Which ram memory is better english language essay

Linguistics, English

IB Diploma ProgramEXTENDED ESSAY: Computer Science" Which RAM memory is better at different frequencies, DDR2 or DDR3?" Supervisor: Adnan ŠalakaStudent: BenjaminKukuljacWordcount: 3569Abstract3Introduction4Hardware and Software used5What is RAM? 9Explanation of RAM timings11Preparation for tests13TESTING15Conclusion23

Abstract

The research question of this essay " Which RAM memory is better at different frequencies, DDR2 or DDR3?" offers me opportunity to fully test their capabilities and check them against each other. There has been a lot of confusion about this topic and that’s why I picked to investigate it. Whole investigation was done on my personal components and I needed to use software which was mostly free for use but ones that are not offered trial version lasting 30 days which was more than enough for investigation. Conclusion was offered in two ways. Formal conclusion using table with scores of each benchmark and the second one is my personal opinion.

Introduction

Hardware of a computer defines that particular machines capability. Random Access Memory (RAM) is one of the key parts of computer because it helps it work much faster than it would without it. Today we have three generations of RAM memory each in possession of different qualities than other. When I first discovered that first generation of RAM is three times the price of third generation I was intrigued and eager to question why is it like that? I had an opportunity to hear argue between people about RAM memory and their

qualities. One said newer is better it has higher frequencies, other one answered that it doesn’t matter newest isn’t necessarily the best, his argument were lower latency timings of DDR2. So I decided to take some tests and find out " Which RAM memory is better at different frequencies, DDR2 or DDR3" My search began on internet mostly on IT forums to see if such discussion is developed and where will it take me. What I found is that people were still arguing, still nobody had answer which is better so I decided to see for myself. I will begin my writing by describing conditions memories were tested in. Providing you with some basic information about test materials and definitions of the RAM. Taking tests and commenting them as well as giving reasons why the results are like they are.

Hardware and Software used

Before I start with definitions and meanings I need to show specifications of computers I have used. I will write all the components of configurations used although not all parts are used or effect the investigation such as graphic card or sound card. Motherboard models are: 1. DFI Lan Party LT X48-T2R2. DFI Lan Party UT X48-T3RSProcessor: Intel Core 2 Duo E8400These motherboards support Intel processors and it was crucial to have if not one then two very similar processors in order for tests to be valid and true. RAM: 2x1GB Crucial Ballistix Tracer 800MHz2x2GB Kingmax 1600MHzAs this is most important part of investigation I picked two of each to have better comparison and freedom to change their frequencies and latency times. Graphic Card: BFG GeForce GTX260 OCXOne Nvidia graphic card was used although it doesn’t have any significant role in our testing. Sound Card:

Standard built in card was used without any significant function to the tests. HDD (Hard Disk Drive)Western Digital 320GB AAKS (SATA)Western Digital is a known brand with deserved reputation of best sellers of HDDs. It was important to have one HDD for testing due to accuracy of data if I had used two different Hard Drives the results would have changed and data would be incorrect. To be able to test two RAM memories I needed some software that would give me professional results and also some applications that are used most commonly like 7-ZIP and WinRar. The software that was used is: Operation System: Windows XP Professional SP3 32-bitI decided for Windows XP because it doesn’t have the visual themes that require as much as his successors and it was easiest to use since I have been using it for a long period now. DirectX: 9. 0cDirectX is a set of multimedia Application Programming Interfaces (API's) written by Microsoft. It is a collection of Dynamic Link Libraries (DLLs) that contain functions useful to a wide range of multimedia programmers, but are all almost entirely platform independent. DirectX provides a key set of tools and commands to enhance games and other multimedia applications allowing the hardware and the software to " talk" to each other with much greater ease. PCMark 2005The tests in PCMark05 are divided into different test suites depending on the part of the PC they measure. Test suite that was used was " Memory Test Suite". This application is capable of giving its overall grade of configuration as well as giving independent results of benchmarks of different components. Lavalys Everest Ultimate: Another application that is used for our benchmark comes from Everest legacy a widely known range of useful applications, and this one is used for benchmark of our RAMs. WinRarWorld known, probably

most used compressing tool ever, it offers us a real time test of how good our CPU and RAM work together. Super PiSuper Pi is software that is made for testing speed, accuracy and stability of RAM memory and it does it by calculating digits of Pi number after decimal point and it can reach amazing 32 million places. wPrime BenchmarkwPrime is a leading multithreaded benchmark for x86 processors that tests your processor performance by calculating square roots with a recursive call of Newton's method for estimating functions, with f(x)= x2-k, where k is the number we're squaring, until Sign(f(x)/f'(x)) does not equal that of the previous iteration, starting with an estimation of k/2. It then uses an iterative calling of the estimation method a set amount of times to increase the accuracy of the results. It then confirms that n(k)2= k to ensure the calculation was correct. It repeats this for all numbers from 1 to the requested maximum.

