

## Peripherals

**Peripheral** = any device attached (i.e. connected) to a computer

### Connections

#### wired connection



#### wireless connection



Three types of peripherals:

1. Input
2. Output
3. Storage

*Examples of the peripheral devices:* printer, scanner, webcam, keyboard, mouse, external HDD, NAS, microphone, speakers, headphones, projector.



Figure 1: Micro-B plug, a non-USB proprietary plug, Mini-B plug (5-pin, upside down), Standard-A receptacle (upside down), Standard-A plug, Standard-B plug

## Computer Bus

### Definition

A **bus**, in computing, is a set of physical connections (cables, printed circuits, etc.) which can be shared by multiple hardware components in order to communicate with one another.

The purpose of buses is to reduce the number of "pathways" needed for communication between the components, by carrying out all communications over a single data channel. This is why the metaphor of a "data highway" is sometimes used.

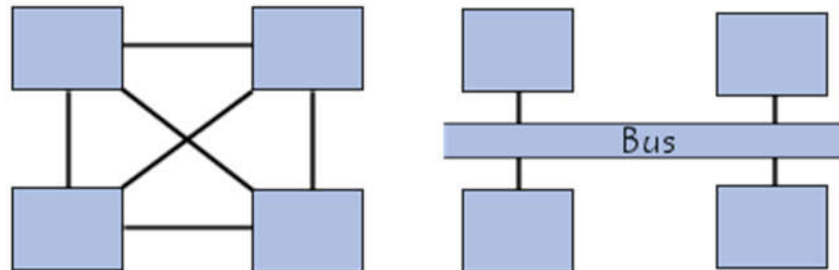


Figure 2: Comparison of separated pathways and connections over a common bus

If only two hardware components communicate over the line, it is called a **hardware port** (such as a **HDMI port**, **USB port** or **parallel port**).

### Characteristics

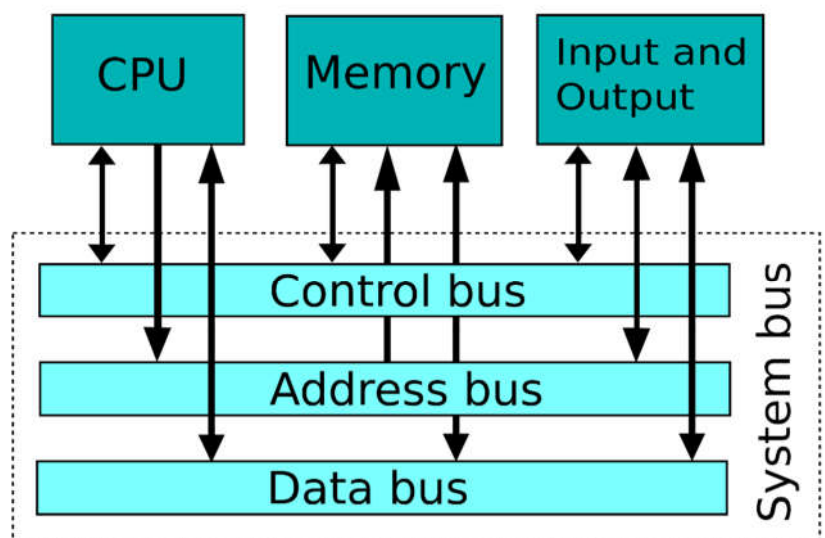
A bus is characterised by the amount of information that can be transmitted at once. This amount, expressed in bits, corresponds to the number of physical lines over which data is sent simultaneously. A 32-wire ribbon cable can transmit 32 bits in parallel. The term "**width**" is used to refer to the number of bits that a bus can transmit at once.

Additionally, the bus speed is also defined by its **frequency** (expressed in Hertz), the number of data packets sent or received per second. Each time that data is sent or received is called a **cycle**.

