

AN506: Performance Impact of Changing Memory Size from 1 GByte to 2 GByte

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Introduction

This report will explore the relationship between a system’s memory array size and its performance. We will build test setups based on current popular hardware and run a variety of benchmarks using both one gigabyte (1 GByte) and two gigabyte (2 GByte) memory array sizes, while keeping memory settings constant. We will tabulate these results and see what conclusions can be drawn.

Test Setup

In order to generate a comprehensive set of results, test setups were constructed based on both the Intel and AMD processor platform. System configurations for the tests were as follows:

Test Platform 1: AMD

For the AMD test platform, the following components were selected:

- Processor: AMD Athlon64 FX57
- Motherboard: Asus A8N-SLI Premium
- Video: Nvidia GeForce 6600GT
- Hard Drive: Western Digital Caviar 250GB SATAII

The system was tested with the following memory configurations:

- 1 GByte testing: For this testing we used the TWINX1024-3200C2. This is a matched pair of 512 MByte modules, each built with sixteen 32Mx8 DDR RAMs. Memory frequency was set to 400 MHz with latency settings

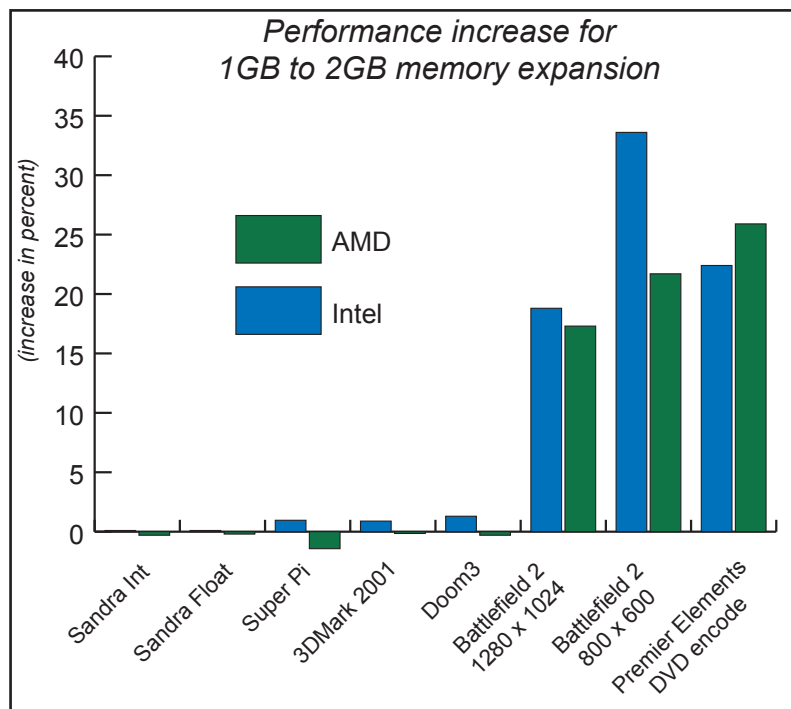


Figure 1. Performance increase for increased memory size



of 2-3-2-6-1T.

- 2 GByte testing: For 2 GByte testing we used the TWINX2048-3200C2. This is a matched pair of 1 GByte modules, each built with sixteen 64Mx8 DDR RAMs. Memory frequency was set to 400 MHz with latency settings of 2-3-2-6-1T.

Test Platform 2: Intel

For the Intel test platform, which uses DDR2 memory, the following components were selected:

- Processor: Intel P4 540, 800MHz FSB, 3.2 GHz
- Motherboard: Asus P5ND2-SLI
- Video: Nvidia GeFORCE 6600GT
- Hard Drive: Western Digital Raptor 36 GByte

The system was tested with the following memory configurations:

- 1 GByte testing: For 1 GByte testing we used the TWIN2X1024-6400. This is a matched pair of 512 MByte modules, each built with eight 64Mx8 DDR2 RAMs. Memory frequency was set to 800 MHz with latency settings of 5-5-5-12-2T.
- 2 GByte testing: For 2 GByte testing we used the TWIN2X2048-6400. This is a matched pair of 1 GByte modules, each built with sixteen 64Mx8 DDR2 RAMs. Memory frequency was set to 800 MHz with latency settings of 5-5-5-12-2T.

Benchmark Descriptions

The following benchmarks will be used to measure system performance:

- SiSoft Sandra 2005 - This system diagnostic has a memory benchmarking tool that is designed to measure memory bandwidth. It provides two output values; one for integer processing, and one for floating point processing.
- Super Pi - Super Pi is a simple application which calculates pi to a specified number of digits. One million digits were chosen for this benchmark. We will measure the time in seconds it takes to complete this calculation.
- 3DMark 2001. The 3DMark benchmarks are game-oriented, and are designed to estimate the relative gaming performance of the system under test. 3DMark 2001 is the release of this popular benchmarking program which shows the most significant performance variance based on system memory configuration.
- Doom 3 timedemo, demo1 - This demo is included with the retail version of Doom 3, and provides a measurement of frames per second. By setting display resolution to 640x480 pixels, the benchmark score focuses on CPU and memory performance, rather than video card performance. This is a real-world benchmark, completely based on a retail game that is available to the public.
- Battlefield 2 Flight Demo - This is a demo created by Corsair from within the retail version of Battlefield 2, a popular retail game recently released by Electronic Arts. This game is generally thought to require large amounts of system memory. The demo was run using



screen resolution settings of 800x600 and 1280x1024.

