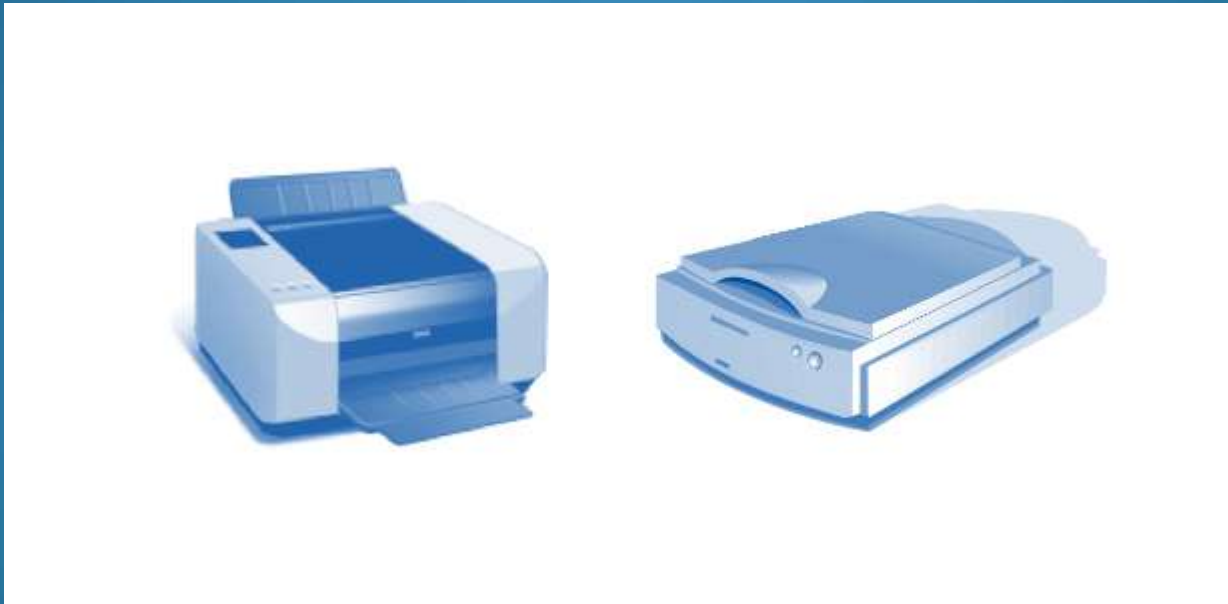


Computer Systems

Lecture 6 : Printers & Scanners



Introduction

- Printers produce paper copies of electronic files.
 - Hard copies of computer documents remain important today.
- Scanners allow users to convert paper documents into electronic files.
- The user must understand the operation of various types of printers/scanners to be able to install, maintain, and troubleshoot any problems that arise.



Printers

- Working in IT, you may be required to purchase, repair, or maintain a printer.
- Printer selection criteria:
 - Capacity and Speed
 - Colour or black and white
 - Quality
 - Reliability
 - Warranty
 - Schedule servicing
 - Mean time between failure (MTBF)
 - Total Cost of Ownership (TCO)

Wired Printer Connection Types

- To access a printer, a computer must have a compatible **interface** with it.
- The following are common interface types:
 - Serial
 - Parallel
 - Small Computer System Interface (SCSI)
 - Firewire
 - Universal Serial Bus (USB)
 - Ethernet

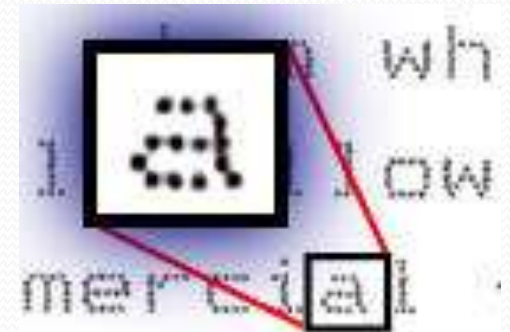
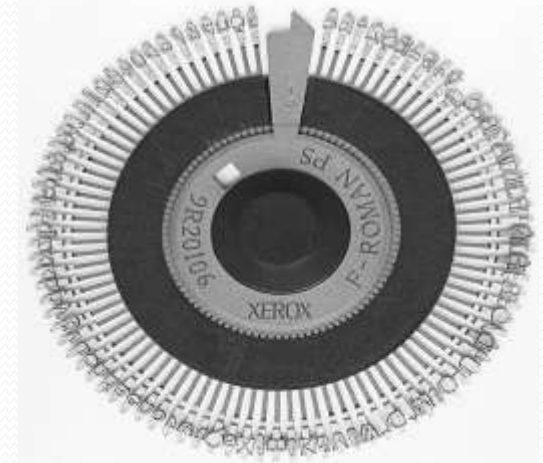
Wireless Printer Connections

- Wireless printers allow hosts to connect and print wirelessly using **Bluetooth, 802.11x, or infrared (IR)**.
- **Bluetooth** - both the printer and the host device must have Bluetooth capabilities and be paired.
- **802.11x** - printers are equipped with installed wireless NICs and connect directly to a wireless router or access point.
- **IR (infrared)** - requires transmitters and receivers on both devices and a clear line of sight between the transmitter and receiver.

Impact Printers

Impact printers have print heads that strike an inked ribbon, causing characters to be imprinted on the paper

- There are two types:
 - **Daisy-wheel** - The wheel contains the embossed letters, numbers, and special characters. Wheel is rotated until the required character is in place, and an electromechanical hammer pushes the character into the ink ribbon and against the paper.
 - **Dot-matrix** - Print head contains pins that are surrounded by electromagnets. When the electromagnets are energized, the pins push forward onto the ink ribbon in patterns, forming a character. The number of pins on a print head, 9 or 24, indicates the quality of the print. Most dot-matrix printers use continuous feed paper with perforations between each sheet.



