

**Czech University of Life Sciences Prague  
Faculty of Economics and Management  
Department of Information Engineering**



**Bachelor Thesis**

**Optimalization of PC based on user requirements**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Department of Information Engineering

Faculty of Economics and Management

## BACHELOR THESIS ASSIGNMENT

Akzhol Doshimov

Informatics

Thesis title

**Optimization of PC based on user requirements**

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### **Objectives of thesis**

The aim is to summarize the current range of computer components and propose the selection procedure for optimal PC. On the basis of supporting documents to describe the optimal solutions to computer configurations according to the requirements and methods of their use.

### **Methodology**

Methodology of this thesis is based on the literature review, analysis and study of various information sources. The following step is the definition of basic criteria for the use of ICT and basic needs of the end-user.

This work has the task of present procedure: the reports characterized by different requirements for working focus, performance and price.

**The proposed extent of the thesis**

Approximately 50 pages

**Keywords**

Personal computer, processor, motherboard, graphics cards, monitor, memories, end-user

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**Recommended information sources**

ALPERN, N.J.; ALPERN, J.; MULLER, R., IT Career JumpStart: An Introduction to PC Hardware, Software, and Networking. New York: John Wiley & Sons, 2012. 336p. ISBN: 1118206150.

Computerworld (Selection)

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TITTEL, E.; CHIN, M., Build the Ultimate Home Theater PC. New York: John Wiley & Sons, 2009. 420 p. ISBN: 0470616873.

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**Ing. Martin Pelikán, Ph.D.**

Dean

Prague on 20. 03. 2015

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## **Declaration**

I declare that I have worked on my bachelor thesis titled "Optimalization of PC based on user requirements" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any third person.

In Prague on 16.03.2015

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**Akzhol Doshimov**

## **Acknowledgement**

I would like to thank, doc. Ing. Prokop Toman, CSc., for his advices and support during my work on this bachelor thesis.

## Optimalizace počítačové sestavy na základě požadavků uživatele

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### Optimization of PC based on user requirements

#### Souhrn

Tato práce představuje přehled o hardwarových součástích s aktuálně používaných technologií. Objasnění jejich specifikace, stručně jejich rolí a funkcí. Základem bylo ukázat některé řešení počítačových sestav podle požadavků a způsobů jejich použití. První bude kancelářský přístroj. Jako druhý kanceláře budou analyzovány pro použití v domácnosti a rodině a poslední výkonný herní stroj. Praktická část obsahuje informace pro výběr správné komponenty, návrh přemýšlet o jistých věcech ještě před nákupem sestavy a vyber komponent pro uvedené konfigurace na základě požadavků.

#### Summary

This work presents an overview of hardware components with currently used technologies. Clarification of their specifications, briefly their roles and functions. The basis was to show some solutions to computer configurations according to the requirements and methods of their use. The first will be an office machine. As a second office will be analyzed for the household and family use and last a powerful gaming machine. Practical part contains information for selection the right components, suggestion to think about certain things before buying an assembly and choose of components for specified configurations based on requirements.

**Klíčová slova:** Osobní počítač, procesor, základní deska, grafické karty, monitory, paměti, konečný uživatel

**Keywords:** Personal computer, processor, motherboard, graphics cards, monitor, memories, end-user

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# 1 Introduction

The problem of selecting the optimal computer assembly is today more relevant than ever. When personal computers began, there was no choice not nearly as many components as today. Previously, it was not so difficult to choose the assembly. Neither the technology was not so much to choose from. But with time, the market for computers and their components greatly expanded. Technology has evolved disappeared, creating new. Nowadays, it is an incredible amount of options. This is also linked to the difficulty of choosing between them. For the uninitiated normal user, even though it knows it is very hard to choose the right set of best products available. You can meet in stores descriptions assemblies and components of the computer from which we learn most needed. Often, however, a different matter and description of components and assemblies is deplorable. Descriptions are often made so that the product looked good on paper. Nicknames as powerful and fully adequate to the needs of today's further enhanced by this feeling, although he often pass true. Now issue the correct selection of reports based on established selection criteria have long been interested in the author of this work. During the whole university study in this perfected. Whether it was because of the studied topics or self-study. Computer hardware is one of his biggest hobbies and suddenly it was his task to find just the optimal solution for different types of users. Therefore author chose this topic. A topic that is very interesting and still relevant, since computers enter our lives more and more, and this trend is just not going to stop.

## **2 Main goal**

The aim of this work is to describe in detail the architecture and history of the individual components. The aim is to summarize the current range of computer components and technologies. Clarify the scope of work, briefly their functioning and most importantly, what they mean to their individual functions and parameters for the user. On the basis of these documents is also to show some solutions to computer configurations according to the requirements and methods of their use. The first will be an office machine. As a second office will be analyzed for the household and family use and last a powerful gaming machine.

## **3 Methodics**

The first part is dedicated primarily to create an overview of existing facilities and technologies. For general principles of their functioning was often used effectively literature in book form. The majority, however, lags far behind the development. For example, in the book of the year 2009 focused on hardware, we find only a portion of the technologies that are now widely available. It is due to the enormous speed of developments in this sector. Therefore it was necessary to also focus on other publications, often in electronic form. The first part of this work was drawn from a combination of sources.

In the practical part, the author used primarily collected and analyzed information recorded in the first part of this work. His experience in selecting hardware and own knowledge gleaned during university studies are also to some extent utilization. Based on this knowledge and experience is designed several sets according to current criteria. These reports are characterized by different requirements for working focus, performance and price. For better orientation in today available hardware and its prices, it was also necessary to turn to specialized online stores.

## 4 Overview of current technologies and their specifications

### 4.1 Cases

PC cases are available in a bewildering array of sizes, shapes, and prices. Form factor is the most important thing about a case because it determines which motherboards and which power supplies fit that case. [1]

#### 4.1.1 Distribution of cases

Cases are available in the following form factors:

- Low-profile desktop: 1x5.25" and 2x3.5" external, 2x3.5" internal
- Desktop: 2x5.25" and 2x3.5" external, 3x5.25" and 3x3.5" internal
- Micro-tower: 1x5.25" and 2x3.5" external, 2x3.5" internal, micro-ATX motherboards
- Mini-tower: 2x5.25" and 3x3.5" external, 2x5.25" and 1-4x3.5" internal, micro-ATX, ATX
- Mid-tower: 2x5.25" and 4x3.5" external, 3x5.25" and 1-5x3.5" internal, micro-ATX, ATX
- Full-tower: 3-12x5.25" and 2x3.5" external, 1-8x5.25" and 1-8x3.5" internal, micro-ATX, ATX, E-ATX

Cases are available in a variety of sizes and orientations, including low-profile desktop, standard desktop, micro-tower (for microATX boards), mini-tower, mid-tower, and full-tower. Low-profile cases are popular for mass-market and business-oriented PCs, but we see little purpose for them. They take up more desk space than towers, provide poor expandability, and are difficult to work on. Micro-tower cases take very little desk space, but otherwise share the drawbacks of low-profile cases. Mini/mid-tower styles—the dividing lines between them are nebulous—are most popular because they consume little desktop space while providing good expandability. Full-tower cases are what we really prefer. They take up no desk space at all, and are tall enough that CD-ROM, tape, and other external drives are readily accessible. Their cavernous interiors make it very easy to work inside them, and they often provide better cooling than smaller cases. The drawbacks of full-tower cases are that they are more expensive than other cases, sometimes

significantly so, and that they may require using extension cables for keyboard, video, and/or mouse. [1]

## **4.2 Motherboards**

The motherboard is the heart of a PC. Some manufacturers use the terms system board, planar board, baseboard, or main board, and Intel calls its motherboards desktop boards. No matter what you call it, the motherboard defines the PC. It provides the common link to all other components inside the PC, including the CPU, memory, disk drives, video and sound adapters, keyboard, mouse, and other peripheral components. If you are building a PC, choosing the motherboard is the most important decision you make and can be one of the most difficult. If you are upgrading a PC, replacing the motherboard is often the best and most cost-efficient means of doing so. If you are buying a PC, the motherboard it uses determines its functionality and future upgradability. [1]

### **4.2.1 Types of motherboards**

#### **a) AT**

The AT form factor is the oldest and the biggest form factor. It was popular until the Baby AT was released, which was around the time of the 386 processor (1992-93). The reason that prompted the Baby AT was the width of the AT (12") and the fact that the board was difficult to install, service, and upgrade. [15]

#### **b) BT**

The Baby AT was the standard in the PC industry from roughly 1993-1997. It is still being used today, usually in Pentium class products.

Some issues with the AT and Baby AT design is the location of the features on the board. The CPU socket is placed so that it may interfere with longer bus cards. In some designs the memory sockets are similarly placed. This can limit the amount and selection of peripheral cards you can install. Also the IO ports are separate and mounted on the case and connected to pin-outs on the motherboard. These are usually located near the floppy and IDE pin-outs and can result in quite a jumble of ribbon cables. [15]

#### **c) ATX**

ATX was developed as an evolution of the Baby AT form factor and was defined to address four areas of improvement: enhanced ease of use, better support for current and

future I/O, better support for current and future processor technology, and reduced total system cost.

