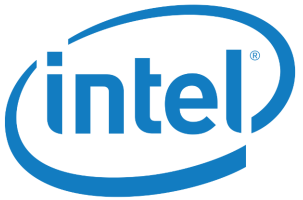


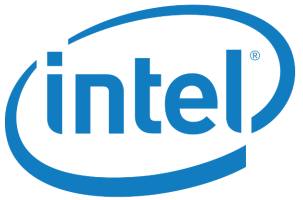
Embedded Systems

Peripheral Devices and their Interfaces

Rafal Kapela

June 26, 2016

Outline



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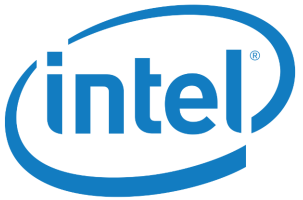

Peripheral device - basics

What is a peripheral device?

A peripheral is a piece of computer hardware that is added to a computer in order to expand its abilities.

The term peripheral is used to describe those devices that are optional in nature, as opposed to hardware that is either demanded or always required in principle.

Peripheral device - basics

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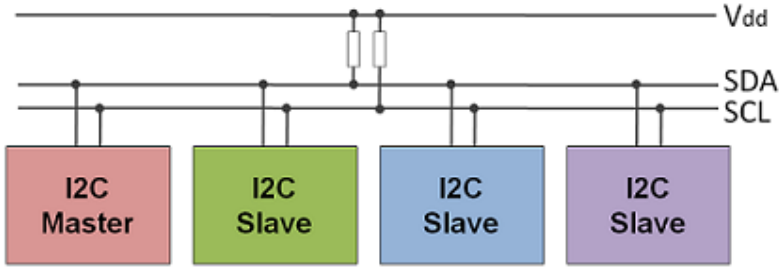
Peripheral device - basics

How does a peripheral device communicate with the host?

Usually (almost always) a peripheral device communicates with the host via some sort of a bus.



A bus is a subsystem that transfers data between computer components inside a computer or between computers.

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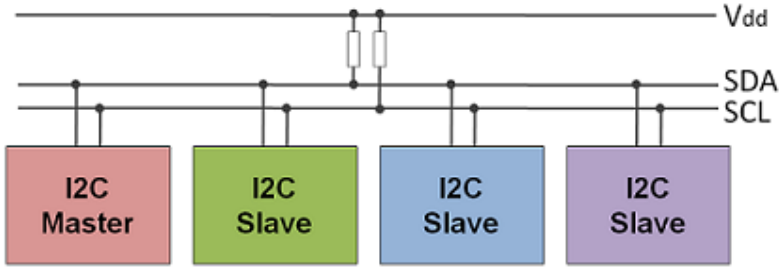

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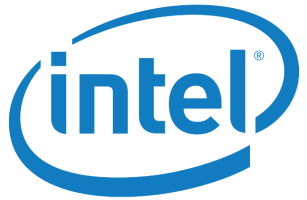
Peripheral device - basics

View on peripheral interfaces



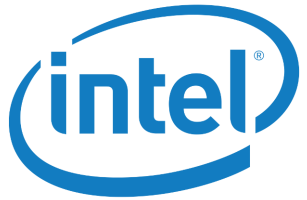
There is a wide range of communication interfaces for peripheral devices. The most commonly used are:

- I2C
- SPI
- PCI
- USB
- CSI
- ...

So which one to chose?

Peripheral device - basics

View on peripheral interfaces



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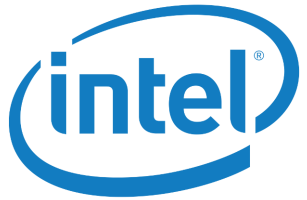
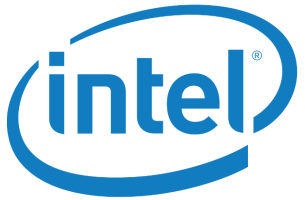


The correct choice of the interface is usually a function of:

- device interface,
- speed,
- availbility,
- price,
- user preference, etc.