### Architecture

In reality, each bus is generally constituted of 50 to 100 distinct physical lines, divided into three subassemblies:

1. The **address bus** (sometimes called the *memory bus*) transports memory addresses which the processor wants to access in order to read or write data. It is a unidirectional bus.
2. The **data bus** transfers instructions coming from or going to the processor. It is a bidirectional bus.
3. The **control bus** (or *command bus*) transports orders and synchronisation signals coming from the control unit and travelling to all other hardware components. It is a bidirectional bus, as it also transmits response signals from the hardware.



## Controller

A controller is a chip, an expansion card, or a stand-alone device that interfaces with a peripheral device. It manages the overall interaction with the peripheral.

**Input/output controllers** receive input and output requests from the central processor, and then send device-specific control signals to the device they control. They also manage the data flow to and from the device. This frees the central processor from involvement with the details of controlling each device. Often the I/O controllers are part of the electronics on the main circuit board (the mother board) of the computer. Sometimes an uncommon device requires its own controller which must be plugged into a connector (an expansion slot) on the mother board.

I/O controllers are sometimes called **device controllers**. The **software that directly interacts** with a device controller is called a **device driver**. When you install a new device on your computer (say, a new graphics board) you must also install a device driver for it.

## Wired Connections

### USB



Name: **USB 3.0**

Max. speed: 5 Gb/s



Name: USB 2.0

Max. speed: 480 Mb/s

What can be connected: keyboard, printer, mouse

The newer kind can cause problems with WiFi and Bluetooth – WiFi and Bluetooth can be disturbed or completely eliminated.

## HDMI



What can be connected: TV, projector/beamer, cameras, laptops, smartphones, tablets

Max. speed: 18 Gb/s

It can carry both video and audio as well as the network connections.

## Wireless Connections

### WiFi



Version	Speed	Frequency Band	Number of channels	Approximate Range Indoors
<b>802.11g</b>	54 Mb/s	2.4 GHz	13 in EU	5 m
<b>802.11n (1 antenna)</b>	150 Mb/s	2.4 GHz	13 in EU	11 m
<b>802.11n (2 or more antennas)</b>	300 Mb/s 450 Mb/s	2.4 GHz 5 GHz	13 in EU 19 in EU	50 m 40 m
<b>802.11ac</b>	500 Mb/s to 5.3 Gbps	5 GHz	19 in EU	40 m

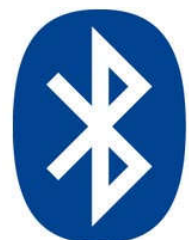
Mind the fact the real range heavily depends on the number, size, and material the obstacles between Wi-Fi nodes are made, as well as on the antennas and ambient noise.

### Bluetooth

Typical speed: 24 Mb/s MAX

Range:

- Class 1 – up to 100 m
- Class 2 (majority of Bluetooth devices) – up to 10 m





## Monitor

- an electronic device, which shows **instant** visible output
  - *instant – immediately changed*
- Newer types → **touchscreens** – they combine output and input.

Terms related to monitors:

- **screen** – the part of a monitor, which displays output
- **size** – screen diagonal measured in inches (1" = 2,54 cm) (examples: 19", 23")



- **display resolution** – the number of **pixels**, which are used to form the output (examples: 1920 x 1080, 1600 x 1200, 1280 x 800)



- **pixel** – a single point of the screen. It usually consists of 3 parts, which display **red**, **green**, and **blue** colour (RGB).



