The Scanner

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A **scanner** is an acquisition peripheral for scanning documents, i.e. converting a paper document to a digital image.
There are generally three types of scanner:

- **Flat scanners** let you scan a document by placing it flat against a glass panel. This is the most common type of scanner.
- **Hand scanners** are smaller in size. These scanners must be moved manually (or semi-manually) in successive sections over the document in order to scan the whole document.
- **Sheet-fed scanners** feed the document through a lighted slot in order to scan them, similar to fax machines. This type of scanner is increasingly built into machines such as multi-function printers.

There are also scanners that are able to scan specific items such as slides.

Characteristics of a scanner

A scanner is generally characterised by the following elements:

- **Resolution**: expressed in *dots per inch* (referred to as *dpi*), the resolution defines the fineness of the scan. The order of magnitude of the resolution is around 1200 per 2400 dpi. The horizontal resolution is very much dependent on the quality and number of captors, whereas vertical resolution is closely linked to the accuracy of the drive motor. However it is important to distinguish the optical resolution, which is the actual resolution of the scanner, from the **interpolated resolution**. Interpolation is a technique involving defining intermediate pixels from among actual pixels, by calculating the mean of the colors of neighboring pixels. This technology helps achieve good results but the *interpolated resolution* thus defined is in no way a criterion that can be used to compare scanners.
- **The format of the document**: depending on their size, scanners are able to accommodate documents of different sizes, generally A4 (21 x 29.7 cm), or more rarely A3 (29.7 x 42 cm).
- **Acquisition speed**: expressed in *pages per minute* (*ppm*), the acquisition speed represents the scanner's ability to pick up a large number of pages per minute. The acquisition speed depends on the document format and the resolution chosen for the scan.
- **Interface**: this is the scanner connector. The main interfaces are as follows:

- FireWire. This is the preferred interface since its speed is particularly suited to this type of peripheral
- USB 2.0. This is offered on all recent computers. It is a standard interface which is recommended if the computer has no FireWireconnection
- SCSI. Preferred interface for the scanner at the end of the 90s, the SCSI standard has now been abandoned in favor of the FireWire and the USB 2.0
- Parallel port. This type of connector is naturally slow and is used less frequently; it should be avoided if the computer has one of the preceding connectors

- **Physical characteristics**: other elements may be taken into account when choosing a scanner:
  - Size, in terms of the physical dimensions of the scanner.
  - Weight.
  - Electricity consumption, expressed in Watts (W).
  - Operating and storage temperatures.
  - Noise level. Scanners can be very noisy, and this may cause considerable disturbance.
  - Accessories: The drivers and user manual are usually provided, but you must check that connection cables are also provided; if not they must be purchased separately.

How a scanner works

The operating principle for a scanner is as follows:

- The scanner moves over the document line by line
- Each line is broken down into "basic dots" which correspond to pixels.
- A captor analyzes the color of each pixel
- The color of each pixel is broken down into 3 components (red, green, blue)
- Each color component is measured and represented by a value. For 8-bit quantification, each component will have a value between 0 and 225 inclusive.

The rest of this article will specifically describe the operation of a flat scanner, although the operating mode for a hand scanner or sheet-fed scanner is exactly the same. The only difference is in the feeding of the document.

A flat scanner has a motor-driven lighted slot which scans the document line by line under a transparent glass panel on which the document is placed, with the scanning side face down.

The high-intensity light emitted is reflected by the document and converges towards a series of captors via a system of lenses and mirrors. The captors convert the light intensities received into electrical signals, which are in turn converted into digital data by an *analogue-digital converter*.

There are two categories of captors:

- **CMOS** captors (*Complementary Metal Oxide Semi-conductor)*, or*Complementary MOS*). This is known as the **CIS** technology (*Contact Image Sensor*). This type of device uses an LED ramp (*Light Emitting Diode*) for lighting the document and requires a very close distance between the captors and the document. The *CIS* technology, however, uses a lot less energy.
- **CCD captors** (*Charge-coupled devices*). Scanners using *CCD* technology are often thicker as they use a cold neon lamp. The quality of the scanned image is on the whole better however, since the signal/noise ratio is lower.

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