

▼ HDMI (High-Definition Multimedia Interface)

Video and audio stream

- All digital, no analog
- ~20 meter distance before losing too much signal

19 - pin (Type A) connector → Proprietary connector



Video Adapter

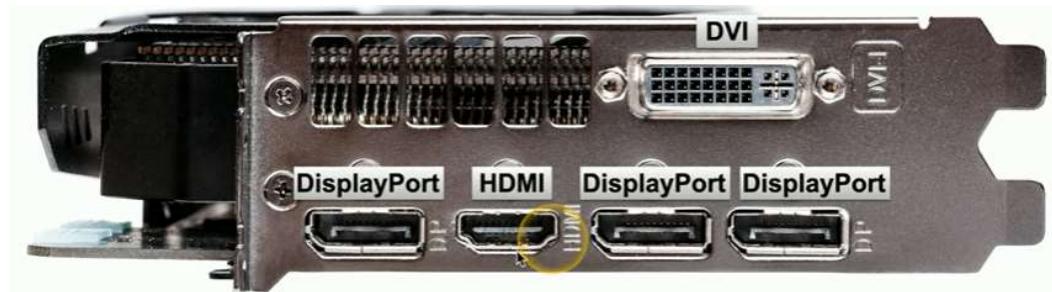
▼ DisplayPort (Video Standard)

Digital information sent in packetized form

- Like Ethernet and PCI Express
- Carries both audio and video

Compatible with HDMI and DVI interfaces (as long as they have a cable for the suited connection)

- Passive adapter
- DisplayPort → HDMI
- DisplayPort → DVI



▼ DVI (Digital Visual Interface)

These allow you to send video signals in Single and dual link

- Single link; 3.7 Gbps (HDTV at 60 fps)
- Dual link; 7.4 Gbps (HDTV at 85 fps) / (twice as much throughput)
- No audio support

DVI - A

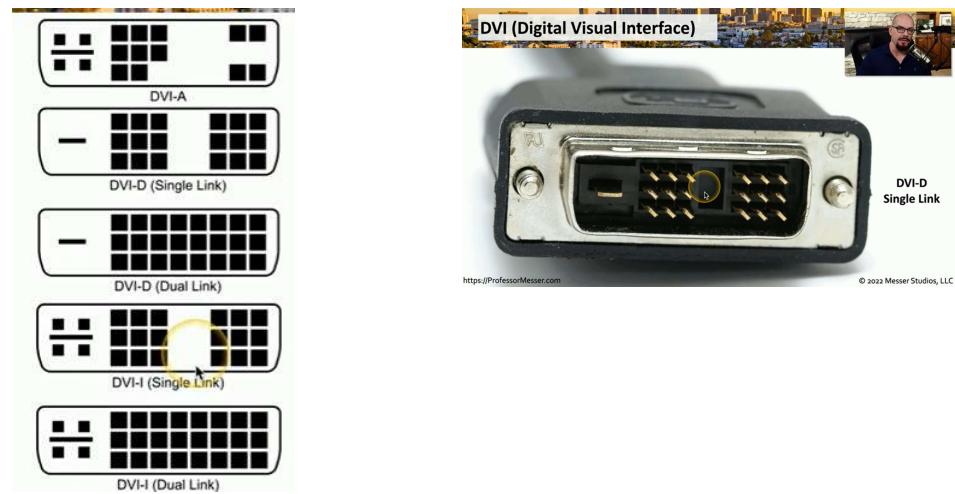
- Analog Signals

DVI - D

- Digital signals

DVI - I

- Integrated
- Digital and analog in the same connector



▼ SATA Device Cables

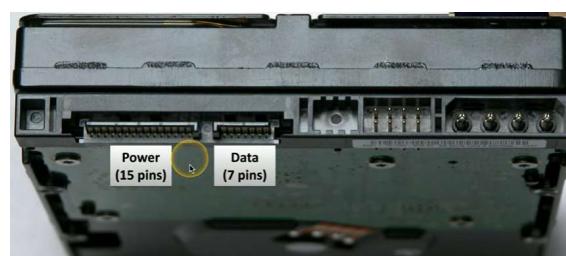
This is an interface not a storage device

▼ SATA (Serial AT Attachment)

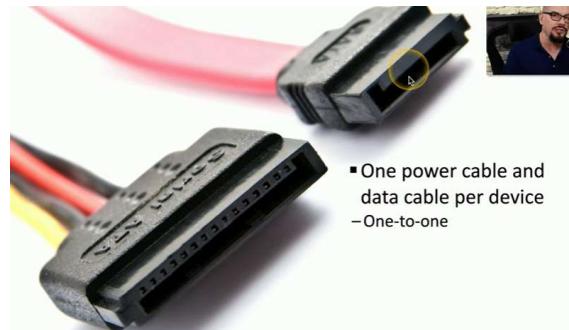
Common interface type found in comps and laps

These connections go directly from the motherboard, into the storage device itself

- SATA Revision 1.0 → SATA 1.5 Gbit/s, 1 meter
- SATA Revision 2.0 → SATA 3.0 Gbit/s, 1 meter
- SATA Revision 3.0 → SATA 6.0 Gbit/s, 1 meter
- SATA Revision 3.2 → SATA 16 Gbit/s, 1 meter
- eSATA (external SATA) → Matches the SATA version , 2 meters



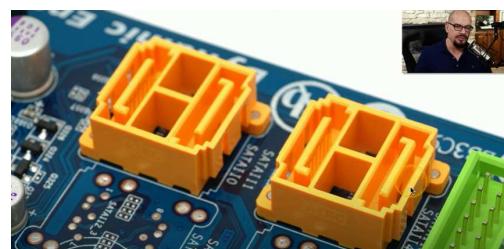
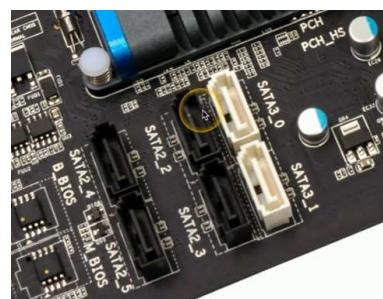
This is a hard drive



Single cable supports single storage device



▼ Revisions



▼ eSATA

In this there are 2 external SATA links built into the computer itself.

External device connections

- Uses the SATA standard

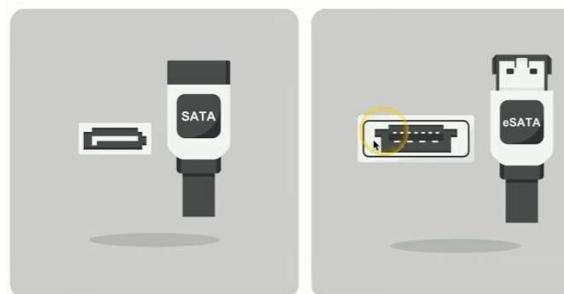
Similar in size to SATA

- Connectors are physically different



These use same standard connectivity

However this is a different connector type when ur using eSATA



Normally SATA has an L shape associated , however eSATA requires an eSATA cable hence it is slightly larger and does have a different layout.

▼ The SCSI Device Cables

▼ The SCSI Standard

Small Computer Systems Interface → Not really “small” any longer

This is a standard that can be used to connect to storage devices, scanner, printer and other devices in the network

Originally designed to string many peripherals together onto a single cable / controller (Up to 16 devices in a SSCI “chain”)

Since it has been an old tech there are a number of different SCSI standards, with a number of different interfaces and cables

- Fast SCSI, Ultra SCSI, Ultra Wide SCSI, Ultra2 SCSI, Ultra3 SCSI, Ultra-320 SCSI, Ultra-640 SCSI, iSCSI (SCSI over IP) ← this is the latest standards

Parallel (PATA) and serial operations (SATA) however SCSI can support both.

▼ SCSI Advantages

Before we had SATA standard or USB to connect peripherals we used SCSI. Not just for hard drives → Scanners, tape drivers, CD-ROM drives

Many devices on a single bus, hence single interface in PC can support up to → 8 on narrow bus, 16 on wide bus

Very intelligent interface functionality it takes care in identifying the devices in the chain. Much of the difficult configuration work is done between the SCSI devices.

Industry longevity although it is not very popular now. Well supported in the enterprise. A standard drive for a virtual system

(https://www.youtube.com/watch?v=0OiLp1_USJE&list=PLG49S3nxzAnnOmvg5UGVenB_qQgsh01uC&index=30)

▼ SCSI ID and Logical Unit (LUN)

Every SCSI device on a single bus is assigned a separate ID number. SCSI ID 0 (SCSI controller), ID 2 (hard drive), ID 3 (CD-ROM). Since every device will have a separate ID number in the same daisy chain

Hence connectivity to a drive array, it is a Single Chassis with many different drives inside if it. It acts like a big block where each SCSI chassis is divided this is further divided into Logical units (LUNs) (Used to specify a single device) are defined within each SCSI ID, Separate drives in a storage device or a separate termination device

The signal at the “end” of a physical SCSI bus is terminated by a SCUSI terminator this is common thing that is required in the cable. Can be internal to the device or a separate termination device.

One of the latest SCSI are Serial attached SCSI (SAS) device no jumpers, terminators, settings to be used , hence no need to need to be manually set up, much more simplified

▼ Serial Attached SCS I

Move from parallel to serial. Increased throughput. Similar to the move from PATA to SATA

▼ PATA device cables

▼ PATA Standard

If you're working with legacy systems you will find storage devices with ribbon cables. This is known as PATA (Parallel ATA Attachment). This name comes from the original computer built which is the PC/AT

An evolutionary process from Circa 1999

Originally this was known as Integrated Drive Electronics (IDE), by the manufacturer, *western Digital* invention

- 2nd generation called EIDE (Enhanced IDE)

The evolution, through the years began to improve

- Promised faster speeds (from 16 Mb/s through 133 MB)
- Additional devices (CD-ROM drives, DVD-ROMs, etc)

Now called Parallel ATA (PATA)

40-wire is the original connection

▼ Adapters & Converters

▼ Adapters and Converters

Converting interfaces from one format to another is made use by adapters, to convert between different connectors they need to be Electrically compatible

Sometimes signals need to be converted from one format to another → You need Ethernet but only have USB

▼ DVI to HDMI

DVI-D and HDMI are electrically compatible

- HDMI is backward compatible with DVI-D
- No signal conversion required
- No loss of video quality

▼ DVI to VGA

DVI-A includes analog signals

- Backward compatible with VGA
- Only 640x480 officially supported

May only need an adapter. Analog to analog

VGA to DVI-D (digital) will need a converter (Check you interface specifications)

▼ USB to Ethernet

Some laptops don't have a wired Ethernet interface (Convert USB to Ethernet)

▼ USB-C to USB-A

Merge the new with the old (Use your older peripherals)

▼ USB Hub

Connect many devices (High speed USB connectivity)

▼ Copper Connectors

▼ RJ11 connector

6 position, 2 conductor (6P2C)

- Some cables will wire additional conductors

Telephone or DSL connection

▼ RJ45 connector

Registered Jack Type 45

8 position , 8 conductor (8P8C)

- Modular connector
- Commonly used for Ethernet

▼ F- connector

Used for Cable television in coaxial cables

- Cable modem

If u subscribe to an internet connection using the cable company

- DOCSIS (Data Over Cable Service Interface Specification)

▼ Punchdown block

Wire-to-wire patch panel, Used to connect users to the network

- No immediate interface required

This is a wiring panel where the Wires are “punched” into the block

- Connecting block is on top

Additional wires punched into a connecting block

- Patch the top to the bottom

▼ USB 1.1/2.0 connectors



▼ USB-C

24 pin double-sided connector (Used for both hosts and devices)

Used for USB, Thunderbolt

- Interface is the same, signal can vary

USB Micro-B plug & USB-C plug

▼ Molex connector

4-pin peripheral power connector

- Originally made by the Molex Connector Company
- AMP also make a version of this known as MATE-N-LOK
- This single connector provides Provides both +12V and +5V

Power for many devices in the computer case

- Storage devices
- Optical drives

- Fans
- Other peripherals

▼ Lightning

Apple proprietary (8 pin digital signals) , both delivering power and data

- iPhone, iPad, iPod devices

Some advantages over Micro-USB

- Higher power output for phones and tablets
- Can be inserted either way

▼ DB-9

If one works with infrastructure devices with console connections. Then your using a DB-9 connector

D-subminiature or D-sub

- The letter refers to the connector size

Commonly used for sending RS-232 signals from your device to a serial port on the other side

- Recommended Standard 232
- An industry standard since 1969

Serial communications standard. As this was originally used for:

- Built for modem communication
- Used for modem, printers, mice, networking

If your working for a data center these days these days DB-9 are now used as a configuration port for management or console port (switches, routers and other infrastructure devices)

▼ 08 / Mar / 2024

▼ Fiber Connectors

Connectors used on the fiber links

▼ LC (Local Connector)

One of the smaller type of fiber connections is an LC connector, This is a single interface that has 2 sperate fiber connections, One of these is for transmit and one of these is for receive.

