, quieter than impact printers.
* **Laser Printer:** Cost-effective per page, faster and uses Xerography.
* **Thermal Printers:** Fast, user-friendly, and durable but has high paper costs.
* **3D Printer:** Creates 3D objects by melting and precisely placing material.

## Display technologies

* **CRT (Cathode Ray Tube):** Heavy and bulky but was the standard before LCDs.
* **LCD (Liquid Crystal Display):** Uses liquid crystals and an external light source. **Plasma:** Used electric shocks on noble gases to produce light, once superior to LCD. **OLED (Organic Light Emitting Diode):** Uses organic material to produce light per pixel, no need for backlight.

# **Portable and mobile devices**

## Definition: Laptop and Desktop

* **Lap:** Flat area between the waist and knees of a seated person.
* **Desk:** Working surface of a desk.
* Early portable computers weighed up to 25kg, resembled a small suitcase, and lacked batteries, hence they were termed:
  + "Luggables". They were sub-par compared to desktops and quite expensive.

## What defines a Laptop?

In essence, has the same components as a desktop but with variations. Main challenges:

* Size and weight
* Heat and power consumption

Components tend to turn off when not in use to conserve energy. Components, for the most part, are not interchangeable between devices. Netbooks are smaller versions primarily designed for browsing, e.g., Chromebook.

## Desktop vs Laptop

* **Portability:** Laptops are mobile.
* **Price:** Laptops tend to be pricier when comparing similar specifications. The cost difference has reduced over the years.
* **Performance:** Typically, laptops are less powerful due to the balance between size and performance.
* **Upgradability:** Desktops are modular. Laptops generally allow upgrades to memory/storage but not much else apart from USB additions.
* **Build Quality:** Laptops need to endure more wear and tear.

## Dismantling and Assembling

* Every screw matters when dealing with laptops as compared to the laxity when dealing with desktops.
* For business desktops, users can self-troubleshoot; for laptops, it's advised to call a technician.
* Always refer to the manual (RTFM - Read The F\*\*\*ing Manual).
* Use the correct tools for the job. A damaged screw head can ruin a laptop. Document everything beforehand and during the process.

## Key Components

* Motherboard: Non-standardized, smaller in size.
* Processor: Differences with desktop versions have reduced over time. Often soldered to the motherboard.
* Memory: Uses the same technology as desktops but in smaller form factors. Examples are SODIMM or MicroDIMM. Sometimes these are soldered to the motherboard, meaning they can't be upgraded.

## Storage

* 2.5" or 1.8" drives are common.
* SSDs (particularly M.2 format) are preferred due to space, heat, and the absence of moving parts.
* Optical drives are available in smaller formats for laptops.

## Input Devices

* **Keyboard**: With or without a numeric pad. Special function keys (FN) for various purposes.
* **Pointing Device:** Trackball, touchpad, point stick, touch screen.

## Mini PCI

Internal expansion slots.

Mini PCIe replaced Mini PCI.

## Storage Evolution

* From the 1.44MB Floppy Disk to 1TB and beyond with M.2.
* M.2, formerly known as the Next Generation Form Factor (NGFF).

## Power

Laptops don't use conventional PSUs. They either rely on batteries or external power adapters.

## Laptop Displays

* Use technologies like LCD, OLED.
* Can come with touch functionalities - Digitizer.
* Brightness in mobile screens is often referred to in terms of "Nits".
* 1080p resolution is common.

## Additional Components

* Digitizer
* Webcam
* Wi-Fi antenna

## Docking Station

Laptops can be connected to a docking station to access desktop-like facilities while retaining the portability of a laptop.

# **Virtualization and XaaS**

## What is virtualization?

* A simulated (virtual) computing environment.
* Computer-generated hardware, OS, storage, etc..
* Allows on physical machine to host multiple virtual environments.
* These environments function independently of each other.

## Advantages of Virtualization

* **Scalability:** It can easily grow or shrink based on needs.
* **Reduced Power Consumption:** Virtual environments use less power than multiple physical ones.
* **Reduced Infrastructure:** Fewer machines are needed.
* **Less Maintenance:** Centralized systems generally require less upkeep.

## Desktop Virtualization

A centralized server delivers and manages individual desktop environments.

## Network Bandwidth

The network's bandwidth can be divided into independent channels. Provides specific servers or devices with precisely the amount of network they need. Businesses might need to have simulated network devices.

## More on Virtualization

**Storage Virtualization:** Combining multiple network storage resources into a single storage unit.

## Hypervisor

Controls the virtual machines. Can either run on top of an OS or directly on the hardware.

## Virtualization vs. Cloud Computing

Virtualization is a technology. The Cloud is an environment (which utilizes virtualization). The Cloud is owned by an external service provider. A company can use virtualization while maintaining its servers and hardware. Data location is a consideration for security.

## Importance of Virtualization

Better utilization of server/desktop resources. Easy disaster recovery. Quicker deployment of new servers. Simplifies system migration.

## XaaS (Anything as a Service)

A business model. Buy what you need, not more. Often a buzzword in the tech industry.

## Infrastructure as a Service (IAAS)

Allows the creation of virtual servers and associated infrastructure. Includes storage, network, and automation. Examples: Microsoft Azure, Amazon Web Services (AWS).

## Platform as a Service (PAAS)

Provides the operating system, databases, and middleware. Often targeted towards developers. Examples: SAP Cloud, Microsoft Azure

## Software as a Service (SAAS)

Any software you use online. Examples: Gmail, Dropbox, and many more. Note: The above is a breakdown and translation of the provided content into English, focused on the core concepts and explanations.