Impact Printers

- **Advantages:**

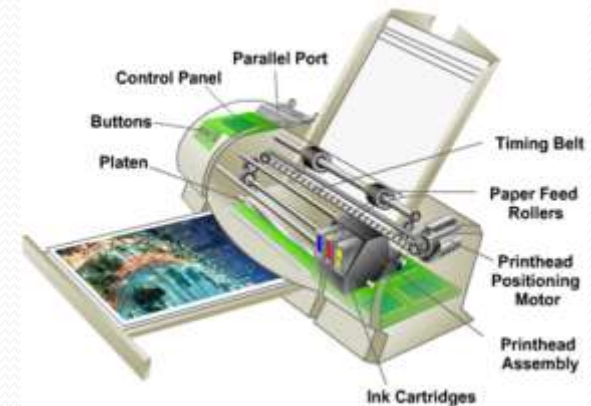
- Uses less expensive ink than inkjet or laser printers
- Uses continuous feed paper
- Has carbon-copy printing ability

- **Disadvantages:**

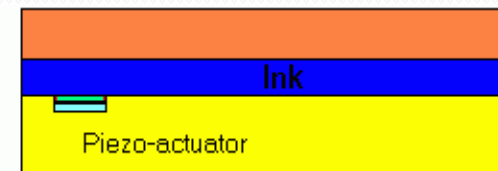
- Noisy
- Low-resolution graphics
- Limited colour capability

Inkjet Printers

Inkjet printers use ink cartridges that spray ink onto a page through tiny holes called nozzles and are located in the print head. The print head and ink cartridges are located on the carriage, which is attached to a belt and motor. As rollers pull paper in from the feeder, the belt moves the carriage back and forth along the paper as the ink is sprayed in a pattern on the page. A **feeding mechanism** draws paper in and the paper passes by the print head where ink is sprayed onto it. Print quality of an inkjet printer is measured in dots per inch (dpi). A higher dpi rating provides greater image detail.



- Two types of inkjet nozzles:
 - **Thermal** - A pulse of electrical current is applied to heating chambers around the nozzles. The heat creates a bubble of steam in the chamber which forces ink out through the nozzle.
 - **Piezoelectric** - crystals are located in the ink reservoir at the back of each nozzle. A charge is applied to the crystal causing it to vibrate. This vibration of the crystal controls the flow of ink onto the paper.



Inkjet Printers

- **Advantages:**

- Initial low cost
- High resolution
- Quick to warm up

- **Disadvantages:**

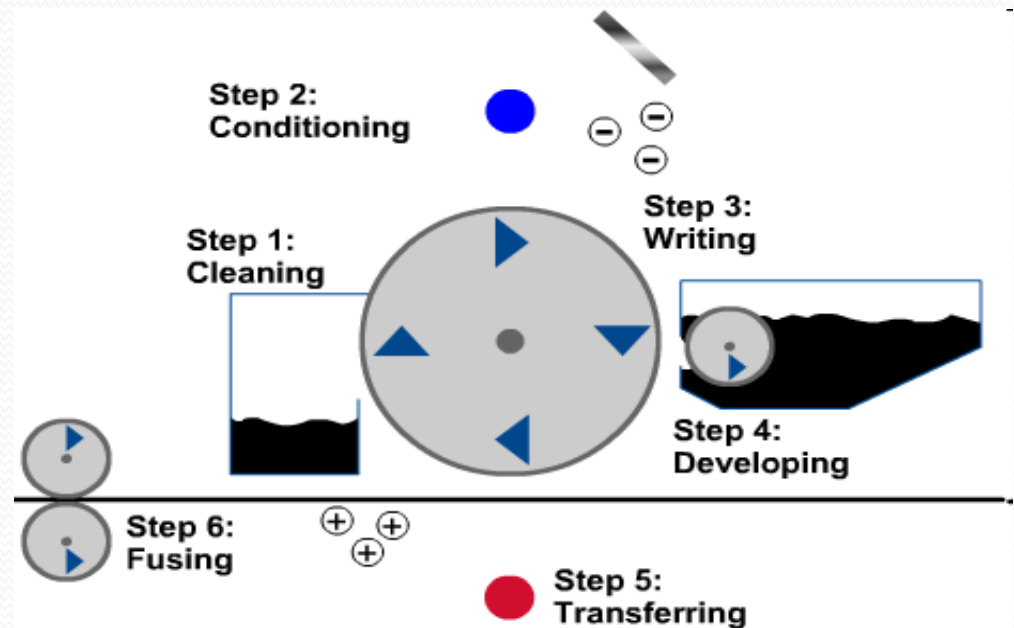
- Nozzles are prone to clogging
- Ink cartridges are expensive
- Ink is wet after printing

Laser Printers

- A laser printer is a high-quality, fast printer that uses a laser beam to create an image.

- **Laser printing process**

1. Cleaning
2. Conditioning
3. Writing
4. Developing
5. Transferring
6. Fusing



- The central part of the laser printer is its electrophotographic drum. When laser light strikes the drum, it becomes a conductor at the point where the light strikes. The laser beam draws an electrostatic image on the drum. The undeveloped image is passed by a supply of dry ink or toner that is attracted to it. The drum turns and brings this image in contact with the paper, which attracts the toner from the drum. A fuser melts the toner into the paper.

Laser Printers

- The laser printer process involves six steps to print information onto a single sheet of paper.
- Step 1: Cleaning - When an image has been deposited on the paper and the drum has separated from the paper, any remaining toner is removed from the drum. Printer may have a blade that scrapes excess toner from drum. Some printers use an AC voltage on a wire that removes the charge from the drum surface and allows the excess toner to fall away from the drum.
- Step 2: Conditioning - Removing the old latent image from the drum and clearing the drum for a new image. Done by placing a special wire or grid, called the primary corona, across the surface of the drum. Drum receives a negative charge of approximately -600 volts DC. The roller is called a conditioning roller.
- Step 3: Writing - Scanning the photosensitive drum with the laser beam. Every portion of the drum that is exposed to the light has the surface charge reduced to about -100 volts DC. As the drum turns, an invisible latent image is created on it.
- Step 4: Developing - Toner is applied to the latent image. Toner contains developer particles made up of magnetic materials coated with a plastic-like material. The toner is charged to approximately -200 volts DC. Toner is attracted to the -100 volts DC areas of the photosensitive drum, but repelled by the more negative -600 volts DC areas. A control blade holds the toner at a microscopic distance from the drum. The toner leaps from the control blade to the drum, where it is attracted by the more positively charged latent image.
- Step 5: Transferring - Toner attached to the latent image is transferred to the paper. Secondary corona places a positive charge on the paper. Paper attracts the negative toner image from the drum. The image is now on the paper, held in place by the positive charge.
- Step 6: Fusing - Paper is rolled between a heated fuser roller and a pressure roller. Fuser roller is heated to about 350 degrees Fahrenheit (177 degrees Celsius). Loose toner powder fuses with the fibers in the paper. Paper is then moved to the output tray as a printed page.

