# Communication of graphics devices with PC

RNDr. Róbert Bohdal, PhD.

# Overview of connection types with computer

- Serial Port
- Parallel Port
- PS/2 - Personal System
- USB (Universal Serial Bus)
- SCSI (Small Computer System Interface)
- FireWire (IEEE 1394 interface)
- Thunderbolt
- Bluetooth

- VGA (Video Graphics Array)
- DVI (Digital Visual Interface) – analog, digital, hybrid
- HDMI (High-Definition Multimedia Interface)
- DP (Display Port)

# Serial port

It was introduced in 1960.

- It belongs to the oldest type of connection.
- Data transfer is serial - only 1 bit at a given moment.
- It has very slow transmission speeds.
- It is used on devices that do not transfer much data: mice, joysticks, trackballs, touchscreens and tablets.

# Parallel port

*Centronics* introduced it in 1970.

- Transfers one byte at a time. Like the serial port, uses some wires for "control" signals.

- Used to transfer the average amount of data.

- It was mainly used by printers and scanners.

# Small Computer System Interface (SCSI)

It became the standard for *Amiga*, *Apple*, *Macintosh*, and *Sun Microsystems* in 1986.

- Data transfer was parallel, currently is serial.
- It allows to connect up to 16 devices, currently 16256.
- It is often used on disk arrays in servers.

| | | |
|---|---|---|
| SCSI-1 | – | 5 MB/s |
| Fast | – | 10 MB/s |
| UltraWide | – | 20 MB/s |
| Ultra2 | – | 40 MB/s |
| Ultra2 Wide | – | 80 MB/s |
| Ultra3 | – | 160 MB/s |
| Ultra-320 | – | 320 MB/s |
| Ultra-640 | – | 640 MB/s |
| SAS 1.1 | – | 300 MB/s |
| SAS 2.1 | – | 600 MB/s |
| SAS 3.0 | – | 1.2 GB/s |
| SAS 4.0 | – | 2.4 GB/s |

# PS/2 port

In 1987, it was introduced by *IBM*.

- Data transfer is serial.

- The transfer is slow and is only used to connect the keyboard and mouse to the computer.

- In 1993, IBM introduced a colored marking: pink for the keyboard and green for the mouse.

# FireWire

It was created by Sony, Apple, TI, DEC, IBM in 1995.

- It used serial data transmission up to 63 devices.
- It was mainly used for digital audio devices, video (DV cam), and data transfer from portable HDD even without CPU.
- Steve Jobs declared FireWire dead in 2008.

FireWire 400 –   50 MB/s

FireWire 800 – 400 MB/s

# Universal Serial Bus (USB)

In 1996, it was introduced by *Intel*, *Compaq*, *Microsoft*, *IBM* ...

- The data transfer is serial but it allows transmission at a higher speed than the previous types.
- Allows up to 127 devices to be connected to one USB host.
- It is versatile for many types of devices.
- It also provides power to devices.

USB 1.1  –     12 Mbit/s (1.5 MB/s)
USB 2.0  –   480 Mbit/s (60 MB/s)
USB 3.0  – 5000 Mbit/s (625 MB/s)
USB 3.1  – 10 Gbit/s (1.25 GB/s) type C
USB 3.2  – 20 Gbit/s (2.50 GB/s)

# Video Graphics Array (VGA)

It has been used since 1987 by IBM.

- Allows to transfer image signals from PC to monitor.

- It uses analogue transmission of three separate color components *R*, *G* and *B*.

- Other wires are used to control monitor. synchronization (H/V pulses) and information transfer.

# Digital Visual Interface (DVI)

It was created in 1999 by the *Digital Display Working Group*.

- There are various versions – DVI-D, DVI-A, DVI-I.
- Used to transfer binary images.
- When CRT was replaced with LCD, it replaced VGA connection.
- Does not use sync signals. Transfer is 1:1 (digital).
  - It is also used for data transmission:
    DDC – display data channel
    EDID – extended display identification data.



Data transfer:
4.95 Gbit/s (single) or 9.9Gbit/s (dual)

10

# High-Definition Multimedia Interface (HDMI)

It was created in 2002 by *HDMI Founders*.

- The signal is electrically compatible with *DVI*.
- It also allows audio transmission.
- It is used to connect digital audio/video devices (satellite receivers, bluray recorders, TV, ...).



Image transfer rate:
HDMI 1.0-2  – 3.96 Gb/s, 1920×1200p60
HDMI 1.3-4  – 8.16 Gb/s, 2560×1600p60
HDMI 2.0     – 14.4 Gb/s, 4096×2160p60
HDMI 2.1     – 42.6 Gb/s, 7680×4320p60

Sound transfer rate:
HDMI 1.0-4  – 36.86 Mb/s
HDMI 2.0     – 49.15 Mb/s
HDMI 2.1     – 49.15 Mb/s

# Display Port

It was created by the *VESA* Group in 2006.

- It is used to transfer image between PC and monitor.
- It also allows audio transmission and uses packet transfer.
- It is not compatible with DVI (HDMI), it has fewer pins but supports higher resolution.



Image transfer rate:
DP 1.0-1 –   8.64 Gb/s, 2560×1600p60
DP 1.2    – 17.28 Gb/s, 4096×2304p60
DP 1.3    – 32.40 Gb/s, 5120×2880p60
DP 1.4    – 32.40 Gb/s, 7680×4320p60

Sound transfer rate:
36.86 Mb/s (8 chanels, 24 bit, 192 kHz PCM)

# Comparison the types of graphics devices connected to PC

|  | **Serial** | **Parallel** | **PS/2** | **USB** | **FireWire** | **SCSI** |
|---|---|---|---|---|---|---|
| Touchscreens | Y |  |  | Y |  |  |
| Scanners |  | Y |  | Y | Y | Y |
| Printers/Plotters |  | Y |  | Y |  |  |
| Keyboards |  |  | Y | Y |  |  |
| Mice, Trackballs | Y |  | Y | Y |  |  |
| Joysticks | Y |  |  | Y |  |  |
| Tablets/Digitizers | Y |  |  | Y |  |  |
| Webcams |  |  |  | Y |  |  |
| HDD |  |  |  |  |  | Y |