## Types

- **LCD** – light, thin, energy efficient
  - It employs tiny liquid crystals, which modify the polarisation of the passing light. The polarisation planes of the crystals can be controlled, thus changing the amount of already polarised light passing through them. The source of the backlight can be white LED diodes or old cathode tubes.
  - **TN** – cheaper, worse colours and viewing angle
  - **IPS** – more expensive, better colours and viewing angle



Figure 3: IPS and TN monitor (source: [http://www.teamliquid.net/forum/viewmessage.php?topic\\_id=326620](http://www.teamliquid.net/forum/viewmessage.php?topic_id=326620))

- **OLED** – latest type – instead of liquid crystals the image is formed by organic LED diodes – red, green, blue – which emit coloured light directly. Colours are vivid; however, it relatively quickly degrades in quality. On the other hand, it can form fully transparent display units.
- **CRT** – older, heavy, thick, flickering; it works better than LCD at different resolutions



## Connectors/Ports



Figure 3: VGA (D-SUB) connector



Figure 4: DVI connector



Figure 5: HDMI connector

## Printer

- It is a device which produces a permanent output – paper, foil
- Terms related to printers:
  - **print speed** – number of pages printed per minute
  - **print resolution** = number of points printed per inch – **pixels per inch = ppi** (150 ppi means average quality, 300 ppi for standard photo, 600 or 1200 ppi for extra high quality) – quite often is **ppi** confused with **dots per inch (dpi)**, but they don't mean the same thing.

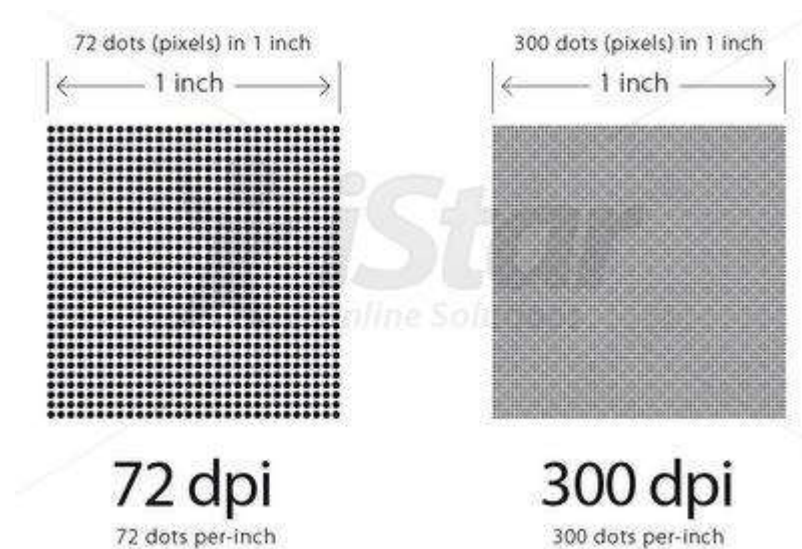


Figure 6: Comparison of print resolutions (in fact there should be 72 ppi vs 300 ppi)

- **duplex printing** – ability of the printer to print on both sides of a sheet
- **cartridge** – a container for **ink** (inkjet printers) or **toner** (fine powder for laser printers)
- **toner** – the powder, which is used to print in the laser printers

## Types of printers

- **Laser**
  - the fastest type, cheap printing, slightly more expensive printer;
  - laser printers produce ozone and nitrogen oxides, which are harmful
- **Ink-jet**
  - cheap printers, more expensive printing than in case of laser printer
- **Dot-matrix printers**
  - cheap and noisy
  - text only
- **Colours**
  - **Black & white** (black cartridge)
  - **Colour** (the primary colours are **Cyan**, **Magenta**, **Yellow**, and **Black** = **CMYK**).



- **Virtual printer** – a program, which pretends being a printer – when it is used for printing, it processes the output to make a PDF file ([CutePDF Writer](#), [PrimoPDF](#))
- **3D printer** – it prints objects instead of pictures
  - Examples: check these videos
    - <http://youtu.be/OiN8wNyLdTI>
    - <http://youtu.be/QnChn7vtWHU>
    - <http://youtu.be/c7GXgAm7sBo>