▼ ST (Straight Tip)

Uses a bayonet connection

▼ SC (Subscriber Connector)

Subscriber Connector → “Square Connector”

▼ **09 / Mar / 2024**

▼ Memory Overview

▼ Memory

RAM is the most common

RAM is no referring to hard disk or SSD storage. Hence data and programs can only be used when moved to RAM

Memory types have changed through the years driven by standardization and technology. (However your motherboard will vary)

▼ DIMM

Dual Inline Memory Module

- Electrical contacts are different on each side hence is it called DIMM
- Information is transferred in and out of the DIMM in 64 bit data widths



▼ SO-DIMM

Small Outline Dual In-line Memory Module

- About half the width as a DIMM (Used in laptops and mobile devices)

▼ Dynamic Random Access Memory

The memory on the DIMM

This is Dynamic → Needs constant refreshing, Without refreshing the data in the memory disappears, a power source is required to do this

Random access → Any storage location can be accessed directly, Unlike magnetic tape



▼ SDRAM

On the PC not only is the memory Dynamic and random but also :

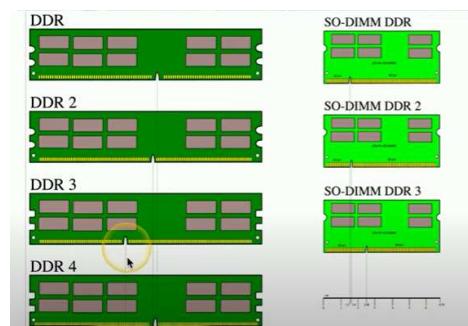
Synchronous DRAM

SDRAM is synchronous with the common system clock

- Queue up one process while waiting for another
- Classic DRAM didn't wait for a clock signal (Provides a standard time frame to send and receive data from memory)

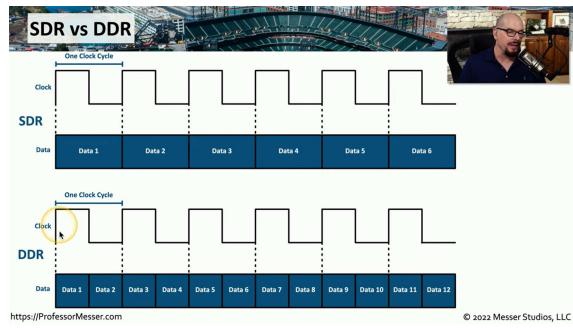
▼ Notches

Notches are used to indicate the type of memory to be used within a motherboard



▼ SDR vs DDR

DDR can transfer twice as much (Double Data Rate memory)



▼ Double Data Rate 3 (DDR3) SDRAM

Twice the data rate of DDR2

- Larger chip capacities, Maximum 16GB per DIMM
- No backwards compatibility (Speed brings sacrifice)

▼ Double Data Rate 4 (DDR4) SDRAM

Speed increases over DDR3

- Faster frequencies
- Maximum 64 GB per DIMM
- No backward compatibility

▼ Double Data Rate 5 (DDR5) SDRAM

Faster data transfers between the memory module and motherboard

- Maximum of 64 GB per DIMM
- The key has moved (notch) hence this can only be used on a motherboard that is specifically designed for such
- No backwards compatibility

▼ Memory Technologies

▼ Virtual Memory

When we run out of memory we swap out memory from RAM into hard drive or SSD

This is managed automatically or manually

▼ Multi-channel memory

Another memory technology to increase throughput in your system. This takes the throughput that would normally be sent to one single memory module and spreads that load across multiple memory modules.

Dual-channel, Triple-channel or Quad-channel

Memory combination should match (Exact matches are best)

Memory module slots are often colored differently.

▼ Memory that checks itself

What might happen to your system, if there happens to be an error with the memory you are using. Some environments, enable you to check the memory with itself, to ensure they perform well.

Used on critical computer systems (VM servers database servers, any servers)

- Parity memory →
 - Adds additional parity bit to the info your storing in RAM.
 - Wont always detect an error, cuz parity memory cant always identify if an error is occurred
 - Cant correct an error, as not method is available to correct the error

If u need to use memory that can make corrections to any problems, they can then use:

- Error Correcting Code (ECC).
 - Detects and corrects on the fly.
 - Not all systems use ECC
 - It looks the same as non-ECC memory

The screenshot shows a presentation slide with the title 'Parity'. It includes a video thumbnail of a man speaking. Below the title, there is a section titled 'Even parity' with the note '-The parity bit makes an even number'. A 9x9 matrix table is shown, with the last column labeled 'Parity Bit'. The matrix contains binary values (0s and 1s) in each cell. To the right of the matrix is a truth table titled 'Valid or error? -Even parity byte'. This table has columns for Bit 1 through Bit 8, followed by a 'Parity Bit' column. The first three rows of the truth table show valid even parity (green checkmark), while the fourth row shows an odd parity (red X). The last row shows a valid even parity again (green checkmark).

Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Parity Bit
1	1	1	0	0	1	1	1	0
0	0	0	0	0	0	1	0	1
1	0	0	1	1	0	0	0	1

Valid or error? -Even parity byte								
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Parity Bit
0	0	0	0	0	1	1	1	1
0	0	0	0	0	0	0	1	0
0	1	1	0	0	1	0	0	1

this can be used for retesting

▼ 10 / Mar / 2024

▼ Storage Devices

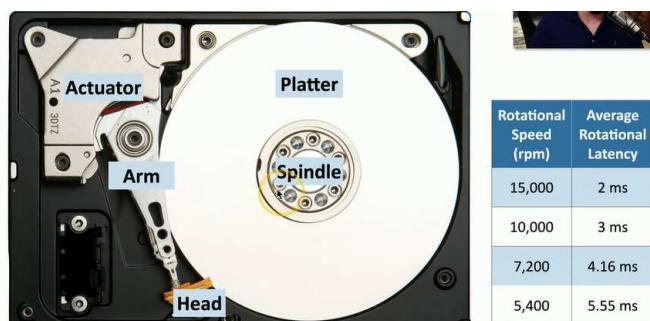
▼ Hard Disk Drive

Non-volatile magnetic storage (even when there's no power data is retained) /
Rapidly rotating platters

Random access → Retrieve data from any part of the drive at any time

Moving parts

- Spinning platters, moving actuator arm
- Mechanical components create limitations to access speed
- Mechanical components can also break



the table is in descending order (best to worst)

▼ Solid-State drive (SSD)

Non-volatile memory (No moving parts, hence no need to worry about mechanical failures)

Very fast performance (No spinning drive delays)

Interface to access SSD's are usually SATA interfaces.

▼ mSATA (Mini-SATA)

Shrink the SATA drive into smaller devices

- Same data, different form factor
- Great for laptops and mobile devices

Smaller than 2.5" SATA drives

- No spinning drive
- Allows for different form factors

Was used briefly (Quickly replaced by the m.2 standard)

▼ AHCI vs NVMe

SATA was originally designed to transfer data from hard drives.

- Uses ACHI (Advanced Host Controller Interface) to move drive data to RAM (This is the protocol used to transfer data from hard drive into the memory of your system)
- SATA revision 3 throughput up to 600MB/s
- SSDs need a faster communication method. Since connecting to a SATA device will limit your throughput

NVMe (Non-Volatile Memory Express)

- Designed for SSD speeds.
- Lower latency, supports higher throughputs
- Take advantage of NVMe with an M.2 interface (This is not a SATA connection, but an M.2 interface)

▼ M.2 Interface

Smaller form factor → No SATA data or power cables

Can use a PCI Express bus connection

- this provides more throughput as high as 4GB/s or faster when using NVMe PCIe x4

Different connector types (the holes used are known as Keys)

- Needs to be compatible with the slot key/spacer
- B key, M key or B and M key
- Some M.2 drives will support both

▼ B-Key and M-key

To ensure that your system get the best possible throughput u need to make sure that ur system supports NVMe .M.2 doesn't guarantee NVMe

- As your M.2 interface may be using AHCI that u may see with a SATA connection. Therefore its best to check for documentation

Your motherboard may only support one type of M.2 Key. Hence its vital to buy the right M.2 SSD for your motherboard

▼ Flash Drives

- EEPROM (Electrically Erasable Programmable Read-only Memory)
 - Non volatile memory
 - No power required to retain data

- Limited number of writes (Can still read the data)
- Not designed for archival storage
 - Easy to lose or damage
 - And it's necessary to always have a backup



▼ Optical Drives

Small bumps read with a laser beam

- Microscopic binary storage

Relatively slow (Archival media)

Many different formats (CD-ROM, DVD-ROM, BluRay)

Internal and external drives (For those uncommon application installations)

▼ RAID

▼ Data Redundancy

Hard drives store huge amounts of data (Important data). They are moving components, which will eventually break.

What happens to the data when the drive fails?

1. You can prepare for that
2. Use an array of drives

This is where RAID arrays are configured to provide this type of data redundancy.
Note that RAID is not a backup

RAID → This is not a copy, it is the data you're actively retrieving and storing cuz of that RAID is simply a way to maintain up time and availability if the drive failed

▼ RAID

Redundant Array of Independent Disks. They are inexpensive disks

Different RAID levels (Some are and some aren't redundant)

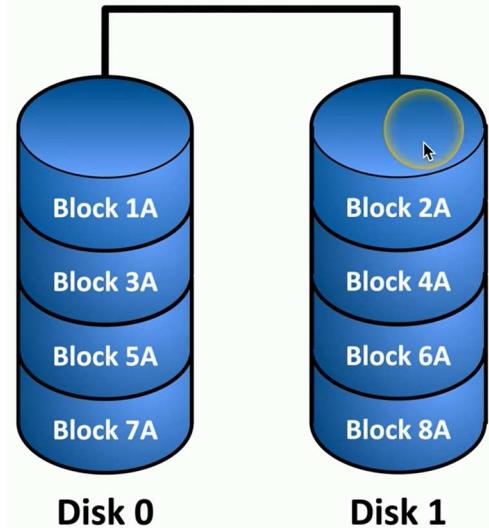
▼ Raid 0 - Striping

Files blocks are split between 2 or more physical drives

High performance (Data written quickly)

No redundancy

- A drive failure in a single drive will mean none of the data is available
- Raid 0 is zero redundancy



▼ Raid 1 - Mirroring

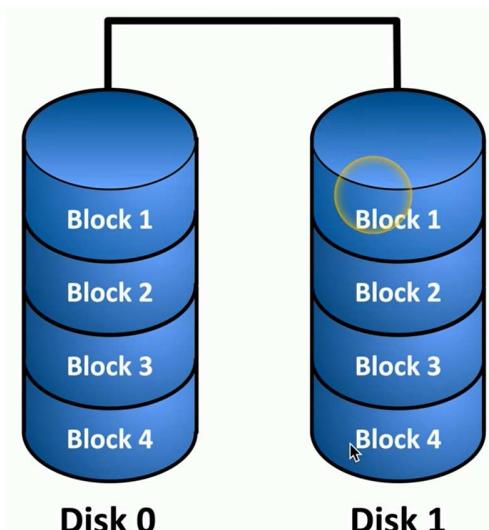
File blocks are duplicated between 2 or more physical drives

High disk utilization

- Every file is duplicated
- Required disk space is doubled

High redundancy

- Drive failure does not affect data availability



▼ Raid 5 - Striping with parity

File blocks are striped along with a parity block

Requires atleast 3 disks

Segmenting the data and putting it separately across different drives, we also store parity info, this enables us to rebuild the data if we happen to loose any of the physical drives

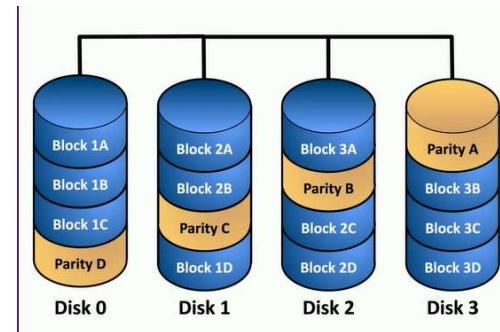
This is a much more efficient use of disk space.