Laser Printers

- **Advantages:**

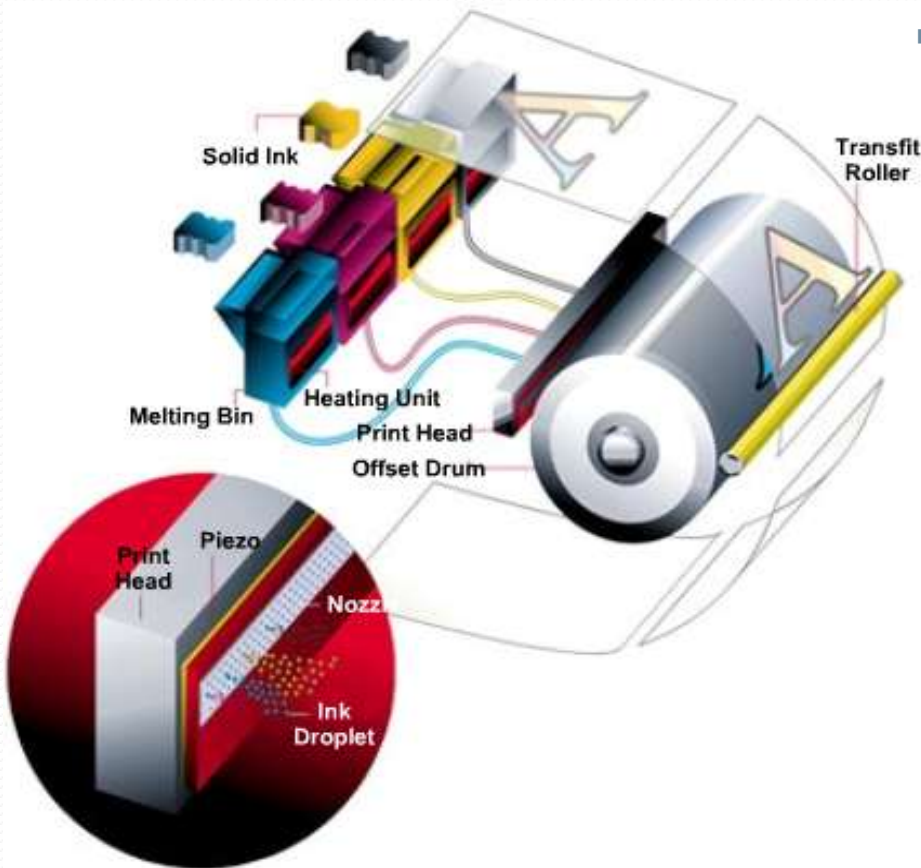
- Low cost per page
- High ppm
- High capacity
- Prints are dry

- **Disadvantages:**

- High cost startup
- Expensive toner cartridges
- Require high level of maintenance

Solid-ink Printers

Use solid sticks of ink rather than toner or ink cartridges. Solid-ink printers produce high-quality images. The ink sticks are nontoxic and can be handled safely. Solid-ink printers melt ink sticks and spray the ink through nozzles. The ink is sprayed onto a drum. The drum transfers the ink to paper.



■ The printing process:

1. Cleaning - Drum surface is cleaned to remove any remaining ink from the previous print.
2. Spraying - The print head and the drum are heated and an image is sprayed onto the print drum.
3. Transferring - Paper is passed between a pressure roller and the drum transferring the image to the paper. The ink is dry when the transfer is finished.

Solid-ink Printers

- **Advantages:**

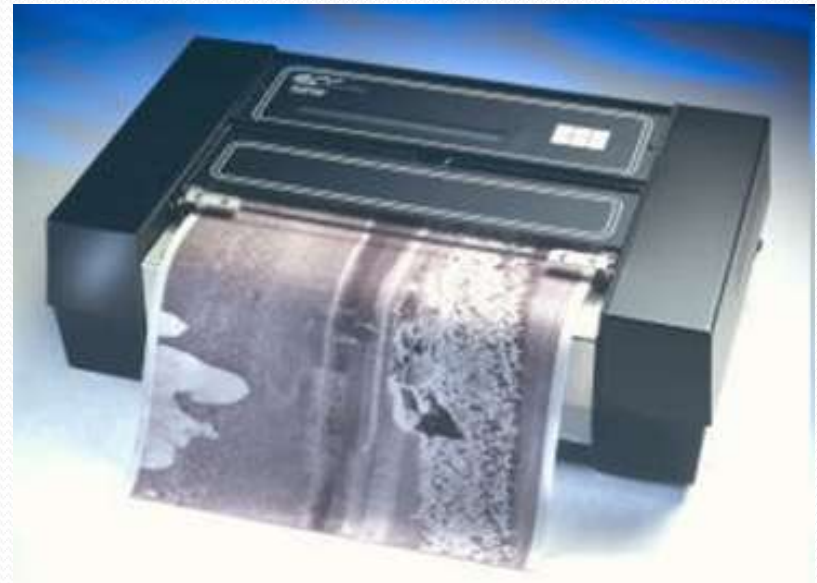
- Produces vibrant colour prints
- Easy to use
- Can use many different paper types

- **Disadvantages:**

- Printers are expensive
- Ink is expensive
- They are slow to warm up

Thermal Printers

- A **thermal printer** uses chemically-treated paper and has a waxy quality that becomes black when heated.
- After a roll of thermal paper is loaded, the feed assembly moves the paper through the printer. Electrical current is sent to the heating element in the print head to generate heat.
- A thermal transfer printer uses a heat-sensitive ribbon, which the print head melts onto the paper. The heated areas of the print head make the pattern on the paper.
- Thermal printers have a longer life because there are few moving parts.
- Some retail cash registers or older fax machines might contain thermal printers.



Thermal Printers

- **Advantages:**

- Longer life because there are few moving parts
- Quiet operation
- No cost for ink or toner

- **Disadvantages:**

- Paper is expensive.
- Paper has a short shelf life.
- Images are poor quality.
- Paper must be stored at room temperature.

Dye-Sublimation Printers



- Also called **thermal dye** printers
- Usually used in producing photo-quality images for graphic printing
- Uses solid sheets of ink that change directly from solid to gas when heated, in a process called **sublimating**
- The gas passes through the paper, where it turns back to a solid. The print head passes over a sheet of cyan, magenta, yellow, and a clear overcoat (CMYO). There is a pass for each colour.