The ATX is basically a Baby AT rotated 90 degrees and providing a new mounting configuration for the power supply. The processor is relocated away from the expansion slots, allowing them to hold full length add-in cards. The longer side of the board is used to host more on-board I/O. The ATX power supply, rather than blowing air out of the chassis, as in most Baby AT platforms, provides air-flow through the chassis and across the processor. [15]

**d) Mini-ATX**

This form factor is basically the same as ATX with a smaller allowable board size.

- ATX = 12" x 9.6"
- Mini-ATX = 11.2" x 8.2". [15]

**e) MicroATX**

This form factor was developed as a natural evolution of the ATX form factor to address new market trends and PC technologies. MicroATX supports:

- Current processor technologies
- The transition to newer processor technologies
- AGP high performance graphics solutions
- Smaller motherboard size
- Smaller power supply form factor. [15]

**f) FlexATX**

A subset of the microATX design. FlexATX offers the opportunity for system developers to create many new personal computer designs. FlexATX allows enhanced flexibility where conforming motherboards may be enclosed; that is, all-in-one computing devices, LCD-personal computers, or standard desktop systems.

This form factor is designed to allow very custom case and board designs to be manufactured. For example; The NBA could commission computers that looked like basketballs. There is not too much limit on the shape of the board and case. We should see some very interesting system designs emerging from this form factor.

Supports current socketed processor technologies:

- Smaller motherboard size

- ATX 2.03 I/O panel
- Same mounting holes as microATX
- Socket only processors to keep the size small. [15]

#### 4.2.2 Components of a Computer Motherboard

The following are the main components found on a computer motherboard:

**Memory and their Slots:** The computer memory (RAM) is one of the most important parts of the system board. The number of memory chips of a motherboard depends on the type of computer and its capacity. There slots are usually white and black and very close to each other.

**Expansion cards:** Expansion cards are a typical component of nonintegrated system board as indicated earlier in this discourse. An example is a graphic card. However this can be integrated into the motherboard it depends on the type of circuitry.

**CPU and slots:** The central processing unit and the sockets is highly prolific part of the computer. It is located right on the motherboard. And it is easily identifiable as a result of the heat sink or cooling fan directly on it.

**BIOS Chip:** Just like the CPU, the BIOS chip occupies a top position in terms of the order of importance on the system board. It directs the CPU with respect to how it relates with other parts of the computer. The Basic Input and Out System chip or integrated circuit is fixed on board and it is also easily identifiable. BIOS and the name of the manufacturer are usually written on the chip.

**CMOS Battery:** The complementary Metal Oxide Semiconductor (CMOS) is a small battery on the system board that powers the CMOS memory. The CMOS memory keep very important settings in the computer such as date, time, configuration of the hard drive etc. in such a way that when the computer is switched off such settings are maintained. In order for this to be, the memory most always has power on. This is achieved via the CMOS battery. If a computer loses correct time and date for example, it is an indication that the CMOS battery is weak.

**Power Supply and Connectors:** This is the electrical unit of the system. It is the unit that supplies power as required for the smooth running of the computer. If it is bad the system will not power on. The power supply pack can be replaced when faulty.

**Keyboard Connector:** This is one of the most important input device for a desktop computer. Its connector is located on the motherboard. Keyboard connectors have two main types, the AT and the PS/2 Connector. The AT has round connecting interface into the motherboard, while the PS/2 connector is rectangular in shape and is smaller. Modern motherboards come with both connecting points.

**Mouse Connector:** The mouse is also a very important input device on the computer. Its connecting port is located on the motherboard. The connecting interface is usually round.

**Floppy and Hard Disk Connectors:** The Hard drive is the mass storage device of the computer system, same with the floppy disk. They are onboard connecting interfaces that enable the computer communicate with both drives.

**Expansion slots:** Expansion slots on the motherboard or a riser board make it possible for an additional card or board to be connected to the main board. There are different types serving different purposes. Mostly you come across PCI, PCI Express and AGP expansion slots. And for those computers manufactured before 1997, their slots are slightly different from what is obtainable today, though most of them are being faced out.

**Peripheral ports and Slots:** The functions performed by the computer require in most cases an external device connection either for uploading or to download data or as the case may be. There are various peripheral ports and slots met for this purpose. The most important peripheral ports are the universal serial bus (USB), Serial, Ethernet, Parallel, Video, sound, Game ports.

**Jumpers and DIP switches:** Jumpers and DIP switches used to configure the system board serving as a regulator for the amount of voltage supply as required by the various components on the motherboard especially the processor. This is automatic in some recent motherboards form factors.

These are the main components of a computer motherboard. There are other peripherals which represents basic electronics components such as capacitors, resistors, regulators etc. All these work together to make up a complete and working circuitry. [16]

### **4.2.3 Important criteria in the selection of board**

- a) What type of microprocessor we can use (mostly fitted with several variants of processors, but it is not possible to combine different manufacturers microprocessors or microcontrollers same manufacturer but different generations). Physically, it is so decided socket (socket) microprocessor board is already fitted. Now the processor into it engages. AMD today most use socket AM3 and Intel 1150, 1155, 1364.
- b) The Chipset - this component is the heart of the motherboard. It is up to each motherboard. Since this element is based on the FSB clock, support the processor type, speed, and maximum size of the memory modules (usually some variant of DDR).
- c) Number and type of slots (PCI and PCI Express), due to a possibility of expansion. Especially if you are planning, whether for the purchase or in the future, linking multiple graphics cards, so we need an adequate number of slots.
- d) The use of BIOS.
- e) Integrated hard disk controller (SATA and SATAII).
- f) Integrated input output interface.
- g) Integrated USB controller.
- h.) The other integrated components - network card, sound card, etc.
- i.) Cooling capabilities, which are closely linked to the computer chassis.

### **4.3 Power supply**

Many but not all PC cases sold with power supplies already installed. The power supply is a key PC component because it converts alternating current from the wall socket into direct current (using a transformer) and also delivers various voltage levels to PC devices (common voltage levels inside PC's include 3.3V, 5V, and 12V, among others).

A power supply must be able to provide sufficient power to handle all devices at peak load. Each device on a PC is rated in terms of peak wattage. What's most desirable is that the sum of all device peaks be less than the peak wattage rating for the power supply. What's absolutely mandatory for the PC to work properly is that the sum of all device peaks be no more than the peak wattage rating for the power supply. [2]



## 4.4 Processor

The processor, also called the microprocessor or CPU (for Central Processing Unit), is the brain of the PC. It performs all general computing tasks and coordinates tasks done by memory, video, disk storage, and other system components. The CPU is a very complex chip that resides directly on the motherboard of most PCs, but may instead reside on a daughter card that connects to the motherboard via a dedicated specialized slot. [1]

Processors make use of different techniques so as to increase their operational performance. One technique used for increasing the performance of processors is to include more number of transistors within the chip. Another method used is to increase the clock speed of processors. Normally, increasing the number of components makes the chip size large. More number of components can be accommodated in the same chip size by reducing the size of components. But the component size cannot be reduced beyond a limit, since the smaller components are having reduced efficiencies. Also, the switching process of small components leads to higher heat dissipation, thereby heating the system enormously. The same result appears in case of increasing the clock speeds of processors beyond a limit. On increasing the clock speed of processors switching speed also increases, which finally leads to an increase heat dissipation.

To avoid these difficulties, processors were begun to be designed using multiple cores. Adding more cores in a processor chip makes a way for its increased performance. Now, the multiple core processors are having more than one core fabricated in the same chip. The operating system of the computer treats each core as a separate processor. Each core of the processor can have separate cache memory or a shared cache memory for different cores. [3]

### 4.4.1 Today used AMD processors

AMD has just as Intel several performance classes of processors. The lowest processors Sempron, then Athlon (today Athlon II) and are classified as the most powerful processors Phenom (Phenom II). Today they mostly use socket AM3. [19]

#### a) Athlon II (AM3)

It is a middle class processor from AMD. Produced version X2, X3 and X4, wherein the number after the letter X indicates the number of cores. Athlon II produced by 45nm technology (sometimes by 32nm technology).

X2

- Frequency of cores: 2.8GHz-3.4GHz
- Consumption: 45W - 65W
- L1 cache: 128 kilobytes per core
- L2 cache: 2048 kilobytes.

X3

- Frequency of cores: 2.6GHz-2.7GHz
- Consumption: 45W
- L1 cache: 128 kilobytes per core
- L2 cache: 1536 kilobytes.

X4

- Frequency of cores: 2.2GHz-2,9GHz
- Consumption: 45W – 100W
- L1 Chache: 128 kilobytes per core
- L2 cache: 2048 kilobytes. [19]

**b) Phenom II (AM3)**

Phenom II processors are the highest range of processors from AMD. It is made of two (X2) up to six cores (X6) by 45nm manufacturing technology. Some Phenom processors featured with epithet Black, and that means an open multiplier and good overclocking capabilities.