- Files aren't duplicated, but space is still used for parity

Higher redundancy

- Data is available after drive failure
- Parity calculation may affect performance

If one set of data is lost, parity bits can be used to rebuild that data this is why its important to spread the parity bits, in different banks



Having to recalculate the data with the parity that's left over in real time will cause, reduction in performance.

▼ PAID 10 (1+0) - A Strip of mirrors

Evenly distributing our files across all 3 individual drives, if we loose any one of the physical drives then any 1 of the data is inaccessible. Hence with RAID 1+0,we add the mirroring aspect, and we start mirroring all of our RAID 0 arrays. Now we are storing 3 separate stripes of data, instead of having one copy of that strip we are mirroring each of those tripes of data. So if we loose any one of the drives we are still up and running cuz we have an exact duplicate of that strip.

In this case we can even loose 3 drives, as long as they are part of the single pairs in each individual RAID 1 mirror

▼ Motherboard Form Factors

▼ Motherboard

Fundamental physical component containing CPU, memory

Physical size → Case sizing

Basic layout → Room for small changes

Power → Standard connector

Airflow → Increasingly important

There are over 40 different motherboard types however only few are used commonly

▼ Exam obj

Question: Given scenario, install and configure motherboards, central processing units(CPU's) and add-on cards

Focus on which motherboard would be the best choice for a scenario

- Memorizing the dimensions of the motherboard probably isn't the most important thing
- ATX or ITX

Which motherboard would you choose? Media center, video editing, thin client

This exam depends on 2 CPU Families

▼ Standard-ATX

- Advanced Technology Extended
- Standard by Intel in 1995 (Seen many updates over the years)
- Power
 - 20 pin connector
 - 24 pin connector (additional 4/8 pin connector)

▼ Mini-ITX

A series of low-power motherboards

- Developed by VIA Technologies in 2001
- Small form factor

Mini-ITX is screw compatible with ATX (Fits almost any enclosure)

Small form factor uses (Single-purpose computing, streaming media)

▼ Motherboard Expansion Slots

▼ Computer Bus

Communication path

Internal PC growth (Independent pathways)

System expansion (Additional capabilities)

▼ Conventional PCI (on older systems)

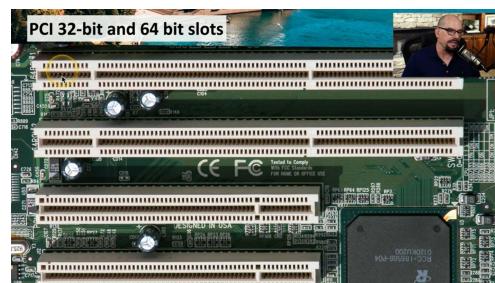
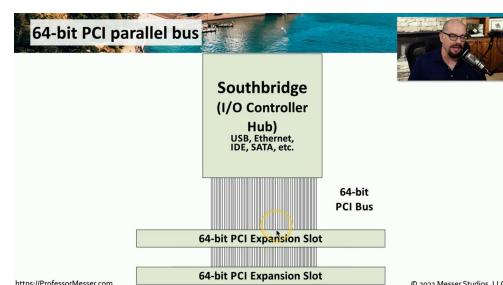
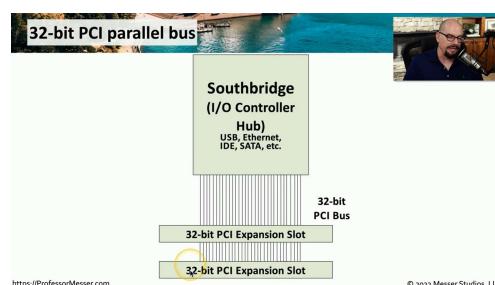
Peripheral Component Interconnect

- Nobody ever calls it that btw and it is created in 1994

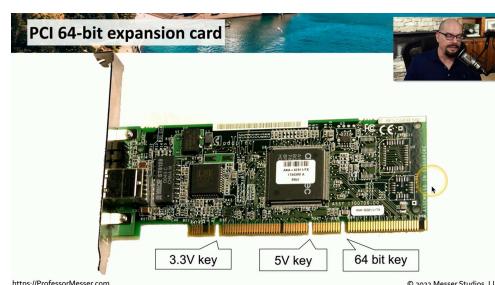
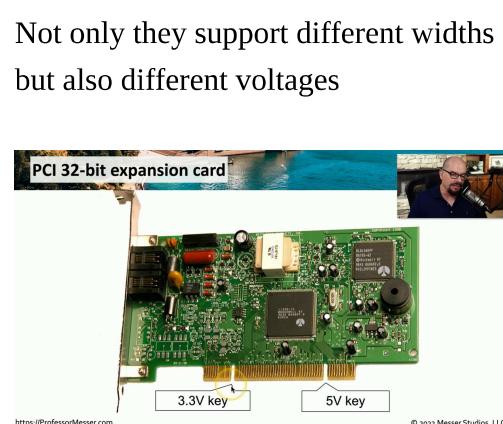
Many Expansion options

- 32 bit and 64 bit bus width
- Parallel communication

A common expansion interface on previous computer generations (PCI Express is the newer technology)



64-bit at top and 32-bit at bottom



Not only they support different widths but also different voltages

▼ PCI Express

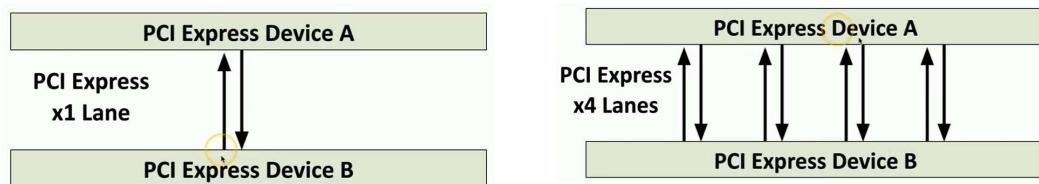
A.K.A. PCIe (Replaces the older PCI Standard)

Instead of a parallel connection this uses a Serial connection (Unidirectional serial “lanes”)

Slower devices don't slow down everyone

Just as you add more lanes to a highway the same can be done to increase the transfer of more data. These lanes are as follows:

- 1, 2, 4, 8, 16, 32 full-duplex lanes
 - x1, x2, x4, x16, x32
 - “x” is pronounced “by” (“by 4”, “by 16”)



PCIe adapter cards are different from a PCIe adapter

▼ Motherboard Connectors

▼ 24-pin motherboard power

Main motherboard power, provides power to the motherboard directly from the power supply

- Provides +3.3 V, +/- 5V and +/-12V

Originally it was a 20 pin connector was the original ATX standard

- 24 pin was added for PCI Express power

The standard now is a 24-pin connector, you can still connect a 20-pin motherboard (Some cables are 20-pin + 4-pin)

▼ 4-pin ATX

These provide additional power to the CPU, these connectors are physically located near the CPU itself.

This is a 4-pin ATX connector (+12 V power)

- ATX12V Advanced Technology Extended (family of) motherboards



Additional 12 Volt power for older motherboards.

- Used primarily for CPU

May be labeled ATX12V, P4m or CPU

- And keyed for the appropriate connector

Storage drive interfaces (SATA) & eSATA expansion

▼ Headers

A pin header

- A simple electrical interface
- The connector is attached to the header

These are used for Power, Peripheral connections, Lights, Buttons. Located on the edge of the motherboard (Ex: TPM, F_USB2)

▼ Front Panel Connectors

On/Off buttons on the case is integrated with the motherboard using these connectors

▼ **11 / Mar / 2024**

▼ Motherboard Compatibility

▼ Manufacturers

2 Solid CPU manufacturers are Intel & AMD

Factors to consider about are:

- Cost
- Different sockets
 - The motherboard is designed for a particular CPU

- Choosing a side
 - Historically AMD is value and intel is performance
 - However this varies from generation to generation

▼ Server Motherboards

- Multi-socket
 - Supports multiple physical CPU packages | Splits the load between the number of CPU's available
- Memory Slots
 - Support 4+ memory modules
- Expansion Slots
 - Many slots and different sizes
- Overall size
 - Designed for a rack-mounted
 - Larger ATX-sized system

▼ Desktop Motherboards

Can range from full-size motherboards to company or monitor only systems

We can do a lot with increasingly smaller systems

- Single CPU (Reducing costs)
- Memory slots (Usually 2 or 4)
- Expansion Slots (May have limited options)
-

▼ Mobile Motherboards

CPU's are made small-scale and light, they are not necessary built for speed but mainly for power usage and efficiency. Since there is not much space for cooling,

the system is designed to throttle when it becomes warmer (Thermal Throttle) this prevents the laptop by overheat damage.

Customizability is reduced with limited modification (Memory, CPU, functionality)

Portability is the goal with lower power consumptions

▼ System Boards

Proprietary (Built to fit, shaped in a specific way)

Replacement isn't easy

- Swap the entire board
- Most components are on the system board

▼ BIOS

▼ Basic Input / Output System

The software used to start your computer (This is known by many terms)

- The firmware
- System BIOS, ROM BIOS
- ROM or flash memory

1)Initializes CPU and memory

- Build the workspace

2)POST (Power on self test)

- Checks to ensure whether the system has adequate memory, CPU, video, some kind of input keyboard, mouse

3)Looks for a boot loader to start the O.S.

▼ Legacy BIOS

The text based BIOS (The original) Has been around for more than 25 years

Older O.S. systems talked to hardware through the BIOS (Accessing hardware directly)

Limited hardware support (No drivers for modern network, video, storage devices)
(No way to upgrade)

▼ UEFI BIOS (Available in most modern computers)

This is a standard type of BIOS that can be used across multiple manufacturers, this was built by INTEL

Unified Extensible Firmware Interface

- Based on Intel's EFI (Extensible Firmware Interface)

A defined standard, enabling many different manufacturers to create a standard BIOS

- Implemented by the manufacturers

Designed to replace the legacy BIOS

- As latest systems require a modern BIOS for modern computers
- Graphical and text-based

▼ 12 / Mar / 2024

▼ BIOS Settings

▼ Secret Buttons

Launching the system setup (Del, F1, F2, Ctrl-S, Ctrl-Alt-S) can be used to access the BIOS Configuration

Hyper-V (Windows 8/10/11) → Turn Window feature on and off

VMware Workstation Player

But this cannot be done using VirtualBox

Many simulators are available online to play around (UEFI BIOS Simulator)

▼ Fast Startup

Windows 8,10 and 11

- Doesn't actually shut down all the way, as when you turn off it is in hibernate mode, so BIOS won't pop up next time you turn it on
- Starts up so quickly, you can't open the BIOS configuration

There are a number of ways you can bypass this process, from the Windows desktop

- Hold down shift when clicking Restart
- settings / Update & Security / Recovery / Advanced Startup / Restart Now
- System Configuration (msconfig)

If you don't have access to the desktop or not have access to any other options.