Dye-Sublimation Printers

- **Advantages:**

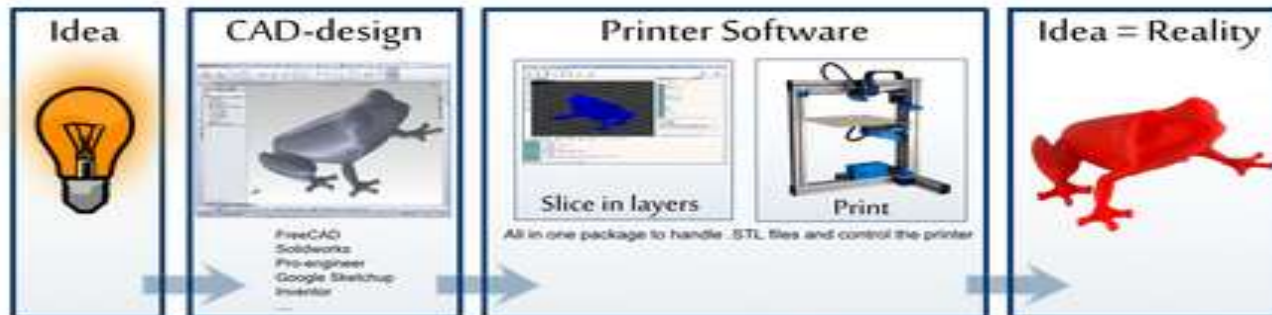
- Very high quality images
- Overcoat layer reduces smearing, increases moisture resistance

- **Disadvantages:**

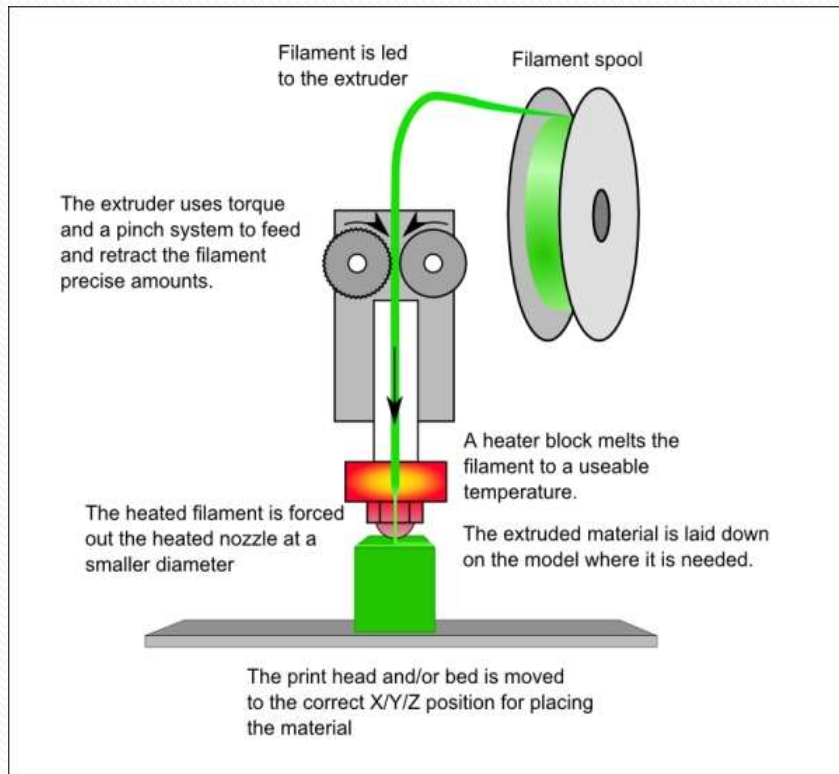
- Media can be expensive
- They are better for colour than for grayscale (black and white)

3D Printers

- 3D printing, also known as Additive Manufacturing, is where a three dimensional object is created by laying down successive layers of material.
- A virtual design is made in a CAD (Computer Aided Design) file using a 3D modelling program.
- The 3D modelling software “slices” the final model into hundreds or thousands of horizontal layers.
- The file is then uploaded to the 3D printer where it reads every slice (or 2D image) and proceeds to create the object blending each layer together with no sign of the layering visible, resulting in one three dimensional object.



3D Printers



- Not all 3D printers use the same technology and there are several different ways to print.
- Selective Laser Sintering (SLS) and Fused Deposition Modeling (FDM) use the method of melting or softening material to produce the layers.
- Stereolithography (SLA) uses the method of curing a photo-reactive resin with a UV laser one layer at a time.
- 3D printers can work with almost any material that can be liquefied, like plastics, glass, metal, polymers, wax, nylon, sand and glue mixes, and even food and human tissue.

FDM system - A plastic material is unwound from a coil and fed through an extrusion nozzle. The nozzle melts the filaments and extrudes them onto a base. Both the nozzle and the base are controlled by a computer that translates the dimensions of an object into X, Y and Z coordinates for the nozzle and base to follow during printing. The extrusion nozzle moves over the base horizontally and vertically, "drawing" a cross section of an object onto the base. This thin layer of plastic cools and hardens, immediately binding to the layer beneath it. Once a layer is completed, the base is lowered to make room for the next layer of plastic.

3D Printers

■ **Advantages:**

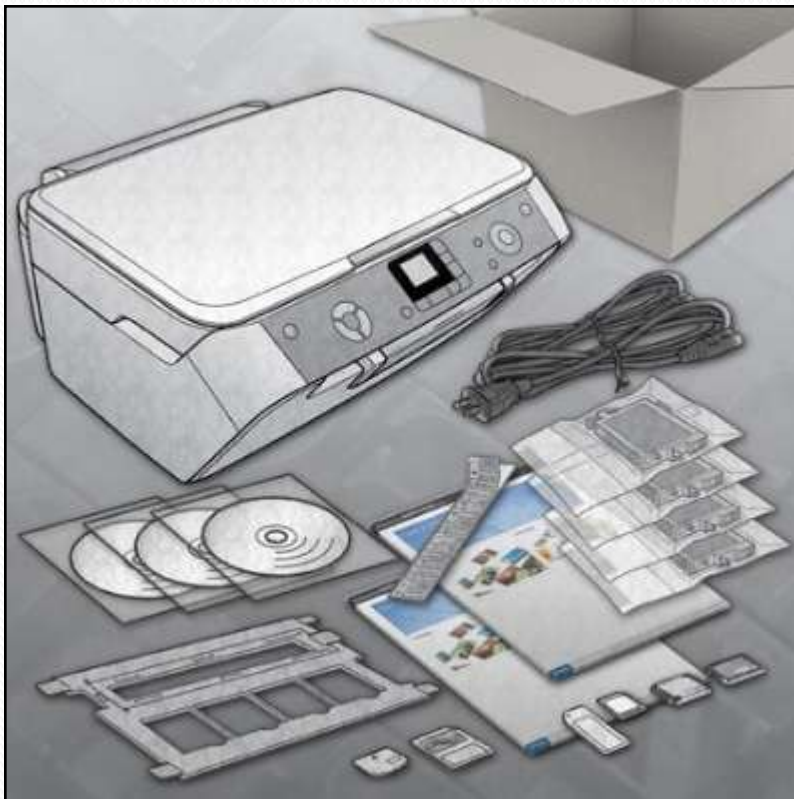
- Ability to customise products
- Rapid production of prototypes
- Low cost of production
- No storage cost
- Increased employment opportunities
- Quick availability of organs