Outline

Peripheral device - interfaces
PCI

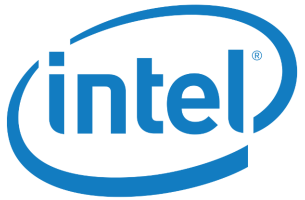


PCI (Peripheral Component Interconnect) is common in modern PCs. This kind of bus is being succeeded by PCI Express. Typical PCI cards used in PCs include:

- network cards,
- sound cards,
- modems,
- extra ports such as USB or serial,
- TV tuner cards,
- disk controllers.

Video cards have outgrown the capabilities of PCI because of their higher bandwidth requirements.

Peripheral device - interfaces
PCI



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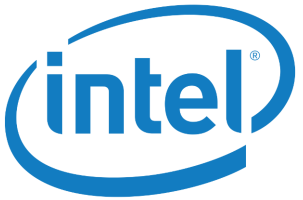
Peripheral device - interfaces

PCI-like interfaces



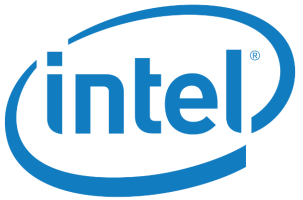
PCI Express was introduced by Intel in 2004. It was designed to replace the general-purpose PCI expansion bus and the AGP graphics card interface. PCI express is not a bus but instead a point-to-point conection of serial links called lanes. PCI Express cards have faster bandwidth then PCI cards which make them more ideal for high-end video cards.

Personal Computer Memory Card International Association (PCMCIA). It was originally designed as a standard for memory-expansion cards for computer storage.

AGP (Accelerated Graphics Port) is a high-speed point-to-point channel for attaching a graphics card to a computer's motherboard, primarily to assist in the acceleration of 3D computer graphics.

Peripheral device - interfaces

PCI-like interfaces



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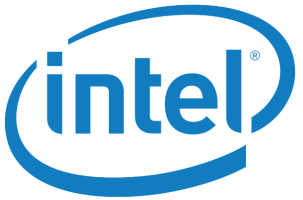

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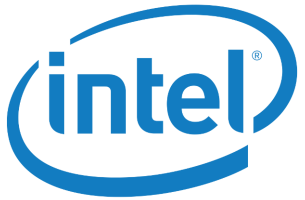
Peripheral device - interfaces
USB



USB (Universal Serial Bus) is a serial bus standard to interface devices. USB was designed to allow many peripherals to be connected using a single standardized interface socket and to improve the plug-and-play capabilities by allowing devices to be connected and disconnected without rebooting the computer. Other convient features include providing power to low-consumption devices without the need for an external power supply and allowing many devices to be used without requiring manufacturer specific, individual device drivers to be installed. USB is by far the dominating bus for connecting external devices to your computer.