- You can interrupt normal boot three times (This presents the boot option screen) . This disables the fast startup process and allows access to the normal start process

▼ Tips

Make a backup of your BIOS configuration.

- Have detailed notes, and take a picture, before u begin configuring the system
(In case u misconfigured the system)

▼ Boot Options

BIOS has control of the computer hardware, meaning that u can disable certain hardware from the BIOS so that it becomes invisible to the O.S.

Modify boot order → Which boots first ? move to the next in order, USB drive, SSD, hardware

▼ USB Permissions

Poses a security challenge (Very small storage devices at very large capacities)

USB connection pose a threat to high secure data , as transmission can occur at high speeds, making it easier for outcasts to hijack information

US Department of Defense banned USB flash media for 15 months in 2008
(SillyFDC Worm)

Best is to turn off USB Auto Run

▼ Fans

Computing power requires constant cooling. this can be controlled by BIOS the degree of cooling by fan

Many different cooling fans (CPU fans / chassis fans)

Motherboard often include an integrated fan controlled

- And temperature sensors
- The motherboard increases and decreases the fan speeds

▼ Secure Boot

We make sure we don't have malware running in our O.S. by antivirus software, but what if the BIOS gets affected, so we need to make sure to protect the BIOS from malware, we can make use of Secure Boot

Malicious software can "own your system"

- Malicious drivers or OS software

Secure Boot

- Part of the UEFU specification

Digitally sign known-good software

- Cryptographically secure
- Software won't run without the proper signature

Support in many different operating systems

- Windows and Linux support

▼ UEFI BIOS Secure Boot

To run secure boot your O.S. needs to have a digital signature associated with it, that is checked in the startup process, that means the public key of the manufacturer needs to be available in the BIOS itself, the BIOS also have fail safes built in to prevent anyone from making changes

UEFI BIOS protections

- BIOS includes the manufacturers public key
- Digital signature is checked during a BIOS update
- BIO prevents unauthorized writes to the flash

Secure Boot verifies the digital signature associated with the bootloader with the public key that is already embedded with the device, if it verifies it means that the BIOS has not been modified, and continues with the boot process

- Checks the O.S. bootloader's digital signature
- Bootloader must be assigned with a trusted certificate
- Or a manually approved digital signature

▼ Boot Password management

BIOS password / User Password

- System wont start

- Need the password to start the operating System

Supervisor Password

- Restrict BIOS changes
- Must use supervisor password to change any BIOS configurations

Remember the password or else you will have to reset the BIOS to regain the access

▼ Clearing a boot password

Store the BIOS configuration (Your settings including the passwords used)

U may see legacy storage such as the CMOS (Complementary metal-oxide semiconductor)

- A type of memory
- May be backed up with a battery

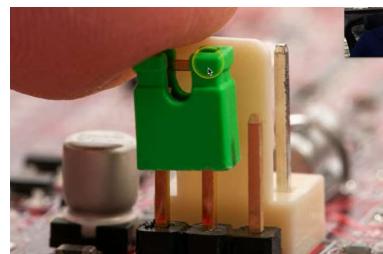
Usually flash memory these days

- Easily stored and accessed

But these days all of the BIOS configurations are stored in flash memory which can be easily stored and accessed

Cuz its in the memory but ur not able to access the system through the flash memory u have to reset the BIOS config or delete, this is commonly done by a jumper

- Jumper cables are used here to short (connect) 2 pins on the motherboard power up your system and that will clear any of those configuration settings in your BIOS



jumper connects the pins for shorting

▼ CMOS battery

Not needed for todays flash-based storage

- Maintains older BIOS configurations
- May only be used to maintain date/time

A bad battery will require a BIOS configuration or date/time configuration on every boot

On older systems, can reset the BIOS configuration by removing the battery
(Newer computers use a jumper)

▼ Trusted Platform Module (TPM)

Your motherboard may support additional hardware, this component is especially important if you're using full-disk encryption, cuz u will need a cryptographic key to decrypt the data on storage

Designed to provide a range of secure functions , listed below

Cryptographic keys could also be created this way

A specification for cryptographic functions

- Hardware to help with encryption functions

Cryptographic processor

- Random number generator, key generators

Persistent memory

- So that certain keys could be burned into the TPM and never be changed as long as they're connected to your computer, this enables us to verify keys that are already in our system. Or we can use this to digitally sign data and send it to a third party and verify that, that info originated on that TPM
- Comes with unique keys burned in during production

Versatile memory

- Storage keys, hardware configuration information

Password protected

- No dictionary attacks

You may think u can hack into the TPM and gain access but it isn't possible to hack into this secure environment, its already designed to protect from attacks such as brute force and gaining access to this data

▼ Hardware Security Module (HSM)

In many organizations cryptographic keys are managed by a HSM

Often used in large environments

- Clusters, redundant power
- Standalone device, or a purpose built appliance (Could also be an adapter card that can be installed into a server)

High-end cryptographic hardware

- Plug-in card or separate hardware device

Key backup

- Secured storage for servers
- Lightweight HSM's for personal use (Smart card, USB, flash memory) / (Used to store personal keys)

Cryptographic accelerators

- This means that you can offload some of the cryptographic functions used by your servers, onto the HSM which would increase the overall throughput (that CPU overheads from other devices)

▼ 13 / Mar / 2024

▼ CPU Features

▼ Operating System Technologies

32-bit vs 64-bit CPU architectures (Processor Specific)

32-bit processors can store (2^{32}) values

64-bit processors can store (2^{64}) values can be accessed in the O.S.

If we look at this as how much memory that can be stored in a system:

- Can access 4GB vs 17Billion GB (however this doesn't mean the O.S. can handle this much at once this can be checked by the processor manual)
- The O.S. has a maximum supported value

The hardware drivers must match the specific O.S. installed (O.S. Specific)

- 32-bit → x86
- 64-bit → x64

32-bit OS cannot run 64-bit apps (But 64-bit O.S. can run 32-bit apps)

Apps in a 64-bit Windows O.S.

- 32-bit apps :\Program Files(x86)
- 64-bit apps :\Program Files

▼ Advanced RISC Machine (ARM)

CPU architecture developed by Arm Ltd.

- They design the chips, other license and build

Simplified instruction set

- Efficient and fast processing
- Less power
- Less heat

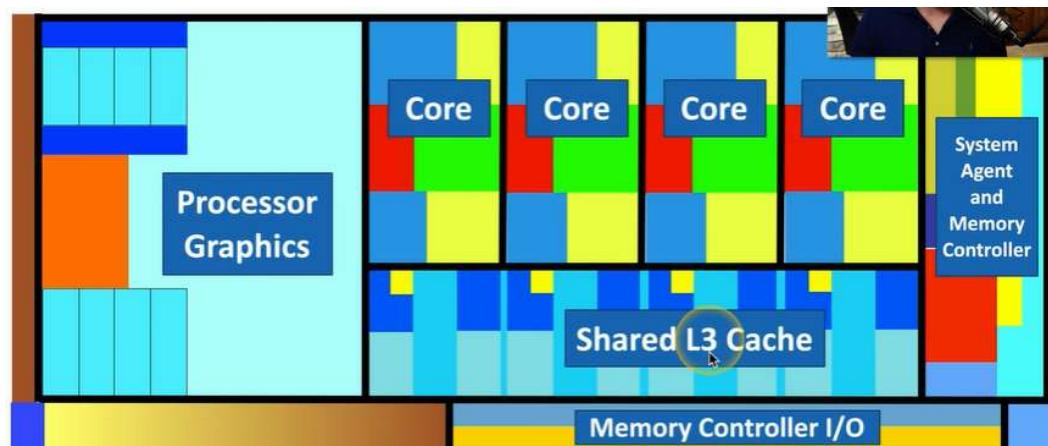
Traditionally used for mobile and IoT devices

- The lines are constantly blurring

▼ Processor cores

Dual-core, Quad-core, Octa-core, Multi-core

Multiple cores have its own cache and a shared cache between all cores



▼ Multithreading

Hyper-Threading Technology (HTT)

- One CPU acts like 2, this doesn't necessarily get twice the work done from a single CPU but it increases the throughput of a single CPU by about 15% - 30%

- In order to use this function the CPU has to support this capability as well as your O.S. (Windows XP and later, nowadays almost all)

▼ Virtualization Support

Run other operating systems within a single hardware platform (VM)

- Multiple operating systems share physical hardware components

Virtualization in software was limited

Virtualization is resource intensive

- Performance and hardware management challenges

Virtualization added to the processor

- Hardware is faster and easier to manage
- Intel Virtualization Technology (VT) AMD Virtualization

▼ Expansion Cards

Extend the functionality of your computer by adding hardware

- You may need more than the motherboards provides

Relatively simple process

- Designed for end-user installation

Composes of installing hardware (Adding the card) and software (Installing the driver - Software for the specific O.S.)

▼ Sound cards

Multiple interfaces can be found such as the headphone jack, 1/4 jack, line in jack, SPDIF,

Output

- High-end audio
- Advanced headphone amp
- Home theatre, Dolby decoding

Multiple inputs

- Music capture
- Podcasting

- Microphone

▼ Video cards (Output device)

Many CPU's include an integrated GPU (RTX)

- Video functionality is built into the CPU package

Discrete graphics are what we call them cuz they are in addition to what's already available

Separate interface cards (High performance)



Monitor should be connected to this not the motherboard port to take advantage of the GPI

▼ Capture Cards (Input device)

Used when we need to put video into our computer, such as used during live streaming

Since video are obviously large these cards have been designed with high levels of video input especially when using higher resolutions

Video as input

- Video capture
- Live streaming
- External cameras

High performance

- Video bandwidths can be quite high
- PCI Express connection



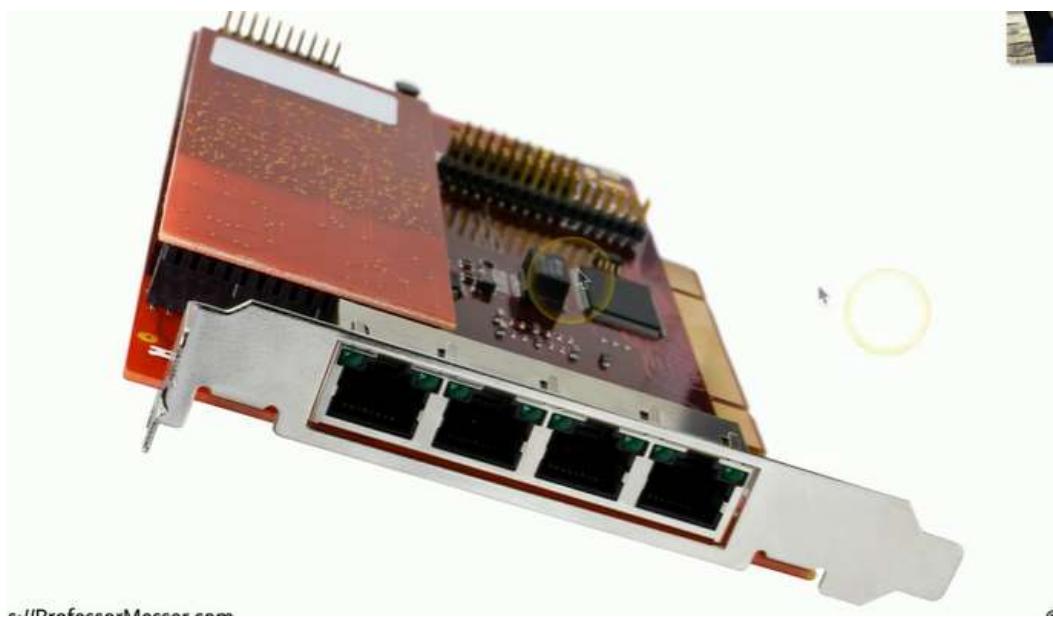
SDI interface can be accessed via COAX (bayonet)

▼ Network Interface Card (NIC)

Used when you need to add an extra NIC to what comes inbuilt, used mainly in servers, routers and security devices which have multiple cards on the same device

- Ethernet connection
 - Motherboard may not include a NIC
 - Onboard NIC may not be working

Multiple Ethernet adapter cards are also available



▼ Documentation

Before purchase, research whether it is compatible with your system

Such as minimum requirements of hardware and software

Knowledge base (Any “gotchas?”)