What is RAM?

RAM (Random Access Memory) is a form of computer storage. It is used to store information and to be able to retrieve and rewrite that memory much faster than Hard Drives because of their design where they need to search for data, separate it then retrieve it and do that over and over again. RAM is divided in two forms static (SRAM) and dynamic (DRAM). SRAM is storing 1 bit of data with a circuit that has two stable states and can be used to store state information. The circuit can be made to change state by signals applied to one or more control inputs and will have one or two outputs. This type of RAM memory is much more expensive to produce but is also much more effective so it is mostly used as cache memory in CPUs. DRAM memory is

slower and it uses a pair made of a capacitor and transistor. Capacitor has its role to hold the electrical charge on low or high level (state 0 and state 1) and transistor acts as a switch to release it through. DDR2 SDRAM is a double data rate synchronous dynamic random-access memory interface. DDR2 allows higher bus speed and requires lower than power than DDR by running the internal clock at half the speed of the data bus. The two factors combine to require a total of four data transfers per internal clock cycle. And that means that it is able to transfer doubled data the DDR could. With data being transferred 64 bits at a time, DDR2 SDRAM at memory clock frequency of 100MHz gives a transfer rate of 3200MB/sDDR3 is DRAM whose main advantage over DDR2 is that it is able to transfer data at double speed of DDR2. With two transfers per cycle of a quadrupled clock signal, a 64-bit wide DDR3 module may achieve a transfer rate of up to 64 times the memory clock speed in megabytes per second (MB/s). At 100MHz memory clock frequency DDR3 SDRAM gives transfer rate of 6400MB/s. Each memory module is defined by two values. Frequency at which it works and latency timings.

Explanation of RAM timings

RAM modules possesses many timings but only few are very important . Similar to an Excel spreadsheet, memory is also organized into a grid of rows and columns. To activate a row of RAM, we have to send to memory controller the address of the row we’re interested in, and similarly, to activate a column, we have to send it the address of the column we’re interested in. CL represents a delay time before memory controller sends

signal to memory module to find and access certain module on RAM. The lower CL time is the better. When buying a memory its timings are usually listed like this: 7 - 7 - 7 - 24. All these numbers have their meanings and names tCL-tRCD-tRP-tRAStCL - delay time between processor asks for data and memory returning ittRCD - Once we send the memory controller a row address, we'll have to wait this many cycles before accessing one of the row's columns. So, if a row hasn't been selected, this means we'll have to wait tRCD + tCL cycles to get our result from the RAM. tRP - When row is selected tRP represents time needed to select another row. tRAS - This is the minimum number of cycles that a row has to be active for to ensure we'll have enough time to access the information that's in it. This usually needs to be greater than or equal to the sum of the previous three latencies but it doesn't exclude possibility that it might be lower than sum which our DDR3 memory confirms by having tRAS= 24 while sum of all other latencies is 27 (tRAS = tCL + tRCD + tRP).

CPU

˂˃tRAStRPˆ tRCD

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For an easier explanation of above values I will illustrate how they work on a library example. CPU represents us the ones who wants a book, CPU wants data. CPU is sending a request for data from RAM, as we are requesting the librarian to find us a certain book. tRCD represents time needed for librarian to go from one row to another same as in RAM time needed for memory to change rows. tRAS is time due which memory have to find information

needed so that represents time our librarian has to search for a book in that row. tRP time stands for time limit that librarian can spend on the ladder once she found the book. So once memory has found data it has tRP time to read it and take off the ladder. tCL is time needed for data to come back from RAM to CPU.