X2

- Frequency of cores: 3.3GHz-3.4GHz
- Consumption: 80W
- L1 cache: 128 kilobytes per core
- L2 cache: 512 kilobytes
- L3 cache: 6144 kilobytes.

X4

- Frequency of cores: 2.6GHz-3.7GHz
- Consumption: 65W-125W
- L1 cache: 128 kilobytes per core
- L2 cache: 2048 kilobytes

- L3 cache: 6144 kilobytes.

X6

- Frequency of cores: 2.7GHz-3.3GHz
- Consumption: 95W-125W
- L1 cache: 128 kilobytes per core
- L2 cache: 3072 kilobytes
- L3 cache: 6144 kilobytes [19]

#### c) **Sempron (AM3)**

The lowest class of processors from AMD. It is the cheapest and the power does not reach the stratosphere. It is especially designed for office and unpretentious home kits. Due to the increasingly lower cost of Athlon processors are rather retreat and encounter them less and less. On the trade at alza.cz there is only two type of these processors. Sempron AM3 are only one core but 64-bit.

- Frequency of cores: 2,7GHz-2,9GHz
- Consumption: 45W
- L1 cache: 128 kilobytes per core
- L2 cache: 1024 kilobytes [19]

### 4.4.2 Today used Intel processors

#### a) **Core i3 (1155, 1150)**

This dual-core processor rather belongs to the lower middle class. It is manufactured by 32nm technologies, and supports Multi-Threading. Only one of the Core iX family that does not have Turbo Boost technology. New Core iX processors have graphics core implemented in the processor housing. It is nothing too powerful, but for graphically undemanding job is sufficient.

- Frequency of cores: 2.8GHz-3.7GHz
- Consumption: 35W-54W
- L3 cache: 3-4MB [18]

#### b) **Core i5 (1155, 1364, 1150)**

Core i5 series processors are a little better than Core i3. It has two or four cores (usually four). Already used TurboBoost, but Multi-Threading can be found only in two core model. Made by 22nm technologies.

- Frequency cores: 3GHz-3.9GHz
- Consumption: 45W-88W
- L3 cache: 3-6 megabytes [18]

**c) Core i7 (1155, 1150, 1364)**

The most powerful family of Core iX is just Core i7 Extreme Edition. This Core i7 series are also very powerful processors. Made by 22nm technology, it has four cores and eight threads.

- Frequency of cores: 2GHz-4GHz
- Consumption: 35W-88W
- L3 cache: 6-8MB [18]

**d) Core i7 Extreme Edition (2011)**

The tip of the families of Core iX. Processor done mainly for high performance at the right price. As one of the Core iX has from six to eight cores and made by 22nm process technology (cheaper cuts are made by 32nm technology and have from four to six cores). All processors in this series support Multi-Threading and TurboBoost.

- Frequency of cores: 3GHz-3.7GHz
- Consumption: 130-150W
- L3 cache: 10-20 megabytes [18]

**e) Pentium (1155, 1150, 1170)**

Pentium processors of lower class. They feature low price and not very good performance, but generally perform better than the Celeron. Another rather office processor. It is made for use 32nm or 22nm (newer processors have better production technology).

- Frequency of cores: 2.2GHz-3.5GHz
- Consumption: 10W-65W
- L2 cache: 2 megabytes
- L3 cache: 3 megabytes [18]

**f) Celeron (755, 1155, 1150, 1170)**

Cheapest line of Intel processors. The manufacturing process made by 22-65nm and is a good choice for office reports and cheaper home computers. Compared to more expensive models is noticeable much smaller cache.

- Frequency of cores: 1.6GHz-2.9GHz

- Consumption: 10-65W
- L2 cache: 512-1048 kilobytes
- L3 cache: 1-2 megabytes [18]

**g) Atom**

The new generation of Intel Atom processors delivers energy-efficient performance to power a dynamic range of devices, including thin, light-weight smartphones and tablets, intelligent cars, cutting-edge healthcare devices, microservers for the cloud, and more. Intel Atom processor innovation drives higher performance at ultra-low power. These processors are manufactured by 14-22nm.

- Frequency of cores: 1.8GHz-3,33GHz
- Consumption: 10W
- L2 cache: 1-2 megabytes
- L3 cache: 512-2048 kilobytes [18]

## **4.5 RAM memory**

Every computer need RAM memory, but not all types of RAM memory will work on a computer. Some physically won't fit in the RAM socket, and others will fit but won't work, preventing the computer from passing power-on self-test (POST).

To select the right type of RAM, you need to know your CPU type and motherboard. Some CPUs, such as Intel Core I5 and I7, work only with motherboards designed to meet the highest performance levels of a particular CPU and, therefore, it determines which types of physical RAM can be used. [4]

**a) DDR memory**

This was the first Double Data Rate (DDR) design. The benefit of this design was that the reading and writing of information was done on both cycles, meaning a greater effective data rate (twice the actual speed of the clock and address lines). DDR RAM speeds ranged from 200 to 400 MHz. DDR RAM were used in older computers from the Athlon 64 and Pentium 4 era. DDR RAM capacities typically ranged from 128 MB to 1GB. [4]

**b) DDR2 memory**

DDR2 is an improvement on the interface specification with a higher bandwidth interface than DDR, making for improved performance. It is not compatible with DDR

because of voltage and timing differences. DDR2 has a lower voltage requirement of 1.8 V compared to 2.5 V in DDR. DDR 2 has data rates of 400-1066 MHz. DDR2 RAM capacities typically ranged from 512 MB to 4 GB. [4]

**c) DDR3 memory**

The DDR3 specification has a higher bandwidth interface compared with that of the DDR2, which allows for improved performance. As with DDR, it is not compatible with earlier versions of DDR, due to voltage and timing differences. Two main benefits of DDR3 over DDR2 are that it can transfer data at twice the rate 9800-2133 MHz and it has a lower voltage rate of 1.5 . DDR3 RAM supports chip size of up to 8GB. [4]

**d) GDDR**

**GDDR** or **graphics double data rate** memory refers to memory specifically designed for use on graphics card. GDDR is distinct from the more widely known DDR SDRAM types such as DDR3, although they share some technologies - including double data rate design - in common. [5]

**e) GDDR3**

It has much the same technological base as DDR2, but the power and heat dispersal requirements have been reduced somewhat, allowing for higher performance memory modules, and simplified cooling systems. [6]

**f) GDDR5**

GDDR5, an abbreviation for double data rate type five synchronous graphics random access memory, is a modern type of synchronous graphics random access memory (SGRAM) with a high bandwidth ("double data rate") interface designed for use in graphics cards, game consoles, and high-performance computation.[7]

## **4.6 LCD monitor**

LCD displays use a relatively new technology, but all of the early teething problems have long been worked out and the prices of LCD displays have fallen to the point that they are now mainstream products. A good LCD provides top-notch image quality in a compact package. Although traditional CRTs have advantages of their own, most people who experience the bright, contrasty image of a good LCD display will never return to using a CRT monitor.

CRT monitors were the dominant PC display technology until recently, but that has changed. For displays bundled with new PCs, LCDs exceeded CRTs in popularity by late 2002. By 2005, LCDs had also begun to outsell CRTs in retail channels. Lower cost and other advantages of CRTs ensure that they will remain available for years to come, but the emphasis has definitely shifted to LCDs. [11]

#### **4.6.1 LCD display characteristics**

Here are the important characteristics of LCDs:

- Resolution:

Unlike CRT monitors, which have a maximum resolution but can easily be run at lower resolutions, LCDs are designed to operate at one resolution, called native resolution. You can run an LCD at lower than native resolution, but that results in either the image occupying only part of the screen at full image quality or, via pixel extrapolation, the image occupying the full screen area but with greatly reduced image quality.

- Interface:

LCDs are available in analog-only, digital/analog hybrid, and digital-only interfaces. Using an analog interface requires converting the video signal from digital to analog inside the PC and then from analog to digital inside the monitor, which reduces image quality, particularly at higher resolutions. Synchronization problems occur frequently with analog interfaces, and can cause various undesirable display problems. Finally, analog interfaces are inherently noisier than digital interfaces, which cause subtle variations in display quality that can be quite disconcerting.

- Refresh rate:

Whereas CRT monitors require high vertical refresh rates to ensure stable images, LCDs, because of their differing display technology, can use much lower refresh rates.

- Response time:

Unlike CRT monitors, whose phosphor-based pixels respond essentially instantaneously to the electron beam, LCD panels use transistors, which require time to turn on or turn off. That means there is a measurable lag between when the

transistor switched on or off and when the associated pixel changes to the proper state. That lag, called rise time for when transistor I switched on and full time for when it is switched off, results in a corresponding lag in image display. [11]

#### **4.6.2 Overview of LCD technologies**

##### **a) IPS panel technology**

IPS (In Plane Switching) panels are generally considered the best overall LCD technology for image quality, color accuracy and viewing angles. They are well suited for graphics design and other applications which require accurate and consistent color reproduction. IPS panels offer the best viewing angles of any current LCD technology, with wide viewing angles up to 178 degrees.