Support forums - what the other people are saying

▼ Driver installation

Some kind of software is essential for your hardware to talk with the O.S. this software is known as a Device Driver this may already be built or should be installed later

Make sure to check for the latest version

Uninstall previous drivers through Windows Device Manager

Manufacturer provided setup program

Manual installation through Windows Device Manager

Check the Device Manager for the status (Does it work is it up and running)

▼ 14 / Mar / 2024

▼ Cooling

▼ Case Fans

Cools air pulled through a personal computer (Always check for good airflow)

Motherboard layout become important, cool air comes in and hot air leaves out

Component location is key, This includes devices, wiring, power

Many different sizes and styles and volume levels

▼ Onboard Fans

Designed to cool an entire adapter card

Can be bulky (May take additional adapter card space)

Usually seen on high-end graphics cards

▼ Fan Specialization

Fan controllers control how much air goes through your system, this can be adjusted accordingly.

Standard sizes are also available at variable speeds (80mm,120mm,200mm)

Available at variable speeds & @ Different noise levels

▼ Fan-less / passive cooling

No fans, no noise, done mainly due to maintain silence, very common on small devices such as DVD players, also due to space unavailability

Specialized functions, TV set top box, satellite receiver, media server

Functions are very controlled, Carefully measured thermal tests to ensure devices won't overheat at high levels of performance

Low-power components can be explored such as a heat sink, when you remove the top layer off these devices u will see the cooling they are using is passive hence a heat sink is used

▼ Heat Sink

Dissipate heat through thermal conduction (Copper or aluminum)

This is a special kind of metal used to take heat from a particular component and dissipate that heat as air is passing by the heat sink

Fins/grids increase the surface area (Heat is then transferred to the cooler air)

They get hot hence dont touch em

Thermal paste creates a good contact between the chip and the heat sink

▼ Thermal Paste

Thermal grease, conductive grease is a thermally conductive adhesive

Place between the heat sink and the component

- Improves thermal conductivity
- Moves the heat away from the component

A little bit goes a long way

- Pea sized amount is used

▼ Thermal pad

A less messy alternative but thermal paste is more effective

Easy to use (Wont leak and damage components)

Almost as effective as thermal paste

Not reusable AS every time u remove the heat sink it requires to replace a new one

▼ Liquid cooling

Coolant is circulate through a computer

- This isn't a new concept as automobiles, mainframe computer also used this
- Used on High end systems for gaming and graphics
- Overclocking

This awesome cycle makes use of radiator to cool the air and exchanges the heat from in and out

▼ Computer Power

▼ Computer power rules

Always disconnect from the power source when working on a device

Some devices store a charge in capacitors even after discharging (Before touching discharge)

Never connect your body to any part of an electrical system, do not connect yourself to the ground wire of an electrical system



▼ Computer Power Supply

Computer uses DC voltage (Most power sources provide AC voltage)

Convert 120V AC or 240V AC to 3.3V DC, 5V DC, and 12V DC

the whole computer system is dependent on this component to operate

▼ Amp and Volt

Ampere (amp ,A) → the rate of electron flow past a point in one second (The diameter of the hose)

Voltage (volt ,V) → Electrical pressure pushing the electrons (How open the faucet is)

▼ Power

Rated by Watts (Measurement of real power use)

$$W = V \times A$$

$$V \times a = W$$

▼ Current

- Alternating current (AC)

Direction of current constantly reverses

Distributes electricity efficiently over long distances

Frequency of this cycle is important

(US/Canada → 110 to 120v of AC(VAC), 60 hertz(Hz))

(Europe → 220- 240 VAC, 50 Hz)

- Direct Current (DC)

Current moves in one direction with a constant voltage

▼ Dual voltage input options

voltage varies by countries hence it is important to be aware of which output your country provides from each wall outlet

- US / Canada → 120 V of AC (VAC), 60 hertz (Hz)
- Europe → 230 VAC, 50 Hz

Manually switch between 120V and 230V

- U can ensure what caliber of power is output using a multimeter
- Or use an auto switching power supply

Don't plug 120V manually configured power supply into a 230V power source, this would mean that the system would eventually smoke up and become unusable

▼ Power Supply output

Different voltages (For different components)

Positive and negative voltage

- Voltage is difference in potential, we specify as it being + or -
- Power supply is now going to convert this to direct current
- The electrical ground is a common reference point
- Depends on where you measure from

At the front door of your house . second floor is +10 feet and basement is -10 feet

Higher voltages are commonly associated with components inside your system which requires additional power

+12V

- PCIe adapters, hard drive motors, cooling fans, most modern components require +12V to be able to operate

Some power supplies can also output +5V

- Some motherboard components
- Many components are now using +3.3V

+3.3 V

- M.2 slots, RAM slots, motherboard logic circuits

+5 VSB

- Standby voltage (This is used by the system when it is in hibernating mode, to constantly check and the standby checks whether anyone is pressing the power button for the system to come back to life)

some older components will use -12V for:

- Integrated LAN
- Older serial ports
- Some PCI cards

Some ports will provide -5V (for legacy systems)

- Available for ISA adapter cards
- Most cards didn't use it
- Todays motherboards dont have ISA slots



This supports an input of 100-240V, 10 A or 5A, frequency range, also supports a wide range of outputs(DC), sum of all the DC voltages can support a total of 850W

▼ 24-pin motherboard power

this is the Main motherboard power (DC)

- Provides +3.3V, +/-5V and +/-12V

20 pin connector was the original ATX standard (24-pin was added for PCI Express power)

You can connect a 24-pin connector to a 20-pin motherboard (this can be done on older motherboards)

- Some cables are 20-pin + 4pin

▼ Redundant Power Supplies

2 or more power supplies (Internal to the server), having more than 1 power supplies

Each one of the power supplies (3 pin black color interface) can always handle 100% of the power but have 2 plugged in at the same time will distribute power evenly

Hot swappable, replace faulty power supply without powering down, red color slide



▼ Power supply connectors

Fixed connectors

Connected to the power supply, may have too many connectors or may not be enough

Modular (some are built as such to enforce certain benefits)

Add cables as needed (cable flexibility), this leads to a more modular system with fewer wires leftover proving a better airflow. Although this is a bit more expensive



Modular power supply connectors



hybrid power supply connectors

▼ Sizing a power supply

Power supplies are rated by watts

- Overall and by individual voltages

Bigger isn't necessarily better

- More expensive however this doesn't necessarily speed up your computer

Physical size is relatively standard (Older cases and systems may have proprietary sizes). The only time this will become a problem is if you're using an older system that doesn't add up to the current standards

To obtain the perfect amount of wattage needed can be calculated

By calculating the the watts required to all components:

CPU, Storage device, video adapter, many online calculators are available for this calculation

Video adapters are usually the largest power draw

- Many video card specifications list a recommended power supply wattage
- 50% capacity is a good rule of thumb
- Power supply runs efficiently and there's room to grow

▼ 15 / Mar / 2024

▼ Multifunction Device (MFD)

▼ Printer

- | | | |
|-----------|------------|------------------|
| • printer | • Fax | • Phone line |
| • Scanner | • Network | connection |
| | Connection | • Print from web |

Complex devices which encompasses many different functionalities together. thereby these can be large devices. Appropriate drivers need to be installed in your O.S. so that it knows how to operate each of these functions.

- Specific to a printer model
- Get the right O.S. drivers (Windows 10, 11)
- Get the right version of the O.S. (32 bit drivers are very different than 64-bit drivers)
- You can mix and match drivers (It's a very specific task)

▼ PCL or PostScript

Most printers will be able to communicate with your system using one of the 2 printer languages

PCL (Printer Command Language)

- Created by Hewlett-Packard for their laser printers
- Commonly used across the industry

PostScript

- Created by Adobe Systems
- Designed for popular with high end printers

Some printers can be configured to communicate using PCL or PostScript. Thereby it is important to make sure the drivers match the printer

- PCL printer, PCL driver
- PostScript printer, PostScript driver

▼ Wired device sharing

Communication is required to print. Physical connections can be used by printers to make use of this.

- USB type B
 - Most common connector
 - USB type B on the printer
 - USB type A on the computer
- Ethernet
 - RJ45 connector
- may include other options as well

▼ Wireless device sharing

- Bluetooth can be used as a medium for this connection however it has limited range
- 802.11 Infrastructure mode
 - We refer to the use of 802.11 and an access point as an infrastructure mode so that you can have everyone in the network can use this access point to communicate to the printer
- 802.11 Ad hoc mode
 - you can also configure this connection to be a 1 to 1 relationship using this Ad hoc mode, meaning there will be no access point used for

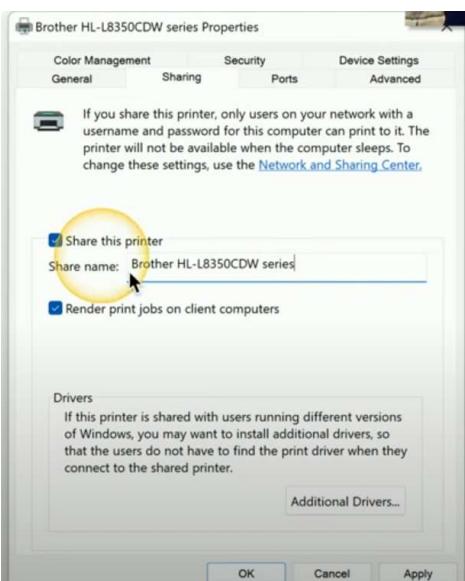
communication instead a single device is able to communicate directly to the MFD.

▼ Sharing the printer

▼ Printer Share

You can allow access to the printer so people can begin to use it by creating a Printer share.

- This works by connecting device A to the printer physically, the device A can then be shared among many and the print jobs can be sent to this device.