Preparation for tests

Our DDR2 memory had these starting latencies 4 - 4 - 4 - 12, and DDR3 hadlatencies as this: 6 – 6 – 6 - 18For testing of these memories we needed to overclock them so we could achive different frequencies and different latency timings. Only well known method for overclocing CPU and RAM is via BIOS. Using BIOS I have been able to increase DDR2 and DDR3 memory frequencies while suppressing as much as I could their latencies for the computer to work stable. DDR3 memory has been clocked to 1800MHz from 1333MHz and latencies have been increased from 6 - 6 - 6 -18 to 9 - 9 - 9 - 24DDR2 had increase from 800MHz to 1200MHz and latencies went from 3 - 3 - 3 -10 to 5 - 5 - 5 - 18. How it is done: BIOS enable you to edit basic parameters of some of components before system starts to boot. With our motherboard unlike the newer ones we had everything on a plate. All we needed to do is to play with latencies which had certain limits. As for newer motherboards with never CPUs the method is different because of few inventions that are made and implemented in them and I will explain method in short terms. I will describe this method because I used it myself on my new computer and it doesn’t hurt to know. RAM speed is equal to BCLK multiplied by memory multiplier. For the beginning I have to explain what

BCLK means. If you were to overclock Intel CPUs before you would have to play with different values of FSB and multiplier. FSB now has been replaced with BCLK. To illustrate why it is like that and to explain FSBs function imagine FSB with a highway. All highways have multiple lanes that are going to two directions. Those lanes are lanes where data is transferred trough. FSB would be doing a good job as highways do, but highways still get congested don’t they? When everyone is going home at 5 o’clock you can experience long waits because everyone is trying to use same road. Same as highway FSB slows down because multiple components are trying to use same road at the same time. QPI was made to reduce that slowdown by providing direct connection between all the main components therefore releasing main bus of congestions. With QPI system BCLK is used to determine frequencies of all major components such as memory, QPI, CPU. This means that if BCLK is overclocked and increased or decreased speeds of all the components that share QPI are going to increase or decrease. Now that we know what BCLK stands for we know how we can overclock our memory frequencies. We can try to gradually raise our memory multiplier for our BCLK to stay the same. If that is not enough we can increase BCLK too but since this is memory test not CPU we can decrease multiplier of CPU and therefore get the same or close to same CPU speed we started with.

TESTING

As we can see on PC Mark 2005 on memory test DDR3 1800MHz CL9 took the first place. What we can conclude from this is that CL rates do not really affect testing with this application but memory speed. DDR3 1800MHz CL9 is

followed by fairly slower DDR2 1200MHz CL5. Interesting is that DDR3 at CL9 is better than DDR2 at CL5 but DDR2 at CL5 is better than DDR3 1600MHz CL7 which implies that latencies have some impact on final result and what we can see on the graph DDR2 1200MHz CL5 with much slower speed but tightened latency is very close to leader DDR3 1800MHz with default latency CL9 and the difference is only 37 points which is small compared to DDR2 800MHz CL3 which is on the last place with 7417 points and 566 behind the leader. As we can see on Everest memory test we tested our RAM in three phases. Reading, writing and copying data. We will start with reading section. Everest reading test showed that latencies do have their role in speed of reading. DDR2 1200MHz CL5 finished as a winner with capability of reading 9372 MB per second. Second finished DDR3 1600MHz CL7 although with higher frequency it had higher latency . Surprisingly DDR2 1066MHz CL4 and DDR2 800MHz CL3 took last two places despite their low latency rates. Writing test was pretty much same they all had writing capability over 8500 MB per second and values at end are pretty close. One thing worth mentioning is that DDR2 800MHz CL3 finally stood up on ladder taking second place but considering data in range of 8504 to 8600 the score of DDR2 800MHz CL3 of 8549 was pretty much behind the leader DDR3 1800MHz CL9 with 8600. Copying was pretty much dominated by DDR3 1800MHz CL9 with astounding 9430MB per second that’s 1032MB difference from second place DDR3 1333MHz CL6 at 8398MB per second. Almost 1GB difference. It confirms us that for copying part speed is what matters most. Contrary to that we have DDR3 1333MHz CL6 on second place with 8398MB while on fourth place DDR3 1600MHz CL7 is holding with 8302MB. It is not

much of a difference but we can certainly conclude that latency has its role in it. For 7-ZIP we have different test mark MIPS. MIPS stands for " Million instructions per second". Surprisingly DDR2 1200MHz CL5 is a victor with 7015 MIPS, following him comes DDR3 1800MHz CL9. Conclusion that comes from this is that speed is not much effective in these tests as we can see and DDR2 800MHz CL3 moved to fourth place this time. Speed has its factor but latencies are decisive. Like in Everest writing test scores are pretty close this time with a gap between first and second place. In WinRAR I tested time needed to unzip a 2GB archive. The lower the time was the better. This test shows that all tested frequencies had similar results, the gap between first and last place was 7 seconds. First place took DDR2 1200MHz CL5 with 52 seconds needed to unpack the archive. Super Pi 1M was really interesting test to me because it showed me something that is almost touchable the time memory needed to reach one million decimal places behind Pi number. The lower time is better time. Despite large latencies DDR3 1800MHz CL9 took a first place with 12, 756 seconds needed to reach one millionth decimal place. Second following is DDR3 1333MHz CL6 with only 0, 003 s behind. As always DDR2 1200MHz CL5 is hanging good in there holding third place together with 1600MHz CL7 and it showed that frequency has most part in the benchmark rather than latency. Smaller time is better. wPrime showed that DDR3 1333MHz CL6 was fastest due to his reduced latencies and he represents medium value of frequency/latency ratio. Although all timings fit in range of 21. 8 to 22, 5 seconds there are gaps between first three places that are visible. DDR3 1800MHz CL9 had its run with 21, 992 seconds although he has biggest latencies it seems that frequency is what is