All these benefits raise IPS monitors to a higher price range compared to VA and especially affordable TN panel LCD displays. The response time of IPS is adequate, ranging from 6ms to 16ms with current panels. This is only slightly slower than TN panels. However, gamers should take this into consideration. Fast paced games may suffer from motion blur or ghosting with IPS panels that have a response time higher than 8ms. [10]

##### **b) VA panel technology**

VA (Vertical Alignment) technology such as S-PVA/MVA is middle of the road LCD panels. They offer better color reproduction and wider viewing angles than TN panels, but have slower response times. They are very similar to S-IPS on paper. They also offer large viewing angles and good color reproduction, though not as good as IPS panels. The response times are generally worse than TN or IPS panels and there have been reports of a few VA panels that suffer from input lag, so VA technology is not be the best choice for fast paced gaming.

VA panels have the advantage of higher contrast ratios compared to other panel types, which leads to better black levels. The biggest disadvantage of VA based panels is color shifting. Color shifting is when the image viewed from one angle changes or "shifts" when viewed from a slightly different angle, making various uneven brightness levels across the display. This bothers many users to the point they will not even consider buying a VA based panel, while other users don't notice or aren't bothered by the color shifting. Color shifts also cause a loss of shadow detail in dark scenes when viewed directly from the center. [10]



### **c) TN panel technology**

TN (Twisted Nematic) panels are the most widely used panel type in the manufacture of LCD monitors. TN panels are cheap and offer excellent response times, making them perfect for fast paced gaming. The response times of current TN panels range from 2ms to 5ms. Unfortunately the color reproduction, viewing angles and contrast ratios of TN panels are the worst of any current LCD panel technology.

Unlike most 8-bit IPS/VA based panels, TN is only 6-bit and unable to display the full 16.7 million colors available in 24-bit true color. They can mimic the 16.7 million colors of 8-bit panels using a technique called dithering, but the results are unimpressive. TN panels have become popular with the average computer user because they are very inexpensive and currently dominate the LCD display market in availability. [10]

## **4.7 Graphics card**

A graphics card typically contains a graphics processing unit (GPU) and special video memory, which stores screen images as they are processed but before they are displayed. Lots of video memory is the key to lightning-fast screen updating for fast action games, 3-D modeling, and graphics-intensive desktop publishing. In addition to video memory, most graphics cards contain special graphics accelerator technology to further boost performance. [12]

### **4.7.1 Components of graphics card**

#### **a) GPU (Graphics Processing Unit)**

A Graphics Processing Unit (GPU) is a single-chip processor primarily used to manage and boost the performance of video and graphics. GPU features include

- 2-D or 3-D graphics
- Digital output to flat panel display monitors
- Texture mapping
- Application support for high-intensity graphics software such as AutoCAD
- Rendering polygons
- Support for YUV color space
- Hardware overlays
- MPEG decoding

These features are designed to lessen the work of the CPU and produce faster video and graphics.

A GPU is not only used in a PC on a video card or motherboard; it is also used in mobile phones, display adapters, workstations and game consoles. [8]

#### **b) Memory**

The memory type for all current gaming grade graphics cards is GDDR5. Older or cheap videocards can come with DDR3 or GDDR3 but this is no longer the standard so it will be mentioned less. GDDR5 is currently the fastest video memory on the market but as with all memory it comes at different clockspeeds. [9]

#### **c) SLI technology**

NVIDIA® SLI™ technology is a revolutionary platform innovation that allows you to intelligently scale graphics performance by combining multiple NVIDIA graphics solutions in a single system with an NVIDIA nForce® SLI media and communications processor (MCP).

Using proprietary software algorithms and dedicated scalability logic in each NVIDIA graphics processing unit (GPU) and MCP, NVIDIA SLI technology delivers up to twice the performance of a single graphics solution.

NVIDIA SLI-Ready components are backed by a rigorous testing and certification process to deliver an entire certified platform solution ensuring unmatched system stability and platform compatibility.

NVIDIA SLI GPUs deliver powerful, elegant and super-rich graphics for games and other graphics-intensive applications. Combining two NVIDIA SLI-Ready certified graphics cards (with the same GPU) in a single system with an nForce SLI MCP results in up to double the graphics performance.

NVIDIA SLI-Ready GPUs feature dedicated, built-in SLI hardware logic and take advantage of the additional bandwidth of the PCI Express bus architecture. Connected by the SLI connector\* (which ships with all SLI-Ready motherboards), each GPU has a maximized connection pathway, and can leverage the second card for reaching top-speed performances. SLI Technology can scale both geometry and fill rate performance for multiple GPUs and output in both digital and analog formats for the highest image quality

To enable NVIDIA SLI technology in your PC, you'll also need an SLI-Ready certified motherboard with an nForce SLI MCP and two physical PCI Express x16 slots.

NVIDIA motherboard partners offer nForce SLI motherboards for both AMD and Intel CPUs. [13]



**Figure 1 - Two graphics cards from Nvidia connected via SLI.**

Source: [http://www.nvidia.ru/docs/IO/64689/header\\_productshot4.png](http://www.nvidia.ru/docs/IO/64689/header_productshot4.png)

#### **d) CrossfireX technology**

CrossFireX is the third generation of graphics-card maker ATI's CrossFire multi-processor technology. CrossFireX enables you to connect up to four graphics processors together for better performance for such demanding business applications as 3-D modeling for computer aided design and manufacturing, 3-D animation, graphic design or video editing. While it competes directly with Nvidia's Scalable Link Interface or SLI technology, CrossFireX has some unique benefits that can make it a more powerful tool for users that require the utmost in graphics performance.

CrossFireX is a technology that connects two or more ATI graphics processing units together to let them share the burden of rendering graphics. With CrossFireX technology, the cards can render different parts of the screen either by splitting it into halves or by rendering it as a checkerboard. They can also use a technique called "alternate frame rendering" where each card generates a different frame of a moving image, flipping back and forth between the two cards multiple times per second. Since each card in a two-

GPU configuration has twice as long to render each frame, they can each render more detail.

The key benefit of CrossFireX is that it improves graphics performance. Having two graphics processors enables you render more details or achieve a higher frame rate for smoother motion. The technology also enables you to get essentially the same performance out of two mid-range graphics cards that you would get out of one high-end card. This can save you money while also helping your computer to better disperse the heat that GPUs generate.

While a CrossFireX configuration can enable each of your system's components to work less, it also places some unique requirements on your computer. You'll need a CrossFire-certified motherboard with a slot for more than one graphics card. Your case will also need to be large enough to hold two graphics cards, bearing in mind that many of them are quite large, and your power supply will also need to be able to power two watt-hungry cards. Finally, you may need to upgrade your cooling system since two graphics cards generate heat that will need to be removed from the case to avoid damaging your computer or its hard drive. [14]

## **4.8 Hard Disk Drive (HDD)**

A hard disk drive is a series of magnetically coated disks that store data. Just above each disk in the drive sits a read/write head that adds a positive charge to indicate a one and removes the charge to indicate a zero.

- A series of disks, called platters, that are stacked together. Each platter has a hole in the middle, and a spindle is inserted through these holes. The platters rotate at high speeds measured in revolutions per minute (rpm).
- A read/write disk head sits on top of the disk surface and reads or writes to the disk as the disk rotates.
- An actuator arm, which is responsible for disk head movement, moves the read/write head across the platter to write or read data. [4]

## 4.9 Solid State Drive (SSD)

A solid state drive (SSD) is a storage device that uses non-volatile memory chips to retain data. SSDs have none of the mechanical components that are present in traditional hard disk drives. As a result, SSDs use substantially less energy and generate almost no heat compared to conventional hard drives. Due to these two factors, SSDs are perfect for use in mobile phones; after all, mobile device users are always concerned with power consumption, heat, and weight.

As with conventional hard disk drives (HDD), SSD drives are generally available with a wide variety of commonly used connectors, including SATA, PATA, SCSI, Fibre Channel (SCSI and Fibre Channel are mainly used in enterprise environments), USB, and eSATA.

SSDs are more expensive than their SATA and even SCSI counterparts. One of the major differences in cost between HDDs and SSDs is that SSDs use integrated circuits (memory chips) instead of platters. Since they are using integrated circuit (IC) chips, the cost difference is almost zero seek latency. Another compelling reason to use SSDs is their MTBF (mean time between failure) of 1.000.000 hours (whereas a more expensive HDD might have a MTBF of “only” 750.000 hours).