- Anybody in the network can print their docs by using the Share name
- However once this main device is turned off everyone loses access to the printer, which is why we use a print server

▼ Print server

This is software running on the printer that allows people to directly place their print job on the printer without needing a middleman, to manage printer setting this can be done using the printer itself (Using a web based front end) or by using a client executable

▼ Configuration settings

once you send your print jobs to a client, there are a number of options

▼ Duplex

Prints on both sides of the paper, without manually flipping over the paper.
However not all printers can do this

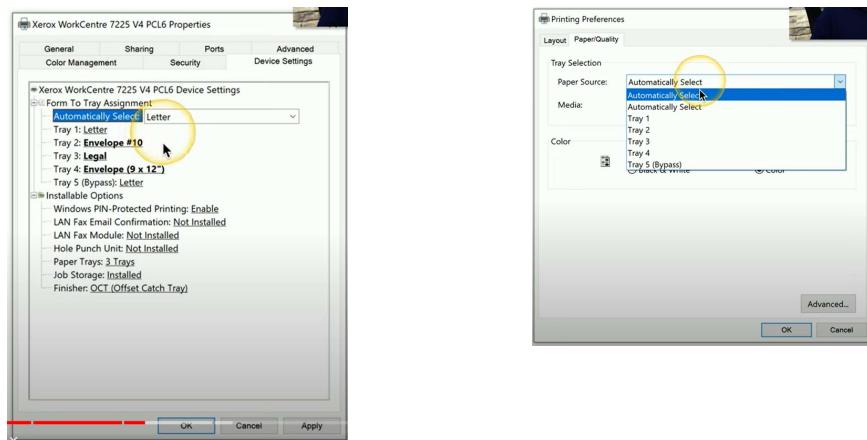
▼ Orientation

Choose between Portrait vs Landscape

the paper doesn't rotate as instead the printer chooses which orientation to print from

▼ Tray settings

Printers have multiple trays, accommodating for plain paper, letterhead, hence it is important to choose the correct tray

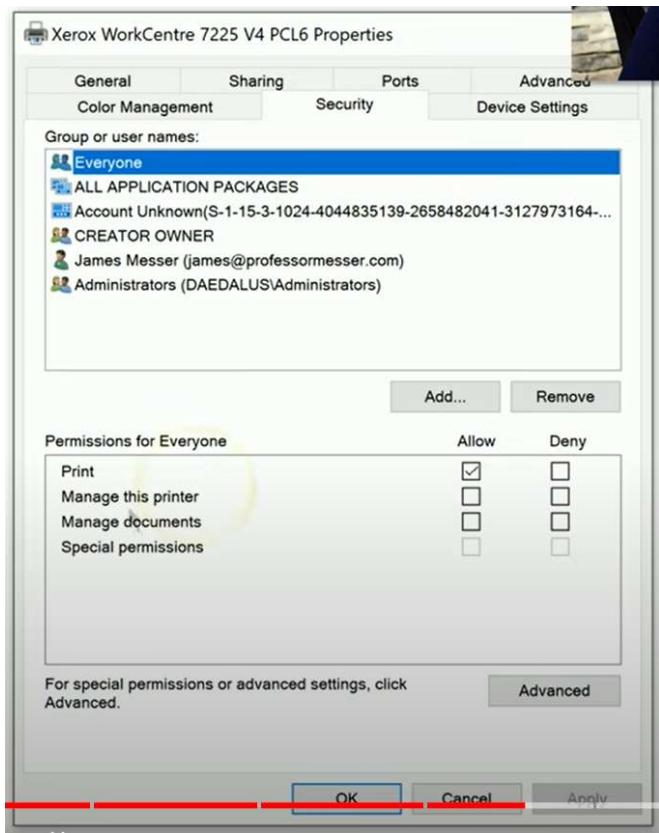


Quality can also be configured using this

▼ Printer Security

User Authentication has to be enforced to prevent wastage of expensive toner (ink) thereby specific settings need to be configured to allow specific people to access the printer

- Set right permission
- Printing cs managing the printer



▼ Badging

some printers may use ID badges (work badges) to certify the print job.
Another form of authentication

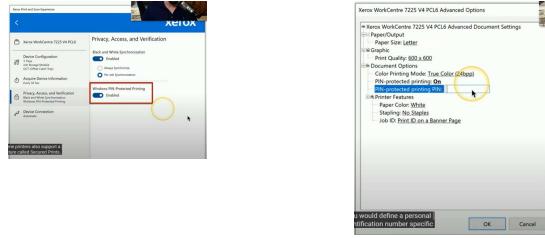
▼ Audit logs

These logs enable you to see who printed the paper, how many pages were printed, and the type of print was used. This can be used to manage budget of toner as well as who printed them

- Cost management
- Security monitoring
- Even viewer / system events. These may be built into the printer or print server

▼ Secured prints

Windows has this feature where u can create a personal identification number to protect any printing. This can be configured in the print settings on your windows device



Thereby once you send your print job, nothing will print until u put ur Personal Identification Number into the console after arrival. However in order to do this the printer must support this feature

▼ Flat bed scanner

You can use the printer output and use them as input

Different form factors (All in one MFD) . This is a standalone flatbed. This allows the scanner to read the info on the page and save it as a file

This is often integrated with an automatic document feeder, by using this we can use a large stack of papers, slide into the scanner and scan each page individually without having to change pages

▼ Network scan services

With most MFD, we can send the scan to email, inbox

Or scan it to a folder windows uses SMB (Server Message Block) or u can send to a MS share

Can be Scanned to cloud as well, which will end up in the google account or dropbox

▼ **16 / Mar / 2024**

Laser Printer

▼ Laser Printer

▼ Laser Printers

Combine a laser, high voltage, charged ions, powdered ink, heat, and paper

- Very high quality
- Fast printing speeds

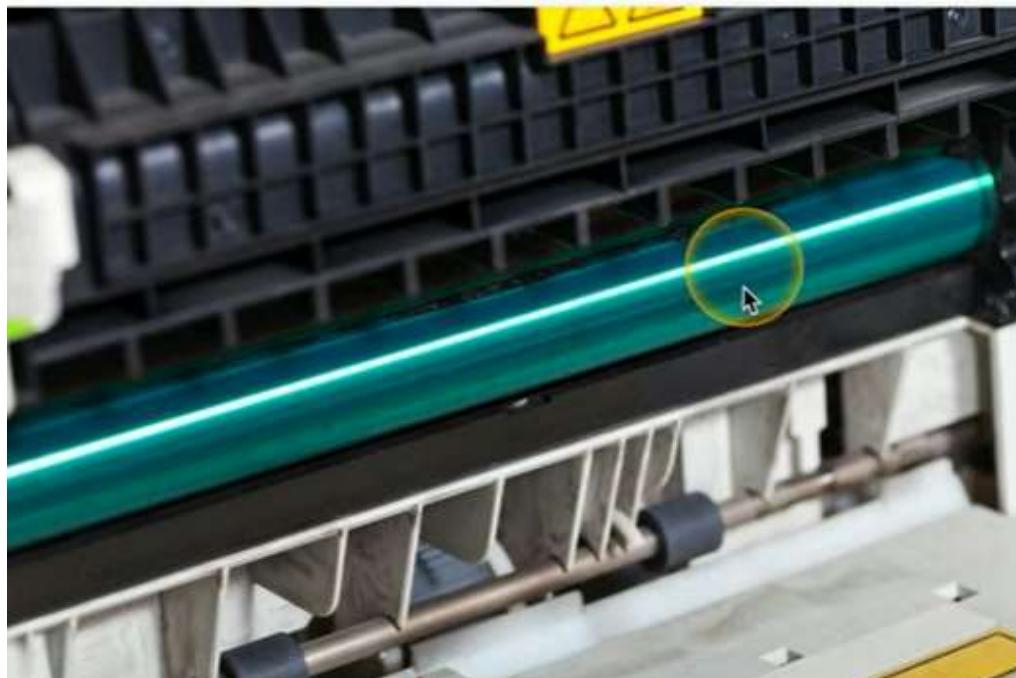
Very complex as there are a lot of moving parts, this also requires on-printer memory, this can also be very messy as a technician

▼ Imaging drum

Printing starts with the imaging drum, which is a photosensitive drum, and the image is drawn into this hence the paper is painted with the laser.

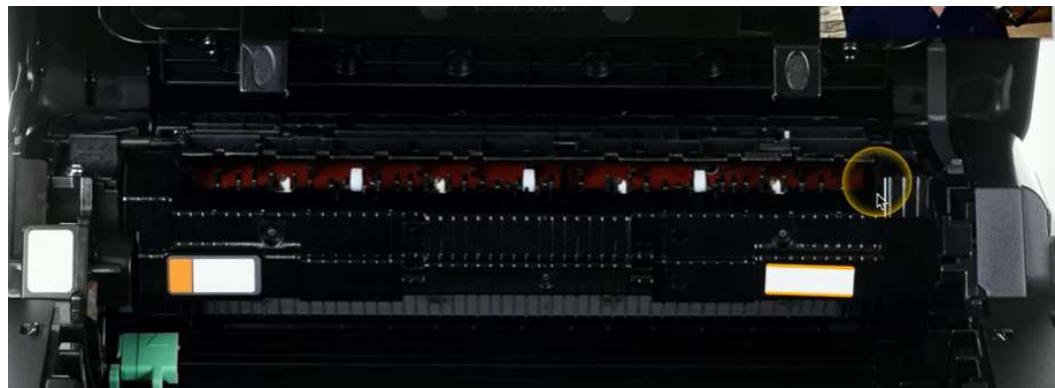
The drum is responsible for taking the image and taking up the toner to the paper, to present the final output

This can be separate from the toner cartridge or combined, if it is combined once when you take the printer for toner replacement they will replace the drum as well



▼ Fuser assembly

Once the toner is transferred from the imaging drum to the paper, we still need to fix the toner onto the page for this purpose we use a fuser assembly which makes use of **heat and pressure** to melt the plastic toner powder so that there is permanently bonded toner to paper



Fuser assembly the dark brown drum

▼ Transfer belt

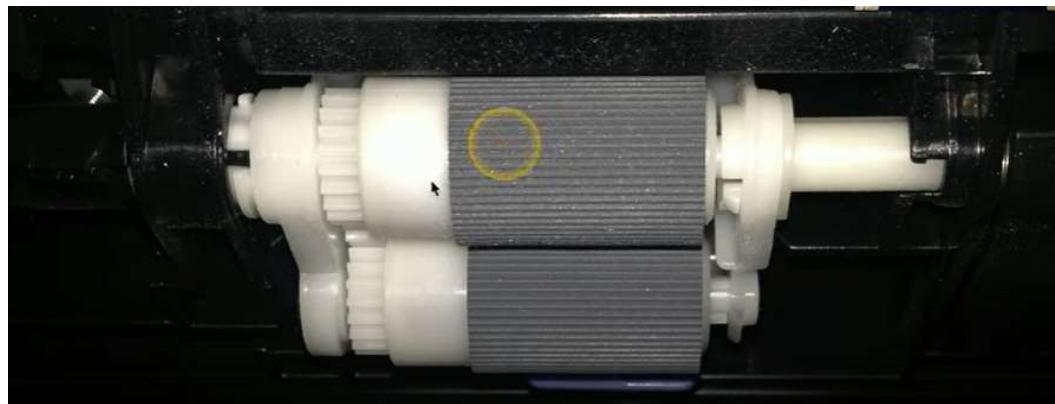
If you're working with a color laser printer, Transfer belts enable you to combine multiple colors, pull the right amount of color (Cyan, Magenta, black & yellow). Image is transferred from all cartridges to the single belt (And then to a single transfer roller)



▼ Pickup Rollers

Before the paper gets into the printer, we need to feed the printer using a stack, the pickup rollers enable you to pickup a single piece of paper each time

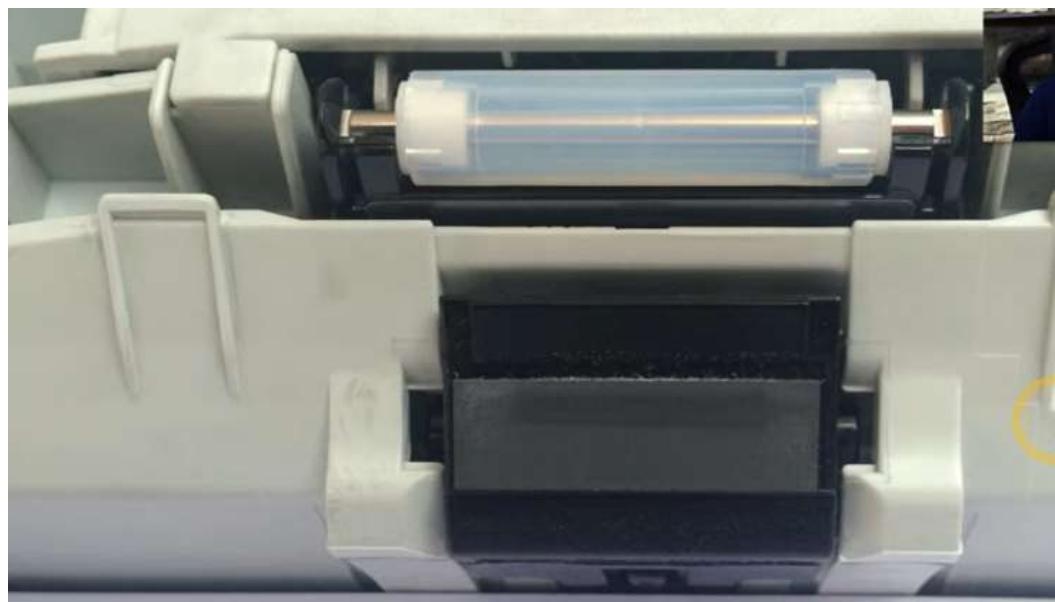
this should be cleaned regularly



▼ Separation pad

Pulls just the top sheet from the paper tray (Not multiple sheets)

Small and inexpensive part



▼ Duplex assembly

Printers usually print on a single side (Not both sides simultaneously).

