

UNIVERSITÉ DE GENÈVE

Communication Multimédia

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Multimedia Technologies

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Information systems for multimedia applications

- Two categories
 - Personal (home) multimedia systems
 - Professional multimedia systems

Personal multimedia systems

- Based on PCs + widely -available standard equipment

Professional multimedia systems

- Based on computers of medium and high power and professional equipment

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Information systems for multimedia applications

- Why hardware ?*
 - Speeding-up the execution time
real-time processing of graphics, audio and video cannot be supported by standard PC
 - For capturing the content
ex scanners, digital cameras, microphones
recall : the goal of PC is *personalisation*
It is possible to install programs + components / peripherals according to the user's wishes

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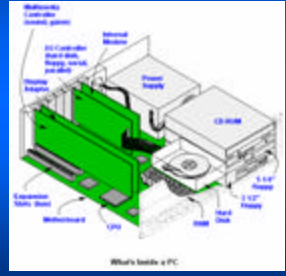
Information systems for multimedia applications

- Additional hardware for speeding-up needed
 - Example: screen HDTV refreshes 60 times / sec
Frame 2048 x 2048 pixels X 24 bits x 60 times
 - Frame is stored in the machine's memory
 - Projection of the frame is necessary but the access to the memory needs to be $2048 \times 2048 \times 24 \times 60 = \sim 6 \text{ Gbit/sec} !!!$
 - For processor de 600 MHz
executing 600 millions instructions / second or
600 millions memory access per second
 - If an access returns always 32 bits
This makes speed of the access = 17,88 Gbits / sec
So, PC needs additional processor for screen refreshment
not to loose half of its time for the memory access!!!

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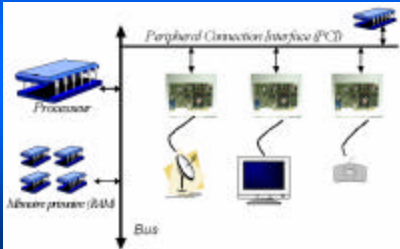
- PC underneath*
 - processor (CPU)
 - clock
 - main memory
- the addition of
control units
input, output and
storage devices
and
operating system



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Information systems for multimedia applications

PC underneath - communication



The diagram illustrates the internal communication of a PC. A central horizontal line represents the **Bus**. Above the bus, a **Processor** is connected. Below the bus, **Main memory (RAM)** is connected. To the right, a **Peripheral Connection Interface (PCI)** connects the bus to various peripheral devices, including a monitor, keyboard, and mouse.


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Information systems for multimedia applications

components

Processor – Central Processing Unit (CPU)

- “engine” of the computer executing instructions
- made up of the Control Unit and Arithmetic-Logic Unit (ALU)



The images show the progression of computer hardware. The first image, labeled **1957**, shows a room filled with large cabinets of vacuum tubes. The second image, labeled **1987**, shows a single integrated circuit chip. The third image, labeled **today**, shows a modern, small microprocessor chip.


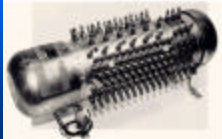
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Information systems for multimedia applications

components

Random-Access Memory (RAM) – primary memory

- computer's primary workspace
- contain all data manipulated by the processor at the moment
- allows for random access and data manipulation
- RAM chips require power to maintain their content


Before chips, RAM was made of tubes of pulsating mercury as well as magnetic drums and cores.
 magnetic drum unit - memory in the IBM 650 - 1954.
 capacity: 2000 x 10-digit words

Information systems for multimedia applications

Ports

components

- Ports in PC allow communication between processor and peripherals
- External equipment
- Parallel port allows transmission of multiple bits together used by printers and external HDD drive
- Peripherals that need high bit rate
- Serial port transmits bit by bit used by mouse, modems
- We wish to connect PC with many peripherals independent of the number of ports, with high data speed



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Information systems for multimedia applications

components

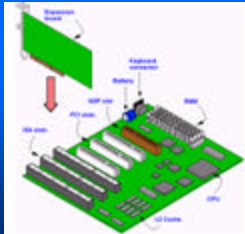

PC bus – common pathway CPU ↔ peripheral devices

- Parallel buses** use slots on the motherboard + provide multiple lines for data (8, 16, 32 etc.) between CPU and peripheral card
 - ISA - Industry Standard Architecture
 - PCI - Peripheral Component Interconnect
 - AGP - Accelerated Graphics Port
 - Obsolete:
 - Micro Channel (MCA) // Extended ISA (EISA) // VESA Local Bus (VL-bus)
- Serial buses** have external ports + cable that plugs into them can connect to multiple devices
 - USB - Universal Serial Bus
 - FireWire (IEEE1394)

Information systems for multimedia applications

components

I/O buses: ISA & PCI & AGP

The diagram shows the evolution of PC buses. It lists ISA, EISA, PCI, AGP, and VL-bus. A red line is drawn across the diagram, indicating that these buses are obsolete.