These drives are designed to fit standard 1.8-inch laptops as well as 2.5-inch and 3.5-inch for desktops. SSDs are also used with PCI expansion cards for computers (mainly server applications due to their high cost). [4]

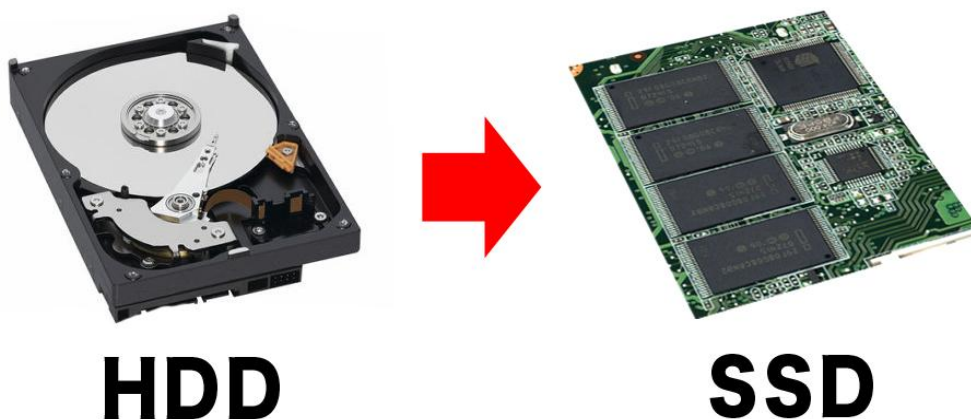


Figure 2 - HDD vs. SSD drives

Source:<http://www.mediatester.pl/wp-content/uploads/2015/02/HDD-VSSSD.jpg>

## 4.10 Optical drives

### a) DVD

DVD (digital video disc or digital versatile disk) is a variation of CD technology that was originally designed as an alternative to VCRs, but was quickly adopted by the computer industry to store data. The initial DVD standard offered 4.7 GB of data storage, that's about seven times as much capacity as CD. Subsequent improvements in DVD technology offer even more storage capacity. A double layer DVD has two recordable layers on the same side and can store 8.5 GB of data. [12]

### b) Blu-ray

Blu-ray is a high capacity storage technology with a 25 GB capacity per layer. The name Blu-ray is derived from the blue-violet colored laser used to read data stored on Blu-ray discs. DVD technology uses a red laser; CD technology uses a near infrared laser. [12]

## 4.11 Various Types of Computer Users

Computer users can be divided into five categories: home user, small office/home office users, mobile users, large business users, and power users:

**Home user** - spends time on the computer for personal and business communications, budgeting and personal financial management, entertainment, and Web access.

**Small office/home office (SOHO)** - user includes any company with fewer than 50 employees, as well as self-employed people that work out of their home.

**Mobile user** - travels to and from a main office or school to conduct business, communicate, or do homework.

**Large business user** - works for a company that has a large number of employees and computers usually connected to a network.

**Power user** - such as an engineer, architect, or desktop publisher - typically works with multimedia, which combines several media elements into one application, and requires the capabilities of a workstation or other powerful computer. [17]

## 5 Practical part

For effective writing the practical part, which was the optimal choice of components for specified types of configurations, to be pumped into the features and prices of components from the online stores [www.alza.cz](http://www.alza.cz), [www.mironet.cz](http://www.mironet.cz), [www.czc.cz](http://www.czc.cz) and from the manufacturer's website.

Also there will be system requirements which were collected from office and multimedia applications and from latest game titles. Office and multimedia applications and latest game titles were chosen by authors prefer.

	Applications / Games	System requirements	Advantages
Office PC	MS Office 2013, LibreOffice	At least 1 GHz, 1GB RAM, more than 3GB of disk space and minimum resolution 1024x768.	Low cost, low consumption.
Home PC	Skype, CS: GO, DOTA 2	At least 2 GHz with quad core, 4GB RAM, more than 15GB of disk space and graphics card with 1GB of memory and minimum resolution 1366x768 and DVD drive.	Better performance, optimal cost.
Game PC	GTA 5, FIFA 15, COD: Modern Warfare	At least Core i5 with quad core, 8GB RAM, more than 35GB disk space, graphics card with a minimum 4GB memory and Full HD resolution and DVD drive.	Best performance, best speed, high quality.

**Table 1 - Criterias for optimal choice of components**

Source: Author's own source

From this collected system requirements was chosen optimal components for each configuration.

## 5.1 Selection of individual components

Selection of case is affected by the size, layout for cooling, and last but not least by material such as aluminum and steel. The advantage of aluminum is its lightness and greater heat conductivity, and its disadvantage is the possibility of lighter damage. The steel case is the opposite. Cooling can be solved through a water cooling, cooling with liquid nitrogen or conventional air cooling and with a little luck of passive cooling. Almost in every case there is space for 120 mm fan and ideally with a fan in the front and rear. Flow enters the front and exits rear with the greatest suction to force heated air away as quickly as possible. Another important choice is the condition of minimum noise with good cooling and better fit components such as hard disc causing spurious vibrations. In contrast, if we are talking about cooling components, so we look at the size of closets and a large number of fans. Perhaps the greatest influence on the selection of the case has an appearance that depends on the user's preferences.

Power suppliers are the basis for a stable system. Really good power supplier should reach at least 80% of their efficiency at 20%, 50% and 100% of nominal load. The advantages are less heat loss, saving on electricity and connect multiple devices, even if the source has fewer watts. The biggest problem occurs with unnamed sources, for example, that has power of 500 W, but it may be that the system requires the consumption of just 500 watts and the system will not boot. The reason is simple, because it is far less effective, which is lost in the circuit or is converted into heat.

Selecting motherboard affects a lot of factors that can be divided into the processor type, which can be on board with. Further, it is the chipset which defines the price relation. Chipset had in the past far more weight than it is today, includes SATA, PCI- E x1, USB and earlier it was the memory controller, integrated graphics, but they are now integrated directly into the processor. We cannot forget form factor of boards and the technical parameters such as the number and type of controllers, buses and other amenities such as Wi-Fi module or integrated graphics unless it is not in the processor.

The processor can be selected according to the results of different benchmarks like SuperPi, 3Dmark or applications, for example, WinRAR, conversions between formats



(video) where comparisons challenging game engines. The choice can be decided by the number of cores, consumption and price.

System memory is nowadays very cheap, if compare it with 2005, when there were two gigabytes of RAM up to 20 000 CZK. Since the greatly expanded motherboard supports DDR3 modules themselves and the price dropped to acceptable levels, it is an obvious choice to purchase. The most interesting parameters are memory throughput, size, voltage and timing. Selection of RAM is decisive if we have a 64-bit system so elects 4GB of 1333 MHz, since it is the most common frequencies supported by the motherboard. Unfortunately you cannot choose the operating memory according only to set parameters, there is a possibility that the board will have problems with memory or worse, will not work. Therefore, the best option is to choose the memory according to the recommendations issued by the motherboard manufacturer, which reduces the risk of incompatibility at minimum. Very interesting is the possibility of involvement of the memory in dual channel or triple channel.

HDD is the slowest component in your computer. Many are very specific either is a server where it is needed faster disc with more than 10k rpm / min or is a normal use with standard 7200 rev / min or less. According to various tests are not large differences in performance hard drives with mechanical parts. These discs are suitable for storage, but for the speed is better to opt for the more expensive SSD drive.

Optical drive can be selected on the basis of the IDE / SATA / USB or formats with which it cooperates. You can buy a classic CD / DVD burner. If DVD is not capable there is also a Blu-ray drive that handles writing also on previous media.

The toughest consumption is undoubtedly the graphics card. The graphics card has many parameters such as performance of graphics, which is best determined using gaming tests. Methodologies are testing using different versions of DirectX, different resolutions to image smoothing. Other parameters such as temperature and consumption are equally important.

Finally you should consider on this things before buying an assembly:

- a) Which users will perform tasks on PC?
- b) Choosing right Operating System.
- c) Which applications and/or games will be run on PC?
- d) What kind of hardware needed for that applications and/or games?
- e) Have the necessary budget for a specific configuration.

➤ **Office PC**

- The users of Office PC will be managers, teachers, personal administration, etc.
- In this configuration better to use Windows 8 because it fits minimal system requirements of Office PC
- Mostly nowadays used office applications like MS Office 2013
- Will not be needed powerful machine to handle smooth running office applications
- Author decided that Office PC's should cost approximately 10 000 CZK

➤ **Home PC**

- The users of Home PC will be from children to old people, students, etc.
- Windows 8.1 will be easy decision for this type of configuration
- Since this computer is designed for different age categories, so this machine will be used by different applications ranging from office and multimedia applications to the latest novelties of games (with minimum system requirements)
- Hardware should be balanced between performance, price and not performing future upgrades for a long period
- Author decided that Home PC should cost more than 20 000 CZK

➤ **Game PC**

- The users of Game PC will be mostly gamers, who will play latest game titles
- Windows 8.1 will be easy decision for this type of configuration
- This computer is designed for playing latest game titles
- Since it will be used for playing, hardware must be very powerful to play latest games even on maximum system requirements
- Author decided that Game PC should cost more than 50 000 CZK

## 5.2 Office PC

Office PC will have as the main criteria for low cost and powerful enough to handle smooth running undemanding office applications. And from that it is good for this type of focus on low consumption. When it is not geared to a performance, so it would not be a problem. In this type of computer we can save practically in everything.. After all, if your computer has to perform office duties effectively for a longer time, better to properly think through what may be necessary requirements for two years and have little power reserve. Also a selection of less-known components of cheaper manufacturers may have a negative effect in the form of disorders.