■ **Disadvantages:**

- Intellectual property issues
- Unchecked production of dangerous items
- Limitations of size
- Limitations of raw material
- Fewer Manufacturing Jobs
- Cost of printers

Installing and Configuring Printers

- When purchasing a printer, the installation and configuration information is usually supplied by the manufacturer:



- Installation media that includes drivers, manuals, and diagnostic software.
- Also available as downloads from the manufacturer's website.
- Although all types of printers are somewhat different to connect and configure, there are procedures that should be applied to all printers.

Installing and Configuring Printers

- Connect the Printer
 - Connect appropriate data cable to the communication port on back of printer.
 - Attach the power cable to the printer.
 - **Warning:** Never plug a printer into a UPS. The power surge that occurs when the printer is turned on will damage the UPS unit.

- Printer Driver

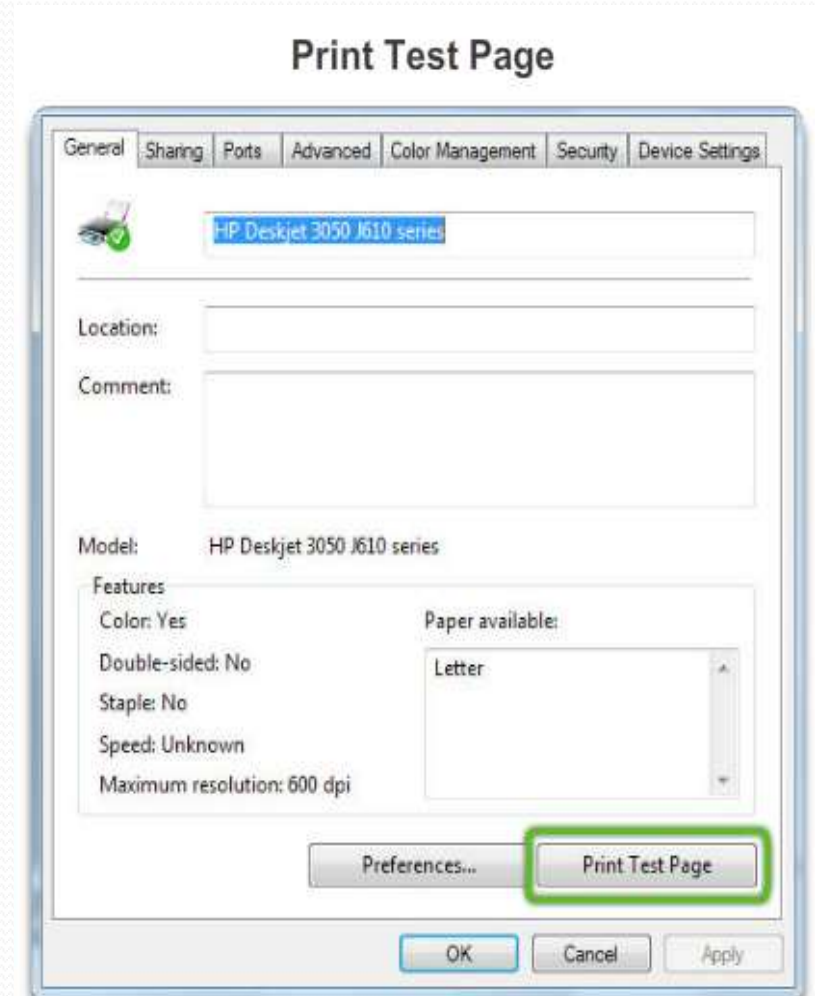
PostScript	PCL
Page is rendered by the printer	Page is rendered on local workstation
Better quality output	Faster prints jobs
Handles more complex print jobs	Requires less printer memory
Output is identical on different printers	Output varies slightly on different printers

- A **printer driver** is the software program that enables the computer and the printer to communicate with each other.
- It is recommendable to find out if a newer driver is available on the manufacturer's website.

Installing and Configuring Printers

- **Test Page Printing**

- After installing a printer, you should print a test page to verify that the printer is operating properly.
- You can print a test page manually, from an application such as Notepad, or from the Command Line.



Common Configuration Settings

- Configuration Options and Default Settings include:
 - **Paper type** - Standard, draft, gloss, or photo
 - **Print quality** - Draft, normal, or photo
 - **Colour printing** - Multiple colours is used
 - **Black-and-white printing** - Only black ink is used
 - **Grayscale printing** – printing using only black ink in different shades
 - **Paper size** - Standard paper sizes or envelopes and business cards
 - **Paper orientation** - Landscape or portrait
 - **Print layout** - Normal, banner, booklet, or poster
 - **Duplex** - Two-sided printing