## Image Scanner

- Input device, which is used to convert 2D or 3D objects into a digital representation (picture, 3D model)
- **Types**
  - Image (2D) scanner (visible light, infrared light, microwave, ultrasound)
  - 3D scanner (mechanical contact, laser, microwave, ultrasound)
    - 3D scan video → <http://youtu.be/-7SH3zxDfdU>
- **Parameters**
  - **Maximal size of the original** (A4 scanner, A3 scanner ...)
  - **Maximal scan resolution** – how many points can be recognized – in **dots per inch (DPI)**
  - **Bit Depth** = how many color shades can be recognized - common:
    - 24 bits – 16.7 million colours
    - 48 bits –  $2^{48} \approx 3.10^{14}$  colours
  - **Speed of scan** = number of objects (e.g. pages), which can be scanned automatically – if available (mostly business class scanners)
- The result of a scan – **image/picture** – it cannot be edited in word processors (e.g. Microsoft Word). Editable document – by **OCR software (OCR = optical character recognition)**, e.g. Abbyy FineReader – it reads the picture and transforms it into a document.

## RGB vs CMYK

Computer monitors **emit** color as **RGB (red, green, blue)** light. Although all colors of the visible spectrum can be produced by merging red, green and blue light, monitors are capable of displaying only a limited gamut (i.e., range) of the visible spectrum.

Whereas monitors emit light, inked paper **absorbs** or **reflects** specific wavelengths. Cyan, magenta and yellow pigments **serve as filters**, subtracting varying degrees of red, green and blue from white light to produce a selective gamut of spectral colors. Like monitors, printing inks also produce a color gamut that is only a subset of the visible spectrum, although the range is not the same for both. Consequently, the same art displayed on a computer monitor may not match to that printed in a publication.

## Keyboard

- A plastic board with a set of keys, which symbolize letters, digits and other symbols as well as predefined functions used to control the behavior of the computer. The same keys can be interpreted in many ways (*keyboard layouts*), thus the same key can have different meanings (e.g. American English layout – a key above Q and W is '2'; the same key on case of Slovak keyboard is 'ľ').
- Keyboard can be attached
  - via USB
  - via PS/2
  - by a wireless connection
- Keyboard keys
  - **Alphanumeric keys** – all of the letters and numbers on the keyboard. A-Z and 0-9.
  - **Punctuation keys** – All of the keys associated with punctuation such as the comma, period, semicolon, brackets, and parenthesis ... .
  - **Special keys** – All of the other keys on the computer keyboard such as the function keys, control keys, arrow keys, caps lock key, delete key, etc.
    - **Ctrl key** – Short for Control, this key is used in conjunction with other keys to produce control characters. The meaning of each control character depends on which program is running.
    - **Alt key** – Short for Alternate, similar to the control key.
    - **Arrow Keys** – Most keyboards have four arrow keys to move the cursor (or insertion point) up, down, right, or left. Used in conjunction with the Ctrl or Shift keys, the arrow keys can move the cursor more than one position at a time or highlight some data, but this depends on which program is running.
    - **Backspace key** – Deletes the character just to the left of the cursor (or insertion point) and moves the cursor to that position.
    - **Caps Lock** – A toggle key that, when activated, causes all alphabetic characters to be uppercase.
    - **Delete Key** – Sometimes labeled *Del*, deletes the character at the current cursor position, or the selected object, but does not move the cursor.
    - **Enter Key** – Used to enter commands or to move the cursor to the beginning of the next line. Sometimes labeled Return instead of Enter.
    - **Esc Key** – Short for Escape, this key is used to send special codes to devices and to exit (escape) from programs and tasks.
    - **Function Keys** – Special keys labeled F1 to F12. These keys have different meaning depending on which program is running.

## Word-stock

wired connection	spojenie pomocou kábla
wireless connection	bezdrôtové spojenie
external HDD	externý pevný disk
webcam	webkamera
device	zariadenie
instant	okamžitý
screen	obrazovka
resolution	rozlíšenie
ink	atrament
microwave	mikrovlnný
ultrasound	ultrazvuk
ultrasonic	ultrazvukový
bit depth	bitová hĺbka
optical character recognition	optické rozpoznávanie znakov