### a) Processor

Suitable processor is a cheap processor. Therefore, we elected to office in either one of series Intel Celeron or AMD Athlon. Most of Celeron processors at an affordable price have a power consumption of 45W. It is thus quite inefficient processor. In contrast, the Athlon can only be obtained with a consumption of 25W. The prices are not so different. Some focus on the frequency, the number of cores or buffer does not make much sense.

- **AMD Athlon X4 5350**

The Celeron processor surpasses almost everything except the price, which is at the Celeron ranges from 1400 to 1600 CZK. Athlon X4 5350 cost around 1500 CZK. However, equipped with quad-core 2,05GHz frequency. Connects the socket AM1 and is made 28nm technology. Even cache memory achieves very good capacity (L2 2048 kilobytes and L1 256 kilobytes).

### b) Motherboard

The first thing is the size of the motherboard. It must match the case. These two components is therefore good to choose at once. For office machines without problems satisfied with one of the smaller variant plate. Such micro ATX will suffice. We need a minimum amount of expansion slots. It's also good to think at least, approximately what CPU will collect and concentrate on the plate with an appropriate base. Graphics card certainly welcome an integrated, if not to buy a processor Core ix, where the graphics card is already present, but rather incline to a cheaper CPU and motherboard with the graphics card.

- **ASUS AM1M-A**

This micro ATX motherboard is one of the cheapest and meets most of the requirements for the ability of elected assemblies. It can be fitted with the chosen processor Athlon X4 processors and DDR3 memory a frequency of up to 1 866MHz. It has a SATA controller for our hard disk and optical mechanics. The board is present graphics card which is fully sufficient for future requirements. The price fits into 1000 CZK.

- c) **Operational memory (RAM)**

Here will be the greatest measure of the operating system selection. In a configuration to office will be the most challenging part of being on this part. For the computer we choose Windows 8 operating system. It has minimal requirement of 1GB. We'll definitely reserve and therefore, we will rather choose 2GB. Due to the necessity of choosing board with DDR3 support (due to cost) is not over what to think twice. Memory speed is up in the background and therefore it is not subject to any specific requirements.

- **Kingston 2GB DDR3 1600MHz CL11 Single Rank**

Using these one module, with a capacity of 2 gigabyte and cost around 600 CZK reach the required capacity. Timing CL11 is sufficient and 1600MHz memory speed is more than acceptable.

- d) **Hard Disk Drive (HDD)**

Here we will not need a breakthrough capacity, let alone speed. The sufficient capacity to store is 160 GB or 250 gigabytes. More is useless, unless it was be a requirement for greater capacity. Nowadays even the cheapest drives reach 7200 rpm. More would also completely unnecessary. The size of 3.5 inches is best. Discs with said capacity and speed buffer containing about 16 megabytes. The values of the search time to read and write to us rather in the background. Cheapest drives with their values are sufficient for intended work.

- **WESTERN DIGITAL Caviar Blue 250GB**

With a capacity of 250 gigabytes, cache memory of 16 megabytes and price around 1600 CZK, this disc is a hot candidate. Reach 7200rpm speed and access time 8,9ms, which is satisfactory. Communication with the board will be through the SATA 6Gb.

- e. **Graphics Card**

Already included on the motherboard. In the case of office computer we will not need any other.

#### **f) Monitor**

For office computer is not much an important point of view (the user sitting in front computer at the table), color, contrast or response. The main thing is that it will not freeze and decently display. This requirement masterfully meets technology TN. Diagonal also not something that can be discussed a lot. Rather it must be determined by the price and due to the fact that the majority of monitors around 2,000 CZK (cheapest) has a 19-inch, we will most likely vote for this diagonal. Latest issue with our interest may be consumption, which should move low.

- **ASUS VS197DE**

This is an inexpensive LCD panel manufactured by technology TN 1366x768 resolution. Price 2200 CZK is friendly. Already properties not so much, but for this computer will suffice. 5ms response looks well. Horizontal and vertical viewing angles are different and that 170 and 160 degrees. Contrast reaches 50 000 000 : 1, brightness of 200 cd / m<sup>2</sup>. Also favorable is that consumption is 23W.

#### **g) Optical Drive**

Here is possible to omit it for the office computer. When specific requirements for the possibility of reading and writing to optical media could be to choose the DVD-RW drive with low price.

- **ASUS DRW-24F1ST black**

If it is necessary, this drive would be able to stand up for their function for only CZK 400. Velocity parameters are not very important. Mainly, that can read and burn DVDs and CDs. That's the only thing in this case depends. SATA controller is standard.

#### **h) Case**

Since it is not assumed any significant expansion of such computers, size is not that important. Rather than larger case would be better to choose one of the smaller ones. It certainly does not belong to the better pieces due to the fact that the appearance of cases and processing, is far from a priority. Also cooling may be not much, just due to planned low energy consumption and therefore low levels of heat output.

- **Zalman T5**

This is a minitower with a price around 700 CZK with a decent look. It can be fitted with selected micro ATX board.

### **i) Source**

It is good to discuss the consumption of individual components and choose accordingly. Consumption by the most powerful computers rises graphics card. In our case, when we have saving processor and integrated graphics card, therefore, consumption will not in any way staggering, and that is good. It is good to leave some slack in the future.

- **Eurocase 400W PFC**

ATX power supply with more than enough power 400W. It is just not the cheapest source, but when buying for a lower price would unnecessarily risking failure due to cheapest sources. Price around 600 CZK is reasonable. It is compatible with all of us selected components.

- ★ **Average price for selected components of Office PC:**

**[www.alza.cz](http://www.alza.cz) - 8 450 CZK**

**[www.mironet.cz](http://www.mironet.cz) – 8200**

**[www.czc.cz](http://www.czc.cz) – 8320**

## **5.3 Home PC**

Price is not as a priority criterion as purely office machines, but it is good also to look on that. We are looking for basically the best balance between performance, price and options not having computer for a long period of time to improve. This computer is characterized mainly by a wide focus. If the computer captures household, so it requires the fulfillment of a wide range of requirements. At a minimum, playing movies and even in HD, playing music, any video editing and last but not least to some gaming. The computer should have an acceptable game performance. Do not have to run it off the newest titles at the maximum possible detail, but most new games should be a modest adjustment handle. It will not be a straight strong game machine. It is characterized by high consumption and higher prices. For our purposes, it is more preferable to something cheaper. At least components like the CPU, memory and graphics card, determining from most gaming performance, can choose less expensive. With playing and playing back movies is also linked with image quality. Selection of the monitor will be a little more thorough, than was the case with office machines.

### **a) Processor**

Nothing else than the processor of middle class cannot be justified. Selection will be centered to Phenom II processor and Core i5. At the rate will not be taken until such consideration. Even there is no point to deal with the number of cores, the selection is the price and performance of routing to four cores. Attention will rather concentrated on the cache. Now the cache is a big difference between the lower and middle class processors. In the case of a choice between AMD and Intel, will also play a big role price and consumption. Core i5 looks inviting with its ratio of performance and consumption. It is one of efficient processors. A big minus is a higher price. Conversely Phenom II processors have higher consumption, but the price is very low. Cache values are comparable. For home multimedia computer, in this case the author chose rather less consumption of new Intel processors. And the use of modern technology speaks for Core i5.

- **Intel Core i5-4460**

This quad-core processor designed for socket 1150 seems satisfactory. Frequency cores achieves 3,4GHz. It produced a new 22nm technology and consumption is 84W. Further L3 processor has cache size of 6 megabytes For a price around 5400 CZK is a compliant processor.

### **b) Motherboard**

The selection will take place between ATX and micro ATX. The author personally inclined to micro ATX. The larger board will only barely needed.

The first thing we will notice when selecting the right size for the board, will be used by the chipset and CPU sockets. It depends on our choice of the other parts of the plate. We have to take into account what kind of processor you want, how many drives and discs will be involved, what type, size and speed RAM memory for your machine and how much we plan, and what connectors due to a possible future facilities we need. Selecting disc is not generally easy thing to do and should be taken very seriously.

- **ASUS B85M-E**

A relatively new and one of the cheaper micro ATX motherboards. The board is present to support new socket 1150, Core i5 and i7 processors and DDR3 memory board can handle up to 32 gigabytes of capacity and frequency of 1600MHz. For sufficient expansion cares 4 SATA 3 with 6GB and SATA 2 with 3 GB. Network and integrated

sound card on the board does not call for an alternative in the form of expansion cards. Price is around 2000 CZK.

**c) Operating memory (RAM)**

In this case, it is already well to choose DDR3 memory technology. Most boards supports it and DDR3 memory have better performance than DDR2 at a minimal price difference. It is worth mentioning lower operating voltages and higher frequencies achieved. What do we have the capacity to choose at least 8GB. We expect the operating system Windows 8.1.