Software Optimisation

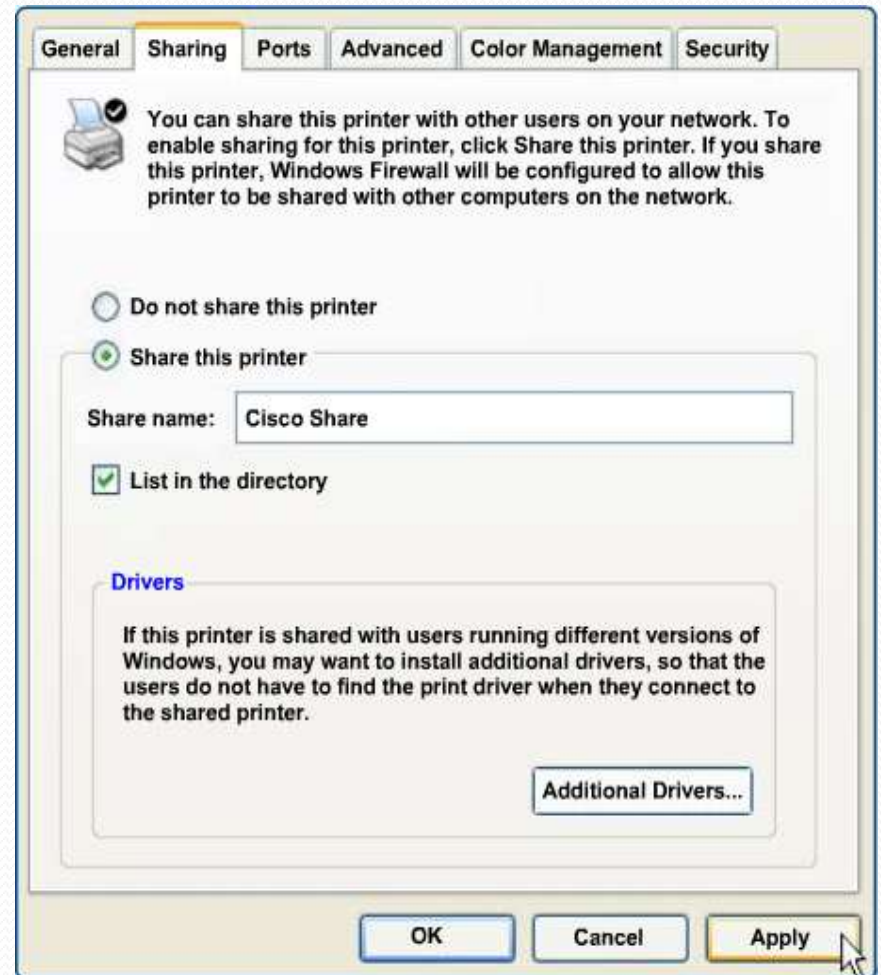
- Most optimisation is completed through the software supplied with the drivers
- Tools to optimise performance:
 - **Print spool settings** - Cancel or pause current print jobs in the printer queue.
 - **Colour calibration** - Adjust settings to match the colours on the screen to the colours on the printed sheet.
 - **Paper orientation** - Select landscape or portrait image layout.

Hardware Optimisation

- **Firmware** - a set of instructions stored on the printer to control how the printer operates. Check the manufacturer's homepage for the availability of new firmware.
- **Printer Memory** – upgrading memory increases the printing speed and enhances complex print job performance.
- Additional upgrades:
 - Duplex printing to enable dual-sided printing
 - Extra trays and/ or specialized trays
 - Network cards to access a wired or wireless network
 - Firmware upgrades to add functionality or to fix bugs

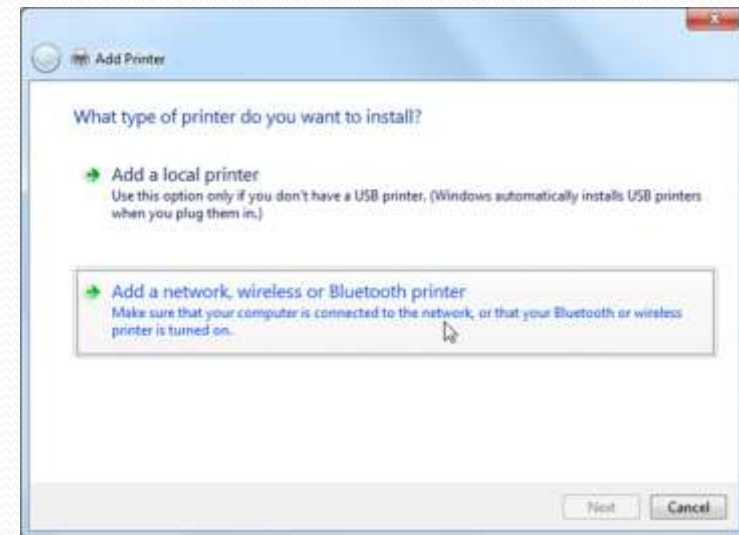
Shared Printers

- Sharing a single printer among a group of users costs much less than buying a printer for each computer.
- Low-cost printers usually require a separate **print server** to allow network connectivity.
- A computer that is connected to the printer can serve as the print server.



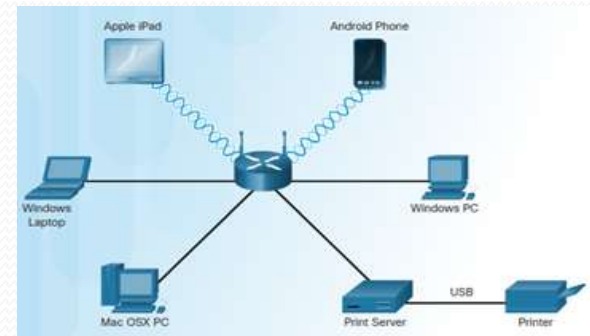
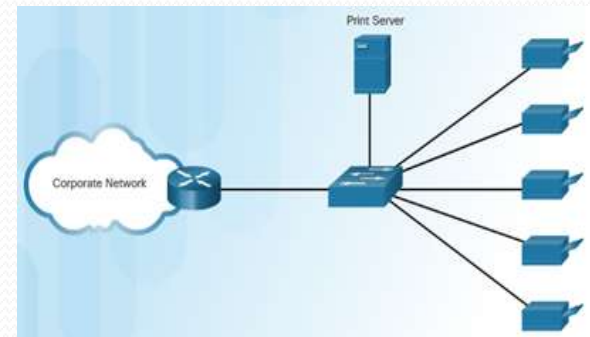
OS Settings for Sharing Printers

- Printers can be shared on a network or using wireless or Bluetooth connections.
- Printer sharing can be configured in the Network and Sharing Center in the Control Panel.
- Shared printers can be connected using wired or wireless methods.
- To connect to a shared printer, navigate to the Control Panel. Choose Printers or Devices and Printers to add a printer.



Print Servers

- A print server has three functions:
 1. Provide client access
 2. Administrate print jobs
 3. Provide feedback to the users
- There are three kinds of print servers:
 1. Network print server devices
 2. Dedicated PC print servers
 3. Computer-shared printers
- Windows allows computer users to share their printers with other users on the network. There are two steps:
 1. Configure the computer attached to the printer to share the printer with other network users.
 2. Configure a user's computers to recognise the shared printer and print to it.