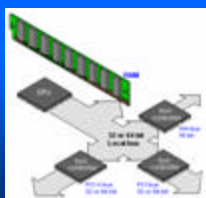
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Components

Peripheral Connection Interface (PCI) - most common I/O bus used today

- bus connecting processor with peripherals
- runs at 33MHz or 66MHz
- supports 32 and 64-bit data paths
- most PCs have PCI slots + one AGP slot for display adapter



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Components – graphics card

- Cards' memory stores the values of pixels
- bus connects card with CPU enabling receiving instructions
- video interface connects card with the screen
- NVIDIA graphic card with memory and dedicated processor



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Components – graphics card

- The simplest cards are buffers storing values of pixels
- Le processor makes some image out of these pixels
For example the 3D effect is not high quality
- For this reason there are graphics cards with processor specialised for processing of the graphics
 - ? co-processor or accelerator can process millions of pixels per second

Information systems for multimedia applications Accelerated Graphics Port (AGP)

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- PCI allows for data transfer 132 MB/sec between the primary memory and card memory
Still too less for 3D graphics
 - 3D image need much more info than 2D image
- AGP is a graphics port working directly with a primary memory of the machine
 - No need to copy of data between card memory and primary memory
 - Developed by Intel, AGP work at speed 133 MHz, 32b data bus
 - allows for data transfer :
 - AGP 1x ≈ 264 Mbytes/sec, AGP 2x ≈ 528 Mbytes/sec
 - AGP 4x ≈ 1 Gbyte/sec, AGP 8x ≈ 2 Gbytes/sec

Information systems for multimedia applications Accelerated Graphics Port (AGP)

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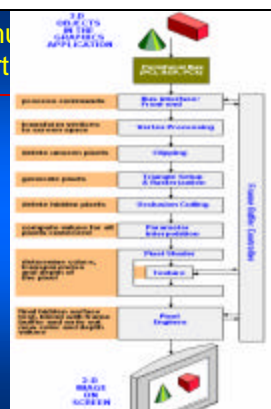
Graphics Processing Unit (GPU) is graphics accelerator

- built-in hardware functions for 2D operations : line draw and pixel block moves
- For 3D - texture mapping and shading
- for video - color space conversion and hardware scaling
- For gamers ≈ realtime photorealistic rendering
- Difficulty ≈ human skin and facial expressions

Information systems for multimedia applications Accelerated Graphics Port (AGP)

Graphics Processing Unit (GPU)

- process of turning objects and images in 3D application ≈ into corresponding image on screen involves multiple stages of processing



Information systems for multimedia applications USB

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- Universal Serial Bus (USB) developed in 1997 by Intel
- Goal of USB is
 - Connect low-speed peripherals such as the keyboard, mouse, joystick, scanner, printer and telephony devices to PC
 - connect simultaneously up to 127 peripherals to PC
 - Offers maximum bandwidth of 12 Mbps
- Nowadays each PC has port USB
 - Most of peripherals have USB port to connect to PC
 - Think of digital cameras, modems and network cards

Information systems for multimedia applications USB hub

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- hub allows for the connection of multiple peripherals in the same port
- These peripherals may be powered by PC
- Many hubs can be connected together for connection of more number of peripherals



Information systems for multimedia applications USB hub in practice

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Universal Serial Bus (USB)



Information systems for multimedia applications USB hub

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- "hot swap" capability = plug and play without restarting Windows – connect or disconnect at any time
- low-power devices can be powered through the USB cable
- USB 2.0 is available
 - hi-speed USB - 480 Mbps
- Tree transmission modes
 - By Interruption like keyboard, mouse ...
 - By Blocks like printers – blocks 64kBytes
 - Simultaneous like digital camera



Information systems for multimedia applications IEEE 1394 (Firewire)