But there are some printers which are Duplex printing (manual intervention is not required) You will need a mechanism to flip the page (automatically), this can be built into the printer or an optional add-on



▼ Printing Process

1. Processing Phase → Data is sent to the printer, printer does not begin printing until the whole page is rendered to the memory.
2. Charging Phase → A corona wire or charge roller is used to provide a negative charge to the Photosensitive drum, this negative charge clears the drum preparing it for the image that will be provided by the laser
3. Exposing Phase → The laser begins writing the image to the Photosensitive drum, the later begins to create a positive charge imprinting the image onto the fresh Photosensitive drum on everywhere it touches.
4. Developing Phase → where toner in the toner cartridge is also negatively charged, which means the negatively charged toner will stick to the positively charged sections of the Photosensitive drum which were charged by the laser.
5. Transferring Phase → Transfer of toner from the Photosensitive drum to the paper. However the toner has not been permanently affixed to the paper yet
6. Fusing Phase → Where heat and pressure are applied on to the paper. This melts the toner causing it to permanently attached onto the paper, which is why the paper is slightly warm
7. Cleaning Phase → Removes any excess toner from the drum, this continues the cycle. After this the Photosensitive drum will undergo the same cycle again just to completely print one page

steps 2-7 is repetitive

Step 1: Processing	Build the entire page in memory
Step 2: Charging	Prepare the drum with a negative electrostatic charge
Step 3: Exposing	Write the image with the laser
Step 4: Developing	Add negatively-charged toner to the imaging drum
Step 5: Transferring	Move the toner from the drum to the paper
Step 6: Fusing	Heat and pressure
Step 7: Cleaning	Remove excess toner

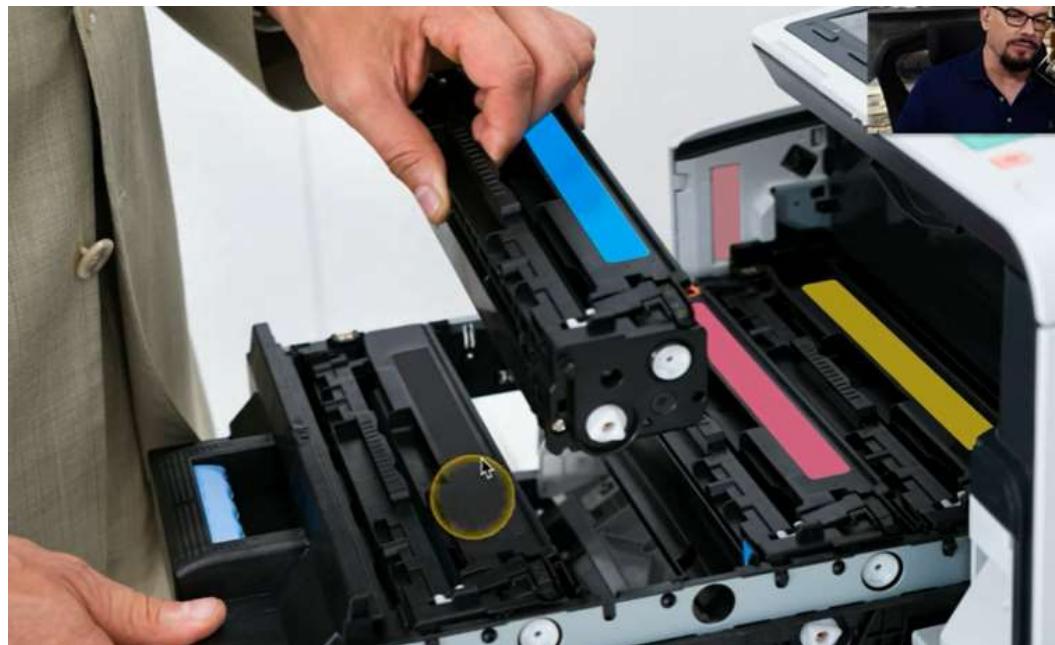
▼ Laser Printer Maintenance

▼ Laser Printer Maintenance

Most common maintenance process of a printer is replace the toner cartridge and sometime the photosensitive drum. messages inform that the toner will be running low.

the toner cartridge also contains the OPC drum (Organic Photoconductor Drum), this is very sensitive to light hence it is covered well . It is very common when u replace the toner the OPC drum also come with it

Power down the printer and remove the packing strips for the new drum has been removed.



▼ Laser Printer Maintenance Kit

Laser printers wear out. All those moving parts included with the heat and pressure add up to reduction in longevity.

Manufacturers often provide a laser maintenance kit including all the parts that are expected to be worn out. (These often include Replacement feed rollers, new fuser unit, etc)

These maintenance times will be informed by the manufacturer considering the time parts are expected to wear out.

Make sure to reset the page counter after you're done with the replacement.

▼ Laser Printer Calibration

Different toner cartridge print with different densities (Some dark some light).

Hence it is important to calibrate the printer to get the right amount of color.

This can be automated or a manual process (hence check the printer manual)

▼ Laser Printer Cleaning

They tend to collect a lot of dust of all the toner and paper dust

Check manufacturer on how to clean it either with water or isopropyl alcohol (IPA)

When cleaning the inside don't use normal vacuum cleaner or compressed air, wash toner from skin with cold water , clean rollers with IPA

▼ Inkjet Printers

▼ Inkjet (ink-dispersion) printer

Relatively inexpensive tech, they are quite quiet as well along with high res image quality.

However they are expensive (Proprietary), and they eventually begin to fade, tends to clog very easily as well

▼ Ink Cartridge

Place drop of ink onto a page (Pulled from a set of cartridge)

CMYK (Cyan, Magenta, Yellow, Key(black))

▼ Print head

Some consumer printers integrate the print head into the ink cartridge. Change the cartridge, get a new print head. However others separate the ink cartridge from the print head.

▼ Feed Rollers

Pick up and feed paper through the printer. (Must be clean and not worn)



Duplexing → Print on both sides , included in some printer

▼ Carriage and belt

Ink cartridge are moved over the paper (Carriage may include its own print head)

Belt moves the carriage back and forth (Another moving part)



Carriage is the piece on the right, brown belt is used to pull the carriage left and right

▼ Inkjet printer calibration

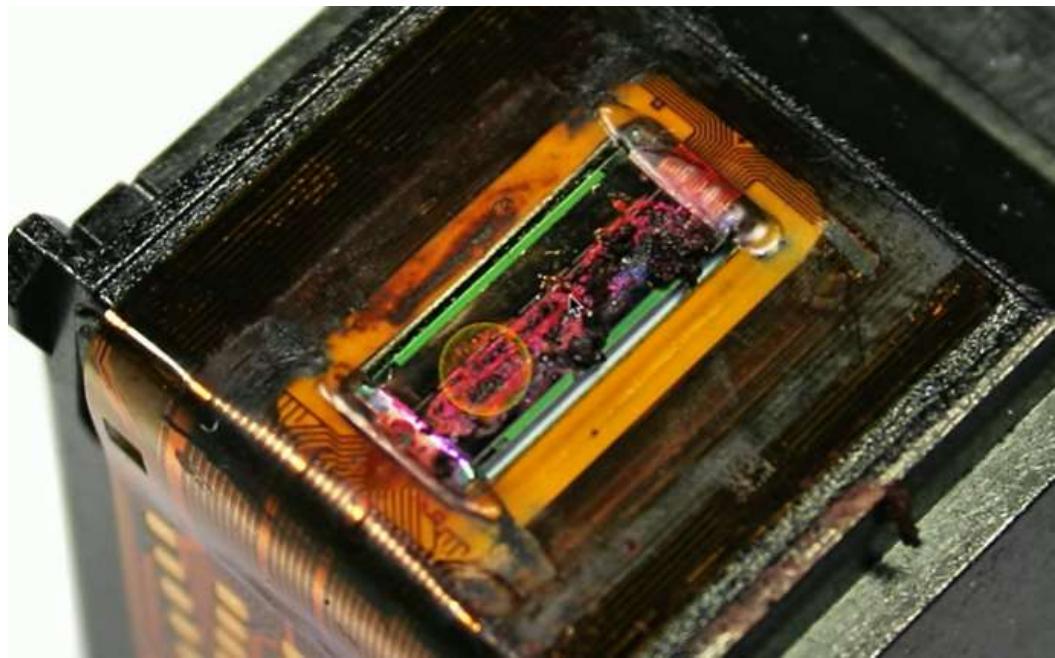
Align nozzles to the paper. hence calibration is required to ensure minor adjustments

▼ Inkjet Printers Maintenance

▼ Cleaning print heads

One of the main factors to be mindful about is that, the ink heads should not be unclogged. Small droplets of ink (and small holes in a print head)

Clogged head is a big issue. Many printers automatically clean every day, Output has streaks or sections of missing color. This could also be done manually using a button that takes several minutes. You can also remove the print head and manually clean them.



▼ Replacing inkjet cartridges

Usually separate colors

- Cyan, Magenta, Yellow, Key (CMYK)
- some cartridges combine less

Takes a few minutes to replace and calibration

Recycle the cartridges.

Makes sure to calibrate the printer after replacing

▼ Clearing Jams

Due to lots of turns and twists, best practice is to remove the paper tray and get rid of any loose paper. Remove paper from the path

▼ Thermal Printers

▼ Thermal Printer

This works by feeding paper that is especially coated white paper, it heats certain parts of the page, and any part that is heated turns black, hence no toner is required, these devices are very quiet. However the paper is sensitive to light and heat (and clear tape - you will notice the part where the paper is covering slowly turns white).

Hence it is important to not use thermal printers for archives

Feed assembly is used to pull paper through the printer (Relatively small paper path)

▼ Heating element

to create this you will need a heating element such as the silver section found below

Full-length heating element (No moving print head)



▼ Thermal Paper

This effect is possible cuz of the chemical added to the paper. This is Thermochromic paper (thermal paper), hence the name suggest it changes color once heated

Cash registers, credit card terminals

Although it looks like normal paper it feels different

▼ Thermal Paper replacement

▼ Thermal Paper replacement

Relatively inexpensive (But impossible to substitute)

Different sizes are available hence it is important, to make sure to get the right size that matches the printer.