Types of Scanners

- Working in IT, you may be required to purchase, repair, or maintain a scanner.
- The following are tasks that a customer may request:
 - Select a scanner
 - Install and configure a scanner
 - Troubleshoot a scanner



Scanners

- Scanners typically create an RGB image that can be converted into image formats such as JPEG, TIFF, Bitmap, PDF and PNG.
- Some scanners can create text documents using **optical character recognition (OCR)**.
- Resolution of a scanner is measured in **dots per inch (dpi)**. Like printers, the higher the dpi, the better the quality of the image.
- Interfaces and cables used for scanners are typically the same as those used for printers: Parallel, USB, SCSI, and Firewire.

All-in-one Scanners

- An **all-in-one** device combines the functionality of multiple into one physical piece of hardware (scanner, printer, copier and fax).
- Normally this type of devices are not expensive and easy to configure. Unfortunately they are usually not designed for heavy use and a single problem can affect all the functionality.
- Advantages:
 - All devices are built in
 - Low cost and easy setup
 - One upgrade for all devices
 - Uses one port for all devices
- Disadvantages:
 - One problem effects all devices
 - Not designed for heavy use



Flatbed Scanners

- Often used to scan books and photographs for archiving.
- For photos or other easily damaged originals and bound material, you need a flatbed.
- Image is acquired by placing the document face down on the glass. The scanner head lies beneath the glass and moves along the item, capturing the image.
- The glass should be maintained clean and protected from scratching.



Handheld Scanners

- A handheld scanner is small and portable, moved by hand over the material being captured.
- Handheld scanners are small and less expensive than their desktop counterparts but partially rely on the user's dexterity to move the unit across the paper.
- Mainly used for scanning barcodes.
- Pass the scanner head across the surface you want to scan.
- When you want to scan an item larger than the head of the handheld scanner, you must make more than one pass to capture the full image.



Drum Scanners

- Drum scanners produce a high-quality scanned image, but they are being replaced by lower priced, high-quality flatbed scanners.
- Still in use for high-end reproductions, such as archiving photographs in museums.
- To scan an image, you attach the image to a revolving drum or load it into a supporting canister.
- Drum is rotated at high speed across optical scanners. Optical scanners move slowly across the drum surface until the entire image is captured.



Portable Scanners

- For when on the road.
- Small devices powered by batteries.
- Save to an SD card.
- Transferring to your computer is done by using a cable or a wireless connection.
- Can be used as a desktop scanner taking up only half the space.



Installation and Config of Scanners

- An installation media includes drivers, manuals, and diagnostic software will be included with the scanner.
- The same tools may also be available as downloads from the manufacturer's website.



Installation and Config of Scanners

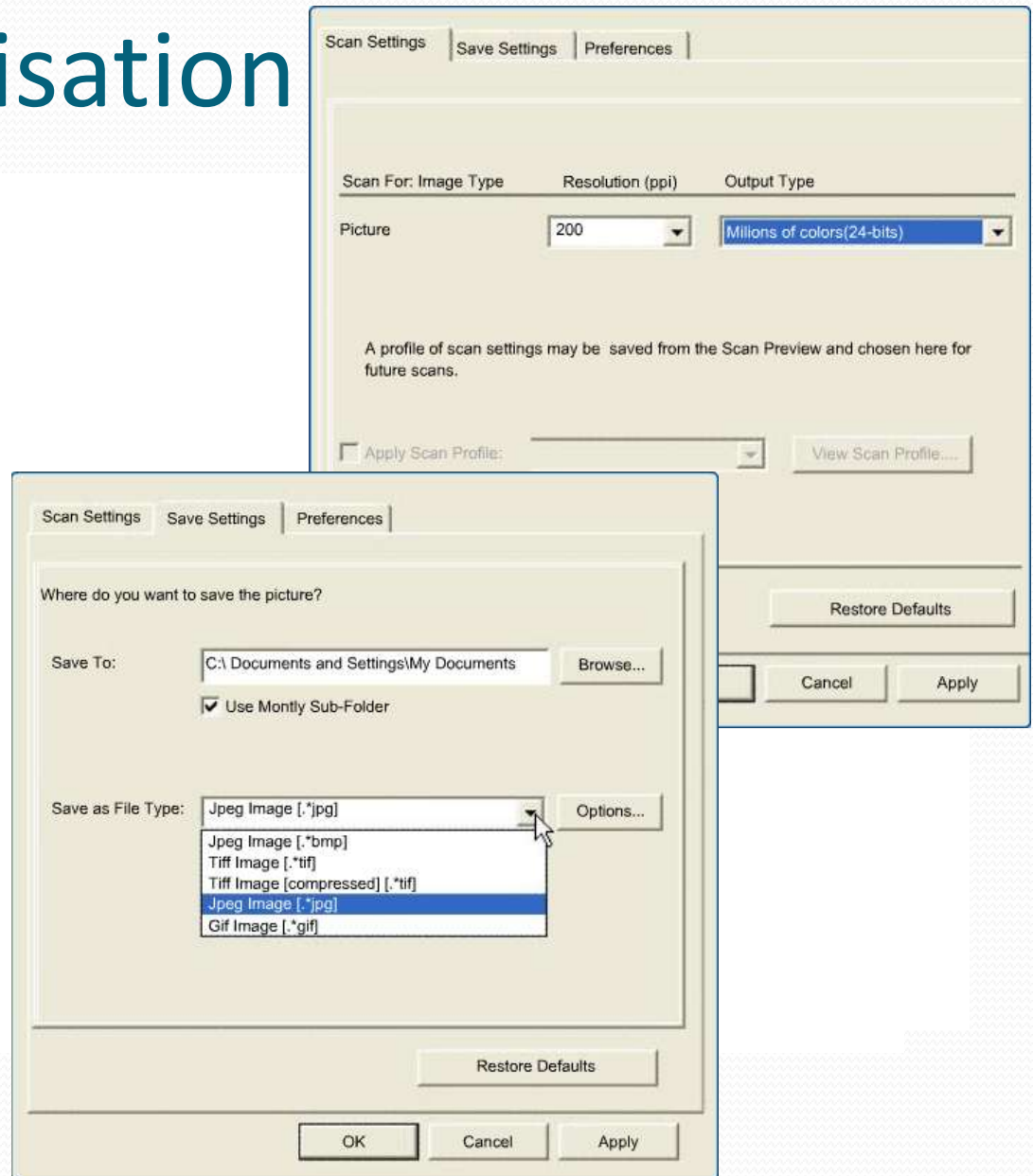
- Power and Connect the Scanner
 - Scanners can connect to a computer using a USB, FireWire, network, parallel port or a SCSI interface.
 - Warning: All-in-one devices that include printers must connect directly to AC power because of the heavy current demands of the printer.
- Scanner Driver
 - Printer driver is the software program that enables the computer and the printer to communicate with each other.
 - Once the scanner is connected and started, the computer operating system may be able to discover the scanner through the Plug and Play (PnP) process.
- Configuration Options and Default Settings
 - A scanner may come with applications such as Graphic software for editing photographs and other images or OCR software.
 - Some configurations that may be available on a scanner are:
 - colour, grayscale, or black-and-white scanning, One-touch scanning into your choice of software, Quality and resolution choices and Sheet feeders