- **Crucial 8GB KIT DDR3 1600MHz CL11**

This memory exactly matching requirements for this configuration. Specifically capacity of 8GB (2x4 memory modules) and the frequency of 1600MHz. Neither latency there's bad (CL11). At a price of CZK 2 000, it is one of the optimum option choice.

**d) Hard Disk Drive (HDD)**

For a family machine is not necessary to select the SSD disk. Their price is still too high for available capacity. In the case of specific requirements for this disk would be appropriate to vote for smaller capacity and identify the disk only at system and demanding applications or games. Suitable size should be around 40-80 gigabytes. Due to the nature, which includes the use of computer has multiple users, who will be using parts of their drive to store a lot of data, it is advisable to select the disk with a minimum of 500 GB of size 3.5 inches and a speed of at least 7200 rpm. The buffer will try to maximize, but it should not turn too high a price.

- **Seagate Desktop SSHD 1000GB**

Hybrid disk with capacity 1TB, 7200rpm, 64 megabytes buffer and with 8GB NAND memory for cache. It is equipped with SATA 6 gigabytes. Latency is less than 3 ms and price around 2500 CZK makes it a favorite for this assembly.

**e) Graphics Card**

For this component is not worth thinking about technology SLI or Crossfire. It will increase the price level of consumption and the need for cooling. Integrated graphics card, whether on board or processor, also will not be right. The rule does not provide sufficient power. But on the market there is a large selection of mid-range graphics cards that provide us with reasonable performance at a reasonable price. This card should also have a TV output. This will allow us to play movies on our TV, which definitely comes in handy.



Cards of middle class will meet quite often with the type GDDR5 with a capacity from 1 to 16 gigabytes, and usually you can buy a bus width of 256 bits, which will also be optimum, to which we will try to select the face. More importantly, the selection of the GPU. Excellent price performance ratio, for example, has a GeForce GTX 760 or R7 cards with these cores can get up to 6000 CZK. These cards should not already mounted cooling overheat.

- **ASUS R7265-DC2-2GD5**

Graphics card with price around 4300 CZK meets the performance requirements of the family machines. This is the card for the middle class and the corresponding parameters. The core consists of a chip card AMD Radeon R7 265 made with 28nm technology clocked at a frequency of 900MHz. The memory module is represented by the frequency of GDDR5 5100MHz, sufficient capacity of 2GB and bus width of 256 bits.

**f) Monitor**

Normal user often looks mainly on diagonal and at price for monitor. However, we will also focus on the use of technology and the associated additional properties. Already mentioned diagonal screen, on this type of assembly should be chosen over 20 inches.

For residential applications certainly not always the user sits at a table right in front of the monitor. Thus, should be given special attention when choosing angles. Some of the technology looks promising on paper, but when you change the angle it significantly worsens colors. Color rendering is also important if you want to watch a movie on our computer. The response should be around 5ms, just to those games. Most of the players on this property gives a lot. According to these properties will therefore advisable to choose one of the MVA or PVA technologies. TN is for this type of machine inappropriate, but often chosen because of its low price.

- **BenQ GW2760HS - LED monitor 27"**

LED monitor produced with VA technology and 27-inch with Full HD resolution 1920x1080. As said before PVA technology provides good performance monitor. LED backlight decreasing consumption and increasing lifetime. The response is 4ms, Contrast 20000000:1 and brightness of 300 cd / m2. Viewing angle both horizontal and vertical reach 178 degrees. And the price is higher 5 500 CZK, but due to the properties is appropriate. At the need to reduce the price could be dialed even some of the smaller TN monitors with a price around 3800 CZK.

### **g) Optical Drive**

What for optical drives, DVD will definitely be elected minimum. And not only mechanics of this medium capable of reading, but also burn. As for the Blu-Ray and HD-DVD, movies on this medium, but also the games are on the rise and already relatively readily available. It would be good to pay a bit extra for at least the possibility of reading these media. HD movie resolution worth it.

- **Pioneer BDR-209DBK (bulk)**

Mechanics able to record and read Blu-Ray media at a reasonable price. In this category is too big possibility of selection for performance drives, but they are in most satisfactory. The same applies also to this. The only thing it is important to look at is the controller. Here is represented in the form of SATA 1.5GB. Price is around 2400 CZK. As a cheaper alternative, we could mount assembly only BD-ROM drive whose prices range within CZK 1,500 or Blu-Ray omitted altogether and take only DVD-RW drive. Their prices are just 500 CZK.

### **h) Case**

Here from far the price is not the most important thing. Workmanship and uses of cheap materials and assemblies are pitifully for this type of assembly insufficient. Physical parameters do not need no means an exaggeration. Standard size suits (miditower). Miditower case type tends to be about five 3.5 "and four sizes of 5.5". When we take into account that we do not plan to participate in the closet more than one graphics card, this size is more than enough. Number of discs also usually does not exceed the number two. As an important additional feature is worth mentioning case cooling. It does not count, although the components that has the required some better cooling, but cooling capacity should be at least average (usually 2 fans). If the case included source is obvious carefully weigh the its performance with respect to our planned assembly.

- **ZALMAN Z11**

ATX Case type miditower capable of holding all the components that we plan to use. Cooling provides one 120mm fan with the possibility of mounting a second of the same size. Price 1400 CZK is very welcoming.

### **i) Source**

For all computers applies the same, to calculate the consumption and keep the reserve. The largest share of total 234W will have graphics card and processor. With

adding components planned and possible future extension will choose a power source of 650W. Should choose from renowned brands. We save is unpleasant surprises in power fluctuations or failure. All sources tend to have a very high failure rate.

- **Corsair VS650**

Branded source providing required power 650W. Can supply 4 SATA devices and is ATX compatible. These features, along with the price around 1500 CZK make it a sensible choice.

★ **Average price for selected components of Home PC:**

**[www.alza.cz](http://www.alza.cz) – 27 490 CZK**

**[www.mironet.cz](http://www.mironet.cz) –29 590 CZK**

**[www.czc.cz](http://www.czc.cz) – 27 610 CZK**

## **5.4 Game PC**

In this specimen focus and major requirement will be clear. More than anything it will be a performance, but with the price we will also be handled carefully. We will look back on it less. There is a few who have unlimited funds to build a computer. Avid gamers will certainly willing to sacrifice his machine more money than was the case in the previous two configurations. After all, wants to play all the latest game titles in high quality and stutter-free and wants to be endured while these options. Thus, the obvious choice of machines with the highest possible power reserve and higher future upgrades. Mainly here is discussion about the graphics card, which is the highest demands. Operating memory quickly cease to provide sufficient capacity and speed, but the capacity can be easily solved by purchasing additional modules. Processor becomes obsolete in terms of gaming performance noticeably slower and its replacement, over time rarely performed. Among other things, due to the possible future pieces incompatibility with our motherboard socket.

**a) Processor**

Here we have a choice from a wide variety of upper class processor. For a summary from AMD is worth to mention Phenom II, that is not enough for efficient, but also more expensive Core i7. In our case this would be worthwhile to pay extra for Core i7. First you need to decide between the number of cores, four or six. Due to the power of quad-core CPU of higher class and lower price compared with the six-core, it would be appropriate to

choose rather a quad-core. The frequency should be around 4GHz and possibility to clocking the processor would not be a bad thing. Processors in our chosen category will definitely suffer from a lack of memory cache, but it has to be above it at least marginally think. Another important fact is to support the RAM memory. Perhaps all higher class processors already support DDR3. The only question is, what the frequency of memory are able to handle.

- **Intel Core i7-4790K**

This processor is one of the suitable options for our configuration. Entitlements of gaming machines is definitely handle and some time with him we only need. The number of cores is four and with support of Multi-Threading has eight threads. It is made 22nm technology and consumption is 88W. Its operating frequency is 4 GHz with overclocking capabilities. Supports DDR3 1333/1600 MHz. It also depends on the board, but this value can often increase. Minus of this piece is definitely a price ranging from 10000 to 12000 CZK. Without overclocking we get by with the supplied cooler, otherwise we would have to look for a more powerful.

- b) Motherboard**

At the micro ATX boards and smaller we will not even look at. It is an ATX motherboard rather provide sufficient space for an elected assembly. An important base for the processor, which must be compatible. As another priority element will be the presence of at least two PCIe16x slot to be able to connect two video cards. They must be sufficiently spaced apart relative to the size of the current graphic cards. Support for DDR3 will also be on-site with a sufficient margin in both the frequency and the maximum possible capacity expansion. Other parameters will be with us elected board upper middle class sufficient, such as a hard disk controller and integrated components.

- **ASUS Z97-PRO**

Suitable ATX motherboard compatible with our chosen processor. Supports DDR3 memory and frequency up to 3200MHz and capacity of 32GB which is quite a bit more than the currently required. It allows sufficient expansion in terms of optical drives and hard drives as SATA 3Gb SATA and 6 GB. The request to the possibility of connecting two graphics cards is also fulfilled in the form of three slots PCIe16x sufficiently spaced apart. Sound and network card present on the board reaches a satisfactory quality. Price around 4000 CZK.

