**Performance of a Computer System**

I have been asked to upgrade a computer system so that it has maximum performance. I will explain how the width of the data bus and address bus affect processor performance and complexity. The following parts of the system will be changed/upgraded to ensure that the task is complete:

* The bit size of the CPU (32 or 64)
* The memory type
* The bus speed
* The address and data bus widths
* Any techniques you will use (e.g. DMA or memory mapping)

**Present Specification:**

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| --- | --- |
| Operating System | Windows XP sp3 |
| Bit Size | 32-bit |
| Processor | Intel Core i3 |
| Processor Speed | 3.10Ghz |
| Memory | 2.94 GB |
| Graphics Card | Intel ® HD Graphics Family |
| Buses | PCI Bus |
| DMA or Memory Mapping | DMA |

**Suggested Improvements:**

|  |  |
| --- | --- |
| Operating System | Windows 7 |
| Bit Size | 64-bit |
| Processor | Intel Core i7 3.6 GHz Processor |
| Processor Speed | 2.8 GHz |
| Memory Type | DDR3 |
| Bus Speed | 2400 MHz |
| Address Bus Width | 64-bit |
| Data Bus Width | 64-bit |
| DMA or Memory Mapping | DMA |

**Justification for New Computer System:**

**Operating System:** I have chosen Windows 7, and not Windows 8, as the operating system to use primarily because it has been tested and used and has been approved by people and organization all over the world. It is known for its easy use and speed. Windows 7 can easily be upgraded on the system that has Windows XP which is another advantage for the situation. The operating system involves remote access which is also a point to look at when comparing the different operating systems. The operating system is a 64-bit and therefore the data is transferred at double the rate of the older operating systems. In other words, the RAM is handled more effectively with the 64-bit operating system.

**Processor Type and Speed:** With a faster quad-core technology that applies processing power where it's needed most, Intel Core i7 processors delivers the fastest experience for users. With the equivalent to four processors in its heart, the speed and performance is 4 times faster than a normal every-day processor. Multi-tasking with maximum performance is also possible. There are high clock speeds and fast memory speeds.

**Memory Type:** DDR3 SDRAM transfers data at twice the rate of the older DDR2 SDRAM, enabling higher bandwidth. With 2 transfers per cycle of a quadrupled clock signal, a 64-bit wide DDR3 module achieves a transfer rate of up to 64 times the memory clock speed in megabytes per second. With data being transferred 64 bits at a time per memory module; this type of memory gives a transfer rate of:

*(Memory clock rate) × 4 (for bus clock multiplier) × 2 (for data rate) × 64 (number of bits transferred) / 8 (number of bits/byte).*

Thus with a memory clock frequency of 100 MHz, DDR3 SDRAM gives a maximum transfer rate of 6400 MB/s. The DDR3 also permits chip capacities of up to 8 gigabytes.

DDR3 memory uses 30% less power which is because of the difference in supply voltages: *1.8V or 2.5V* for DDR2 and *1.5V* for DDR3.

**Bus Speed:** 2400MHz is one of the highest speeds that can be achieved in the buses of the computer system. A bus is simply a circuit that connects one part of the motherboard to another. The more data a bus can handle at one time, the faster it allows information to travel. The speed of the bus is how much data can move across the bus simultaneously. We therefore want the highest bus speed available to ensure maximum performance and speed.

Address and Data Bus Width: The Width of the buses determines how much information can be held at one time, and obviously, the more information that can be held, the faster the rate of transfer. I have therefore chosen the 64-bit buses as they can hold maximum information within the buses. They are also compatible with the operating system that we are going to use. The width of the address bus determines the amount of memory a system can address. A 64-bit register can store 264 (over 18 quintillion) different values. Hence, a processor with 64-bit memory addresses can directly access 264 bytes of byte-addressable memory.

The data bus, on the other hand, determines how much data can be transmitted at one time. For example, a 16-bit bus can transmit 16 bits of data; whereas a 32-bit bus can transmit 32 bits of data and as for our case, 64-bits of data can be transmitted at one time.

**DMA:** DMA is a method used for transferring data from the computer's RAM to another part of the computer without using the CPU for commands. While most data that is input or output from your computer is processed by the CPU, some data does not require processing, or can be processed by another device. In these situations, DMA can save processing time and is a more efficient way to move data from the computer's memory to other devices. While DMA allows other devices to perform tasks without its involvement, the CPU can perform other tasks, parallel. More work is done in the same amount of time as a result.

To allow DMA, different cards are inserted into the CPU. Such as the graphics card or sound card, these can then perform the tasks without the CPU interfering. These are known as the DMA controllers. It may include:

* **Disk drives**
* **Graphics cards**
* **Sound cards**
* **Network cards**

In DMA, the CPU is not *completely* out of the process. It gives the command to the DMA and then gets on with its other jobs. This command includes the data and the address of the task. The devices then take over and raise an interrupt when they have finished the job. In this way, the CPU is kept out of the process throughout that time when it is actually happening.

**References:**

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