Verify Functionality

- Installation is complete only after successfully testing all device functions.
- Print Test
 - Use the Print Test Page option from the printer.
 - Use the Print Test Page option from Windows.
 - Use the print function of an application.
 - Send a file directly to a parallel port printer using the command line.
- Scanner Test
 - Test the scanner by scanning a document.
 - Use the automatic scanning.
 - Initiate scans from the scanner software.
- All-in-one Test
 - Fax - Fax to another known working fax.
 - Copy - Create a copy of a document.
 - Scan - Scan a document.
 - Print - Print a document.

Scanner Optimisation

- Resizing
- Sharpening
- Brightening or darkening
- Colour correction
- Resolution changes
- Output file format
- Colour inversion



Preventive Maintenance Techniques

- Preventive maintenance decreases downtime, increases service, guarantees good quality prints, and ensures uninterrupted operation.
- Most manufacturers sell maintenance kits for their printers. For laser printers, the kit might contain replacement parts that often break or wear out:
 - Fuser assembly
 - Transfer rollers
 - Separation pads
 - Pickup rollers



Preventive Maintenance Techniques

- Printer Maintenance
 - Printers have many moving parts and require more maintenance than most electronic devices.
 - Also moving parts can be affected by dust and other particles.
 - CAUTION: Unplug the printer from the electrical source before beginning maintenance.

- Paper and Ink
 - Using the correct type of paper can help you to ensure that the printer operates longer and prints more efficiently.
 - Types of printer paper available include inkjet and laser. Some papers, especially photo paper and transparencies, have a right and wrong side marked by an arrow on the package.
 - Manufacturer will recommend the brand and type of ink to use. Do not refill ink cartridges because the ink may leak.

Preventive Maintenance Techniques

- Scanner Maintenance

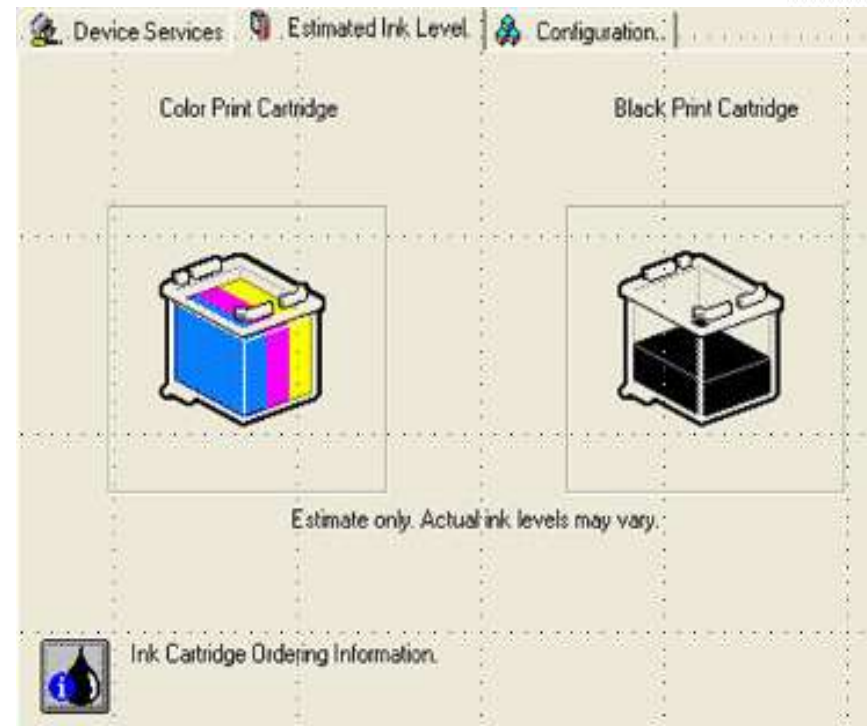
- The scanner surface should be kept clean. If the glass becomes dirty, consult the manufacturer's user manual.
- If the inside of the glass becomes dirty, check the manual for instructions on how to open the unit or remove the glass from the scanner.
- When the scanner is not in use, keep lid closed.
- Never lay anything heavy on a scanner.

Preventive Maintenance Techniques

- Clean printers and scanners regularly to avoid downtime, loss of productivity, and high repair costs.
- Cleaning methods
 - Printer maintenance:
 - Using a damp cloth wipe clean the exterior and the utility supplied with the printer to clean the print heads
 - On inkjet printers, clean the paper-handling machinery with a damp cloth.
 - Use a specially designed vacuum cleaner to clean a laser printer.
 - Scanner maintenance:
 - Using a damp cloth wipe clean the exterior.
 - On flatbed scanners, keep the lid closed when the scanner is not in use to prevent dust build-up and accidental fingertip smudges.
 - Consult the user guide for the manufacturer's cleaning recommendations of the glass.

Ink Cartridges and Toners

- When an inkjet printer needs ink, it produces blank pages.
- When a laser printer needs ink, it begins to print very poor-quality printouts.
- Some printers have LCD message screens or LED lights that warn users when ink supplies are low.
- You can set the printer software to reduce the amount of ink or toner that the printer uses.



Upgrade Printers and Scanners

- Some printers can be expanded to print faster and to accommodate more print jobs by adding hardware.



- Scanners can also be configured to do more to meet needs.

Printer Upgrades

- Upgrade printer memory:
 - Improves printing speed
 - Enhances ability to perform complex print jobs
 - Improves printer efficiency (Job buffering, page creation, photo printing, and graphics)
- Additional printer upgrades include:
 - Duplex printing to enable dual-sided printing
 - Extra trays to hold more paper
 - Specialised tray types for different media
 - Network cards to access a wired or wireless network
 - Firmware upgrades to add functionality or to fix bugs