Actually replacement process is easy (Simple paper feed, small device)

▼ Cleaning the heating element

there could be times when the printer is missing info on the output to counter this effect it is important to clean the device. Use:

Liquid cleaner (Making use of Isopropyl alcohol (IPA))

Get a cleaning pen & obviously check manufacturers recommendations

Use cleaning cards, which cleans the entire paper path, and heads

▼ Removing debris

Relatively small amount (Paper bits and dust, no toner), usually due to dust

Blow out the printer (using a compressed air gun)

Avoid using a vacuum, unless it is designed for a computer. This resists static buildup/discharge. this is cuz the movement of all that dust tends to create static electricity, however this is very bad for electronic devices

▼ Paper sensitive to heat

Head is used to create the output on the thermal page (More heat will darken the entire page)

Avoid hot areas (car dashboards, radiators, hair dryers)

Receipt will also fade over time , don't use it as archival media

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▼ Dot-matrix (impact) printers

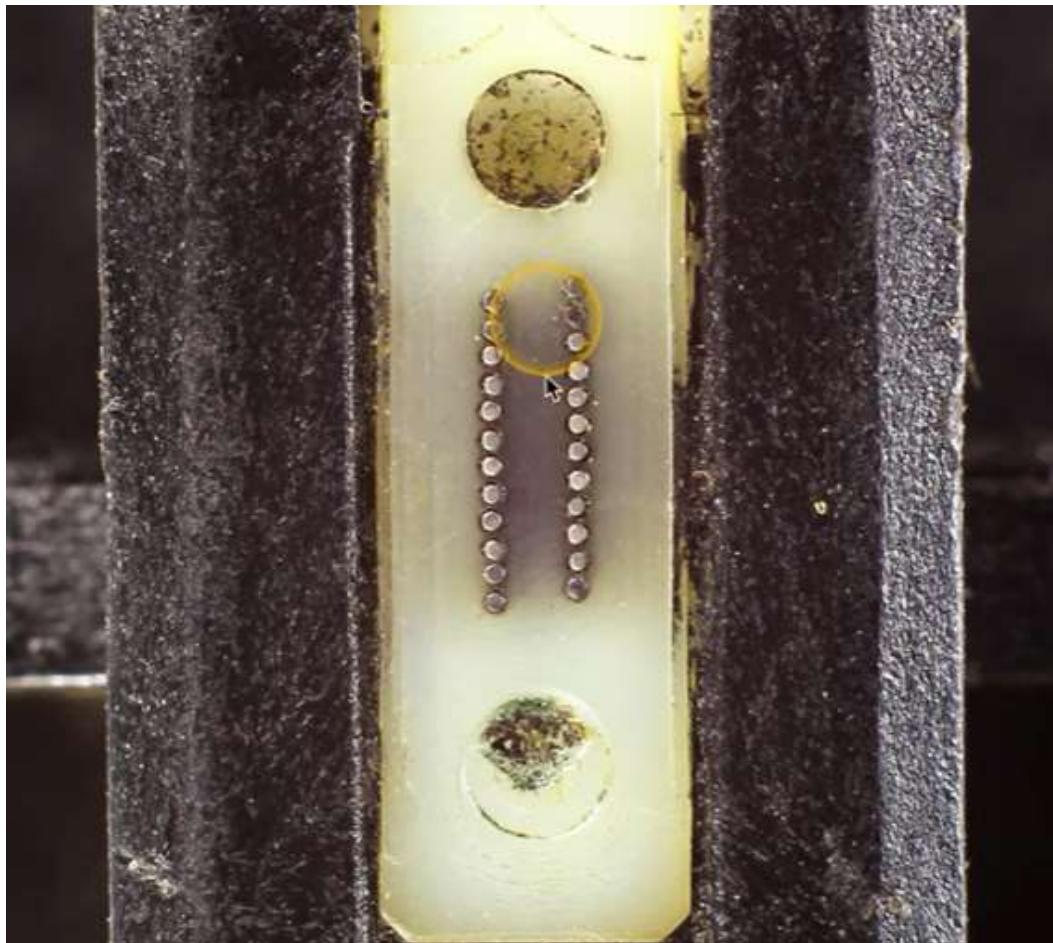
▼ Dot-matrix (impact) printers

This presses against a ribbon(ink is inside the ribbon) to print this makes a mark on paper, print head with a small matrix of pins

Good for use with carbon papers as this can make multiple copies at once, this means that it low cost per page

Although this is NOISY having very poor graphics and uses in relatively niche markets.

the print head moves back and forth - the pins hit the ribbon



▼ Printer ribbon

In order to show output on the page we need to move ink that is inside of a ribbon onto the printed page itself. So the pins are pressing into the ribbon, the ribbon is pressing onto the page, this outputs the mark on the page.

The ribbon is made out of fabric, and this is very long ribbon used constantly cycling through the printing process, this make is easy to replace as there is only one single unit. The has a proprietary size that is specific to the printer ribbon

▼ Tractor feed

Uses a tractor feed to pull paper into the printer this means there are holes on the sides. Continuous paper feed, (Perforations between the pages). Holes have to line up perfectly, tractor paper can be perforated to remove holes. (Green bar papers are also used these types of paper is mostly associated with mainframe printing)

▼ Impact printer maintenance

▼ Printer ribbon replacement

Single ribbon can be replace which is self contained, and is one long circle. Replace when ink becomes too light. Fortunately these ribbons are designed to be very modular, hence they can be replaced in less than a minute

▼ Print head replacement

Due to the impact of the printhead constantly hitting the pins, which causes the printhead to eventually fail, it gets hot pretty quick hence heat sinks are also built in, Replace with the ribbon for the best effect

▼ Replacing paper

Not as easy as a laser printer. Paper must feed perfectly into holes (tractor feed)

Forms must be positioned correctly, Text needs to fit a predefined space, paper must feed without constraint, make sure nothing is in the wa.

▼ 3D printers

▼ 3D printers

Print in three dimensions. Create a 3D item based on an electronic model.

Additive manufacturing

- Builds in layers to create the object
- No mathcing process requires

Rapid prototyping

- Design and create relatively quickly and inexpensively

Deploys designs anywhere in the world (or in space)

▼ Filament Printing

Fused Deposition Modeling (FDM)

- Melt filament to print 3D objects
- This is probably the printing type you have seen

Print a layer, move up, print another

- Watch the printer create the object

Good all-around printer

- Larger print bed than resin printers
- Easy to manage filament
- Minimum of mess and fewer disposal issues



▼ Resin Printing

Stereolithography (SLA) 3D Printing

- Smooth and finely detailed 3D prints

Resin is hardened using a light source

- Ultraviolet light or a laser

- Layers are added to the bottom
- Entire print hangs from the build platform
- Layers are hardened one by one from the bottom up as it is dipped into the liquid, a UV light is used to create the structure

Resin must be handled properly

- Wear protective gear
- Take unused resin to your local hazardous materials disposal

▼ Print bed

A flat adhesive surface

- the foundation of a 3D print
- Everything builds on that first layer

Need to be level and clean

- Prints “stick” on the bed

Filament printing

- The print bed is the printing surface
- Many different print bed options

Resin printing

- The bed is the location where the resin is hardened by the UV light

▼ Cloud Models

▼ Cloud Computing

More than just a server hosted elsewhere

- Extend the management of applications and services

Deploy an infrastructure in minutes

- Create and tear down as you need
- Creating an application incorporates of many different components together using a cloud base system you can deploy a web server , application server which ever it might be with just one click. If you have an application that requires more resources you can increase the application instances to deal with that load, and once this is decreased you can remove any excess instances to perfectly size your particular application.

International Scope

- Deploy in specific parts of the world

Use only the required resources

- Cost is based on the amount of use

▼ Private Cloud

When a company builds their own cloud which nobody else have access to.

Private → Your own virtualized local data center

Public → Available to everyone over the internet

Hybrid → a mix of public and private

Community → Several organizations share the same resource who have the same goal

▼ Infrastructure as a service (IaaS)

End user is responsible for the application, the O.S. and everything in between

Sometimes called Hardware as a Service (HaaS)

When organizations build their own databases, web servers and other devices in those situations a company will only need the raw infrastructure to load the software and deploy the cloud instances. If an organization only needs CPU storage and a network to be able to deploy this application instance they want to use Infrastructure as a Service as a cloud deployment model.

- Outsource your equipment

You're still responsible for the management and for the security. The end user is responsible for a large amount of the implementation, the cloud provider is effectively providing the hardware to run this application and in some cases even the O.S., everything else is in the responsibility of the end user.

- Your data is out there, but more within you control

An example of this would be a company that provides web services

- they will provide you with the server to be able to load the website and you will be responsible for building and deploying the website content

▼ Software as a Service (SaaS)

End user doesn't have to deal with anything related to the application and the O.S. the end user will simply have to log in and manage an email distribution list, payroll, or any other type of software as a Service implementation

On-demand software

- No local installation
- Why manage your own email distribution? or payroll

End user doesn't have to worry about building their own application, they don't need to deploy an application or update or manage that application they don't have to find a way to store the data or protect any of the data that may be there.

Instead the software as a service provider is the one responsible for maintaining the application

Central management of data and applications (Your data is out there)

A complete application offering Ex:

- No development work required
- Google Mail, Microsoft 365

▼ Platform as a Service (PaaS)

No servers, no software, no maintenance team, no HVAC

- Someone else handles the platform (provides you with the platform), you handle the development

You don't have direct control of the data, people , or infrastructure

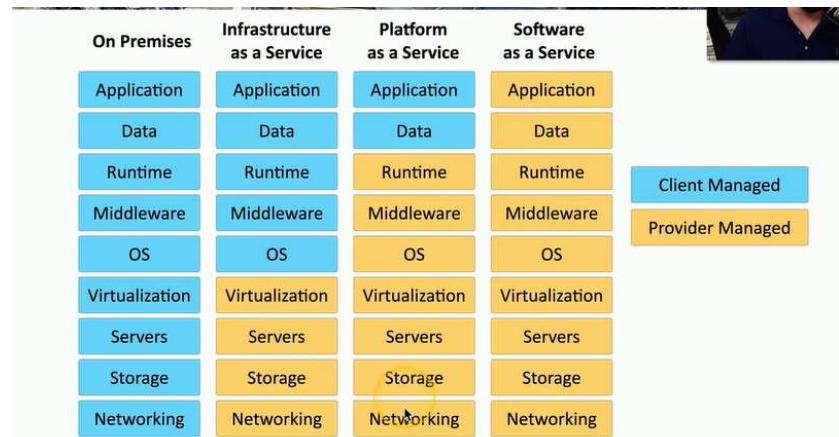
- Trained security professionals are watching your stuff
- Hence they may control access login as well
- They may also provide you with a set of modules that you can put together to build your own app, so you might have a login page module and an inventory module, this enables you to check in and check out pieces of information from that inventory. You are responsible for putting together each of those modules and placing them on the platform as a service so that you can then make that application available to others, the service provider has made this application so you don't have to do a lot of programming , you simply put together the modules you may need.

Put the building blocks together

- Develop your app from what's available on the platform
- SalesForce.com

▼ Cloud Models

if you're planning to deploy these applications in your own data center, on your own hardware using applications that you yourself have written then you're probably using as on-premise model, where everything on the model is managed by the client in Cloud based tech a portion of the services are provided by the cloud



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▼ Cloud Characteristics

▼ Shared Resources

▼ Internal Cloud

This means that you're creating resources in your own internal network that will be used for the application deployments.

- No resources are shared
- Build your own cloud / data center / racks
- Pay for everything up front
- No ongoing cost

▼ External Cloud

You are sharing resources that are available on this very large public cloud. Most of this is usually stored in the cloud providers data centers.

Underlying infrastructure owned by a third-party

Cost may be metered or up-front depends on how much you are using, or pay as you go.

▼ Pay as you go

Or sometime referred to as pay for only the resources you are using is sometimes referred to as metered cloud services

- Cost to upload, store, download

Non metered

- You pay for a block of storage
- No cost to upload, download

▼ Rapid Elasticity

One of the pros of this is that you're able to create more instances as the load increases and decrease the number of instances as the load decreases, this flexibility is known as Rapid Elasticity

High availability , systems are always available, Redundancy provides availability with the help of generators and multiple network lines they can provide an efficient service.

File synchronization → Information can be duplicated across cloud locations

▼ Desktop as a Service

Basic application usage, or entire windows desktop can be accessed remotely.

- Applications actually run on a remote server
- Virtual Desktop Infrastructure (VDI), Desktop as a Service (DaaS). This is how the application are run as , this means all u need is a keyboard, mouse and screen
- Network connectivity
- This uses Remote Desktop Technology, to send a minimal amount information, between the client as the desktop, but you still need that network connection in order to leverage DaaS
 - Big network requirements
 - Everything happens across the wire

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▼ Client side virtualization

▼ Virtualization

One computer, enabled you to run many operating systems at the same time(macOS, Windows 11, Linux Ubuntu)

To each O.S. it seems that it has its own memory but this is only an illusion as the memory is shared between all