Peripheral device - interfaces

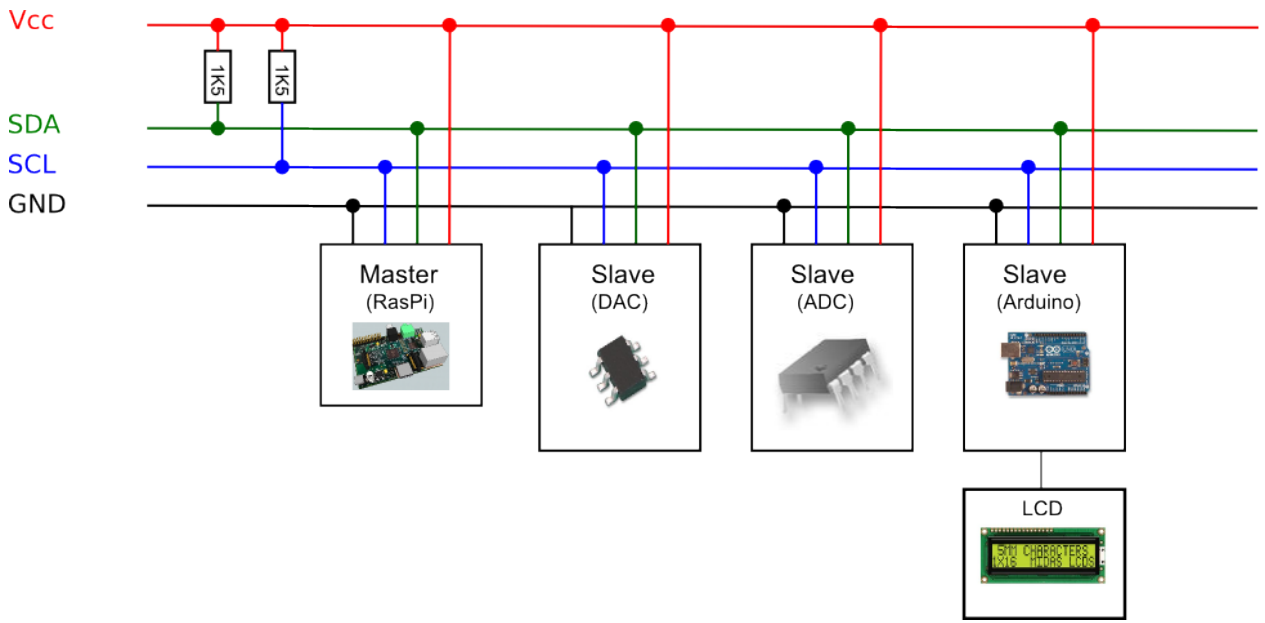
FireWire

Firewire (technically known as IEEE 1394 and also known as i.LINK for Sony) is a serial bus interface standard for high-speed communications and isochronous real-time data transfer, frequently used in a personal computer. Firewire has replaced Parallel ports in many applications. It has been adopted as the High Definition Audio-Video Network Alliance (HANA) standard connection interface for A/V (audio/visual) component communication and control. Almost all modern digital camcorders have included this connection.

Peripheral device - interfaces

I2C

I2C was originally developed by Philips (now nxp) and is used in all sorts of equipment including virtually every tv, monitor and computer motherboard. I2C is a flexible protocol but has fairly limited bandwidth.



Peripheral device - interfaces

I2C - details

I2C features:

- 4-wire interface (2 for data, 2 for power),
- if there is aupport for additionnal interrupts there can be morer wires,
- up to 127 devices,
- master-slave interface (in theory),
- fairly limited bandwidth - standard speed: 100 kbit/s, full speed: 400 kbit/s, fast mode: 1 mbit/s, high speed: 3,2 Mbit/s.

Peripheral device - interfaces

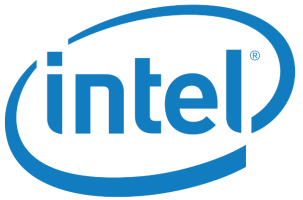
I2C - details

I2C devices:

- Digital-to-analogue converters (DACs),
- Analogue-to-digital converters (ADCs),
- LCD displays/monitors,
- Keyboards,
- Motor drivers,
- LED drivers,
- Memory chips and cards (EEPROM, RAM, FERAM, Flash),
- bus expanders/extenders (chips with 8 or 16 I/O pins controllable via I2C),
- other microcontrollers.

Peripheral device - interfaces

SPI



The SPI interface was originally developed by Motorola (now Freescale). SPI is much simpler than I2C. Master and slave are linked by three data wires, usually called MISO, (Master in, Slave out), MOSI (Master out, Slave in) and M_CLK.

As the names suggest, the M_CLK line carries clock pulses which provide synchronisation. When a transfer is taking place, a bit of data is transferred via MOSI from Master to slave and at the same time a bit of data is transferred via MISO from Slave to Master.

Peripheral device - interfaces

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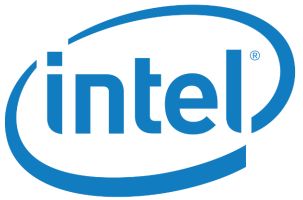

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About the course

Literature

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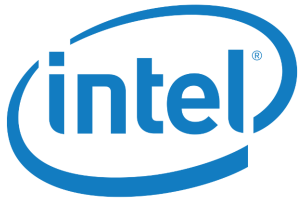

Questions ?

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