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- Another serial standard for connection of peripherals (video) to PC
- Started by Apple, then taken over by Institute of Electronic and Electrical Engineers (IEEE) as standard
 - Standard for transfer of big amounts of data, high-speed
 - Speed 100, 200, 400 Mbps up to 4.5 meters
 - Up to 63 peripherals per connection (connected in a chain)
 - widely used for downloading video from digital camcorders to the computer
 - Supports hot-swapping, multiple data speeds on one line



Information systems for multimedia applications USB versus Firewire

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- Standards 'war' ?
 - 2 technologies are similar
 - Difference is between the approach of industrial consortiums

Feature	Firewire	USB
Data Transfer Rate	400 Mbps	1.5 Mbps / 480Mbps
Number of Devices	63	127
Plug and play	Yes	Yes
Hot plugging	Yes	Yes
Simultaneous devices	Yes	Yes
Bus power	Yes	Yes
Bus termination required	No	No
Bus type	Serial	Serial
Cable type	Twisted pair (8 wires: 2 power, 2 twisted pair sets)	Twisted pair (4 wires: 2 power, 2 twisted pair sets)
Interconnectable	Yes	Yes
Network topology	Star-chain	Hub

Information systems for multimedia applications



- **DVI (Digital Visual Interface), 1991,** standard to communicate between PC (graphic card) and screen, data projectors, plasma displays, digital TVs (DTVs)
 - converts signal digital / analogue / digital ⚡ with some signal loss
 - signal stays digital until the graphics memory ⚡ signal is coded in pixels at the screen
 - may include HDCP (High-bandwidth Digital Content Protection) - encryption method for safeguarding copyrighted material
- **DVI allows for transmission up to**
 - 4.9 Gbit/s (single link)
 - 9.9 Gbit/s (double link)

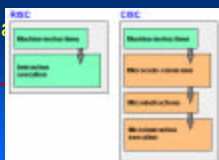
Information systems for multimedia applications



- **VGA (Video Graphics Array)**
The video display standard for PC, 1987
- transition from VGA to DVI is ongoing, display adapters support both interfaces



Information systems for multimedia
personal multimedia systems



- Dominant technologies
 - CPU x86 (Intel and clones)
(example: Pentium)
with Windows OS (95/98/NT/XP)
 - PowerPC (Macintosh) with Mac OS
 - RISC (reduced) & CISC (complex instructions' list)
- Other
 - PCs (x86) with Linux or BeOS
 - BeOS - object-oriented operating system that supports multiprocessing and multithreading, designed for multimedia applications, including 3D graphics

Information systems for multimedia applications:
personal multimedia systems

- ✦ CPU x86 comparison
- ✦ Floating point methods – used for calculating large range of numbers quickly

[illegible]

Information systems for multimedia applications

Advantages and disadvantages

Systems based on x86 (PCs with windows)

- Low cost (complete set with CPU 1.6GHz ~1200 CHF)
- Large number of peripheral multimedia add-ons
 - Good quality PCI cards for audio / video
 - Small video camera with serial input
 - External devices (joy stick, gloves, etc.) at low cost
- Large number of applications available (from free to thousands of CHF)

Information systems for multimedia applications

Disadvantages of PC

- Windows 95/98/XP *is* not a stable system
 - Too many bugs
 - New versions are not compatible with older
 - Security problems (viruses)
- Third part add-ons (install and bless !)
 - Incompatibility of drivers (you load a new driver and older device no longer works)
- Emerging technology
 - Linux is more stable **but** very few drivers for cards and applications are available today comparing to Windows
 - BeOS available **but** even less elements available than for Linux, this OS is designed for multimedia

Information systems for multimedia applications personal multimedia systems

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Macintosh systems

- The oldest surviving OS to incorporate multimedia functionalities
- The choice system for professionals in the areas of photocomposition, photo-editing, magazines etc



1984



today

Information systems for multimedia applications personal multimedia systems

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Macintosh systems

Advantages

- Stable platform
- Intuitive and simple user interface
- Minimum maintenance
- Availability of high quality professional software (ex. QuarkExpress, PhotoShop)
- Nice design

Information systems for multimedia applications personal multimedia systems

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Disadvantages of Macintosh

- High cost comparing to PCs) (but falling!)
- Low availability of external (third party) hardware devices
- Advanced multimedia applications are ported on Macintosh much later from the time they are available on PC