- Adobe Premier Effects, DVD Encoding - This benchmark was created by Corsair using Adobe Premier Effects, a popular DVD authoring application. The benchmark measures the time required to encode a DVD based on a sample movie composed of video, still photographs, and music.

Test Results

Test results are shown in Table 1, and percentage performance increases are shown in graphical form in Figure 1, which can be found on page 1. Results are summarized below.

Test Name	Intel		AMD	
	1 GB	2 GB	1 GB	2 GB
Sisoft Sandra - Int	4879 MB/s	4905 MB/s	5879 MB/s	5862 MB/s
Sisoft Sandra - Float	4881 MB/s	4913 MB/s	5944 MB/s	5935 MB/s
Super Pi 1M digits	41.8 sec	41.4 sec	48.8 sec	48.1 sec
3DMark 2001 SE	17927	18087	21610	21578
Doom3 timedemo 640x480	90.5 fps	91.7 fps	134.5 fps	134.1 fps
Battlefield2 flight demo 1280x1024	30.8 fps	36.6 fps	31.2 fps	36.6 fps
Battlefield2 flight demo 800x600	50.3 fps	67.2 fps	57.1 fps	69.5 fps
Adobe Premier Effects	737 sec	572 sec	673 sec	499 sec

Table 1. System performance versus memory size

form in Figure 1, which can be found on page 1. Results are summarized below.

SiSoft Sandra

As Sandra is a test specifically designed to measure memory bandwidth, we expected to see no significant improvement when moving to the higher memory density. As all memory settings were equivalent, the bandwidth should be identical. As expected, the impact on Sandra scores was insignificant, showing a variance of less than one percent on both AMD and Intel platforms.

Super Pi

Super Pi is generally an excellent indicator for measuring the impact of memory settings changes. However, we suspected that we would not see a significant improvement when moving to the larger system memory array, as our suspicion was that this relatively simple algorithm did not use a large amount of main memory. This suspicion was confirmed, as we saw an improvement of less than one percent when moving from 1 GByte to 2 GBytes of system memory.

Super Pi is generally an excellent indicator

3DMark 2001

Of all the benchmarks in the 3DMark series, 3DMark 2001 tends to exhibit the most variance when memory parameters are changed. However, the data shows that changing the size of the main memory array while keeping other settings constant results in a negligible performance change for this benchmark.

Doom3 Timedemo

When first released, Doom 3 was rumored to require more memory than most games. Subsequent testing seemed to confirm that it ran very well with 1 GByte of memory. This testing exercise confirmed this conclusion, with Doom 3 showing an insignificant variance on the AMD platform and a 1.3 percent increase on the Intel platform.



Battlefield 2 Flight Demo

We were very eager to run testing on Battlefield 2, as current user feedback indicated that this game performed much better with larger amounts of memory. As expected, the increase in memory array size from 1 GByte to 2 GBytes had a very substantial performance impact on this game. We found this to be the case regardless of processor platform, as well as regardless of screen resolution. In fact, our testing consistently showed an even greater performance benefit of the larger memory array when running at reduced (800x600) screen resolution.

Adobe Premier Effects

DVD encoding showed perhaps the most significant performance increase as a result of adding system memory. Performance was improved on both the Intel and AMD platforms by well over twenty percent. This performance gain is particularly important because it results in a significant reduction of the time required for the computer to perform a lengthy, time-consuming task, rather than doing something more subjective like increasing the quality of a gaming experience.

Summary - Real World Benefits of 2 GByte

Since PC3200 dual channel systems came to market in early 2002, one gigabyte of RAM has been the standard for enthusiasts building performance computers. And, this testing shows that for many applications, one gigabyte is still the sweet spot, regardless of computing platform.

However, as games and applications continue to progress in scope and complexity, we are beginning to see significant situations where more memory provides compelling benefits. As is often the case, a new ground-breaking game leads the way; Battlefield 2 in the current instance. Perhaps more significantly, ground is also being broken by general purpose consumer applications, notably DVD encoding, which is becoming increasingly popular among a variety of home users. We expect to see this trend continue as new, more sophisticated games, applications, and operating system versions are launched over the next several months.

The performance increase realized in real-world applications like Battlefield 2 and Premier elements indicate that the current generation of enthusiast systems will certainly benefit from the selection of 2 GByte memory arrays. These benefits will become greater in the next six months as new memory-intensive applications and games are brought to market.