### c) Operating memory (RAM)

Here we clearly select the DDR3 with 1600MHz frequency, due to the processor. This is certainly a sufficient speed. As another memory capacity arises. With Windows 8.1 would be appropriate to have a capacity of 16 gigabytes It is already relatively large amount, but again, the more the later will need to expand.

- **Crucial 16GB KIT DDR3L 1600MHz CL11 ECC Registered**

Pack of two memory modules at a frequency of 1600MHz and 8GB of each. This met our requirements for the selection of memory. These are modules from a reputable manufacturer. The timing corresponds to an improved standard (CL11). Their price is around 6000 CZK.

### d) Hard Disk Drive (HDD)

If we wanted to pay extra, so we can choose around 80 GB SSD and as a dedicated system for demanding games. As a second to other data just classic HDD. Today's applications and games, certainly do not require SSD and HDD can be easily enough. The author would rather vote for one HDD and purchase of SSD put off a later date when will be more affordable favorable prices. Meanwhile, the price per GB for SSD quite enormous. SSD also have a clear disadvantage in a limited number of entries. If we choose only the HDD, we will reduce costs considerably. For our purposes, therefore we choose the classic hard disk 3.5 ".

The most prominent on disk is always its capacity. This should be at least 500GB disk but every once filled, and so we might as well opt for a 1TB or more. As another come the revolutions per minute. There is the choice between 7 000 rpm and 10 200 rpm. The first option is slower, but the noise level will be lower again. Speed is also quite noticeable on the price of disks. A better choice would rather 7200rpm with good access time. Memory cache today is about 64 megabytes and even our selected disk it should have. The last question is the controller. We have a choice of SATA 3Gb or SATA 6Gb. The price difference between these two technologies is not so big, so SATA 6 Gb wins.

- **Seagate Desktop SSHD 2000 gigabytes**

Compliant disk with a capacity of 2TB and 8 GB NAND memory for faster starting and working and rotation speed 7200rpm. Provide sufficient capacity, latency is good (2.8ms) and extra cache memory with a capacity of 64 megabytes certainly happy. It has a

SATA 6 Gb, which we had thought when choosing a motherboard. It is an internal disk 3.5" whose price is around 3400 CZK.

#### **e) Graphics Card**

For gaming performance it is the most important. At the beginning we have to decide between one or more graphics cards. The author would rather recommend one powerful graphics card, but the board should have the possibility of a possible future extension to the two using CrossFire or SLI technology. Others would be if the user had planned involvement of multiple monitors, then two cards would have greater merit. But we will count on one card. Important will be the choice of the chip that would in this case should offer a good dose of power. When choosing we will certainly look at the chip rate, pixel shaders and vertex shaders. Here is a simple rule, the more the better. Also important is the memory that will definitely standard GDDR5. Its capacity should exceed 2GB and frequency should definitely go over 4GHz. Bus width of 320 bits is satisfactory, but 512 bits would certainly be a plus. As further the number of slots, which occupies the selected card. If we were to it soon wanted to purchase another one, this must take into account that these cards can fit side by side.

- **MSI Gaming R9 290x 8G**

It is one of the newer graphics cards and is equipped with chip AMD Radeon R9 290X. It achieves high frequencies (1000MHz) and the number of pixels (2816) and Vertex (2816) shaders is also good. It's a little more expensive piece of hardware, but the price corresponds to the demands imposed. The card is also compatible with CrossFire technology and can treat it on the board to connect a second, if required in the future stronger performance increase. Memory chip lag behind. GDDR5 is commonplace here. 8192 megabytes capacity and frequency of 5500MHz memory is more than sufficient. Another parameter could be better, but in this case will suffice. We are talking about the bus width of 512 bits. The problem with this card is weaker cooling, which, however, we will compensate with well ventilated case. Conversely advantage is the low power consumption if the card is not in the load. The load consumption reaches up to 250W. The price ranges from CZK 11 000 to CZK 14000.

#### **f) Monitor**

For players would be completely inappropriate TN technology. A frequent mistake is the choice of inexpensive monitor for expensive assembly and often just technology TN

monitor that looks pretty good on paper. For our purposes, therefore we choose rather MVA, PVA or IPS. Diagonal size will definitely vote of over 24 inches. For players, the primary response, it needs to minimize because of the nature of the use. Other properties should not lag behind.

- **BenQ BL2710PT**

IPS monitor technology of 27-inch and a resolution of 2560x1440, which is one of its properties, the optimum option choice. Mainly 4ms response is good. Other parameters correspond to lag and the used technology. Horizontal and vertical viewing angle is 178 degrees, contrast, unfortunately, only 1000: 1 and brightness of 350 cd / m2. It's not optimal, but the price is already high enough and that about 12500 CZK.

- g) **Optical Drive**

Because of today's games is already far not fit on a standard DVD, and often double layer is definitely need to choose the drive capable of reading Blu-Ray. For the needs of the player it is appropriate that this drive was able to record these media as well. Read speeds for these media are not so important. Available drives have sufficient speed. The only concern in this case, the controller and the color matching with the housing. The controller will be the most appropriate SATA 1.5GB.

- **Pioneer BDR-209DBK (bulk)**

This is the same mechanics as we have as a primary designed for home multimedia report.

- h) **Case**

Selection of cases in this case is more complicated. We have two main criteria of sufficient size for all components and perhaps future expansion and ensure sufficient air flow through the housing. Of course, the board must fit into it.

- **Cooler Master HAF 932 Advanced**

An example of an enclosure that meets our priority requirements. The size will be sufficient. It can be equipped five 5.25 "devices or the same number of 3.5". With an overview ATX motherboard fit into it. Cooling is provided by two standard 230mm fan. Thus, it should be ensured adequate airflow for our needs and if eeded extra cooling, it is possible case complement by two other fans. Price around 3600 CZK.

**i) Source**

In this case, the graphics card and processor require up to 338W. Consumption drives and by the number of disks in one of each should not exceed 40W with other parts of the computer total consumption fails to climb over 600W. But in this assembly we expect plenty of potential extensions from fans after another graphics card, and so we should reach for the source of power of about 800W.

- **Cooler Master Silent Pro M2 1000W**

This is a brand ATX power source of 1000W with good efficiency and sufficient possibilities as to the quantity of connected devices and encouraging the participation of two graphics cards. Price is around 4800 CZK.

- ★ **Average price for selected components of Game PC:**

**[www.alza.cz](http://www.alza.cz) – 62 320 CZK**

**[www.mironet.cz](http://www.mironet.cz) – 61 560 CZK**

**[www.czc.cz](http://www.czc.cz) – 56 150 CZK**



## 6 Conclusion

One aim of this work was to create an overview of current technologies and components of computer assembly. Clarifying their specifications, a brief statement of their roles and functions with a focus on the user. This objective was fully met in the first part of the thesis in a way appropriate to the extent thereof. By analyzing and processing information contained in books and electronic resources, has created a comprehensive overview facilitates orientation in the offered components greatly simplifies the correct choice.

Using data from the first work was also achieved the second objective. Thus was creating optimal designs computer configurations. Also author has provided information about how to choose the right components and suggested from his point of view to think about certain things before buying an assembly. Reports focused on office, home and play the latest games. Each was different in terms of the criteria for office equipment on the price, which eventually came to a very reasonable 8200 CZK from Mironet. There was not big difference on price between stores. With system requirements for usually used office applications of a minimum 1GHz processor, 1GB of RAM memory, more than 3GB of disk space, and with a minimum display resolution 1024x768. Low power consumption are reflected on the regular cost. At home kits was no longer so much about the price, but to optimize the best performance, affordable prices and eliminating the need in the short term to improve performance. System requirements for multimedia applications and games with a minimum requirements was at least 2GHz quad core processor, 2GB of RAM memory, more than 15 GB of disk space, graphics card with a minimum 1GB memory, with display resolution 1366x768 and DVD drive. The choice was therefore focused more on middle-class facilities. Thanks to the findings of the first part has managed to create a design exported home computer, whose main advantage is not having 29 590 CZK price from Mironet, but the possibility of functioning as a player, HD movies, and especially the fact that our machine lasts a long time in terms of performance provided. At home assembly but it is still relatively high price and thus been disclosed a series of compromises so as to bring the price more favorable to 27 490 CZK. The last proposed gaming machine had its price about 56 150 CZK from CZC definitely lacks focus on low price. For this type of machine was collected recommended system requirements from latest game titles which

was at least Core i5 quad core processor, 8GB of RAM memory, more than 35GB of disk space, graphics card with a minimum 4GB memory and Full HD display resolution and DVD drive. The selection was made but some compromises that amount not climbed even higher. Even so successfully design a very powerful gaming machine with a good possibility of future expansion, and to keep up with new game titles. Now think about the future us a little more spending at the beginning can save much larger sum in the future. This applies generally to each group. Finally the most expensive store is Mironet, the cheapest is CZC. And Alza has optimal prices.

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