pulling this one from test to test. DDR2 1200MHz CL5 shows itself on third place and sets its ground comfortably as he averagely finishes on second place. Surprisingly double faster DDR3 1600MHz CL7 couldn’t beat its precursor DDR2 800MHz CL3 who seems to be on this place only due to his low latency rates.

Conclusion

Since all frequencies tested finished all tests I decided to grade them with points. Scale goes like this: 1st place: 5 points2nd place: 4 points3rd place: 3 points4th place: 2 points5th place: 1 point6th place: 0 pointsThis table will not be my guide for the final conclusion but it will show us differences between all tested memories. When all scores are summed and sorted final standings look like this: Memories/TestsPC MarkEverest: ReadEverest: WriteEverest Copy7-ZIPWinRarSuper Pi 1MwPrime 32MTotal: DDR3 1800MHz5355445435DDR2 1200MHz4533553331DDR3 1600MHz3422333020DDR3 1333MHz1204024518DDR2 1066MHz2111122212DDR2 800MHz0040221110Total: 151515151515181815126When I began to write this essay I was thinking which frequencies would be best to test DDR2 and DDR3 against each other. If I used only standard frequencies the result that I would get was that DDR3 working at 1333MHz is almost two times better than DDR2 at 800MHz. But now from the results we can see that DDR2 overclocked at 1200MHz rips off DDR3 at 1600MHz by half and it shows us what little bit of overclocking can do and what potential is hidden in that memory. One surprise to me was that the gap between DDR3 1800MHz and DDR3 1600MHz is so big that it is

unbelievable. Although DDR2 at 1200MHz took second place and beat almost all DDR3 and DDR2 memories the only way it was achieved is by overclocking. That is a process that if done incorrectly could damage your memory or even worse it could damage other components. It requires a lot of repetitive work of changing values one by one and also if you’re not satisfied with what you can get within the limits you can change the voltage and that’s when the problems occur. To be able to decide which memories won at which frequency range I divided them in three pairs. First pair would be DDR2 at 800MHz and DDR3 at 1333MHz. The reason I have DDR3 memory at this frequency is because I wanted to see how it will act on lower frequencies so I downclocked it. Also DDR3 1333MHz used to be standard when DDR3 memories just came on the market so I basically compared two of the standard memories. From results we see that DDR3 won by almost double amount of points scored on tests. Second pair would be DDR2 at 1066MHz and DDR3 at 1600MHz. In this case only DDR2 memory is overclocked as DDR3 was already at this frequency when first bought. From the tests we can conclude that DDR3 won by 8 points difference which is a lot. When first looking you would say that DDR3 won just because of crude speed of its module but when we look at latencies difference we have DDR2 at CL4 and DDR3 at CL7 which is considerably wide difference. This puts one more question in my mind, is latency that much important or is it frequency who dictate the speed. Third and the last pair is DDR2 at 1200MHz and DDR3 at 1800MHz. my achievement. DDR3 had its frequency clocked by 200MHz and DDR2 by 400MHz. Now, anyone who has ever engaged in any overclocking business knows that rise of 400MHz at stock components is

considerable achievement for someone doing it at home. Considering very big difference in frequencies with a gap of 600MHz the score that DDR2 achieved in my opinion is better than DDR3. DDR3 did won by final points and everything but it has also considerably higher speed than DDR2 and DDR2 still finished second beating DDR3 at 1600MHz and 1333MHz. In the third pair my call is that DDR2 won. Overall, DDR3 takes the victory and by that answers the research question " Which RAM memory is better at different frequencies, DDR2 or DDR3?" with the answer DDR3. It has proven itself as better in two out of three cases of different frequencies. What is important to add is that DDR2 at 1200MHz showed itself in best possible way and should not be considered as weaker memory in any way. If other frequencies were just as effective as 1200MHz DDR2 would took the victory for sure.