PHYSICAL CORES V. ENHANCED THREADING SOFTWARE:
PERFORMANCE EVALUATION WHITEPAPER

Preface

Today's world is ripe with computing technology. Computing technology is all around us and it's often difficult to decipher what is actually being offered at any given moment with any given advancement. Oftentimes advancements can come so quick that we do not take the time to understand the importance it has on our fields.

One such advancement in computing technology is *Parallelism*. Parallelism is defined by the execution of many computing calculations carried out simultaneously. The foundation behind parallelism is that large calculations can be completed quicker if they are divided into smaller calculations and all solved in parallel, hence the root definition of the word. Parallelism has just recently achieved mass popularity in the technology industry long after the advent of the microprocessor.

Recent physical constraints like power delivery and heat dissipation, and the need for higher clock frequencies have made single-core processors outdated. Parallel computing capabilities enabled in common software applications coupled with advances in microprocessor technologies have made multi-core processors the preferred architecture for today's PCs. Multi-core processors standout and are differentiated by their core-count, or the amount of physical cores contained on the processor die itself. Core-count differentiates processors and is often used in the nomenclature: i.e.: "the AMD Phenom™ II X4, *quad-core* processor".

Parallelism and multi-core processors go hand-in-hand. When large calculations are divided into many smaller calculations it is best to have dedicated technology resources ready to work on each of those smaller calculations simultaneously. This is where the performance of physical multi-core processors really begin to shine, and where multi-core processor technology shifts from a *want to have* to a *must have*.

Introduction

In this performance evaluation whitepaper we are going to examine the difference between dedicating processor cores to completing smaller calculations simultaneously versus the speed of enhanced threading software on cores.

Performance Measurements[1]

For this performance comparison we'll be comparing four different processors, two from both AMD and Intel. The list of processors used for the performance evaluations is listed in Figure 1. The two AMD processors both have six cores each while the two Intel processors both have four cores each.

Figure 1:

Model Name	Company Make	# of Cores	Clock speed (Frequency)	Total Cache (L2+L3)
AMD Phenom™ II 1090T	AMD	6	3.2GHz	9MB
AMD Phenom™ II 1055T	AMD	6	2.8GHz	9MB
Core™ i7 930*	Intel	4	2.8GHz	8MB
Core™ i5 750	Intel	4	2.66GHz	8MB

** Equipped with Intel Hyper-Threading™ Technology*

Apart from their brand and model numbers, both Intel processors appear very similar, and are primarily differentiated by their clock speeds. Both the Intel Core™ i5 750 and Intel Core™ i7 930 are equipped with four cores and 8MB of total cache. One key difference between these two processors is that the Intel Core™ i7 930 processor has a feature called *Intel Hyper-Threading™ Technology*. Intel Hyper-Threading™ Technology utilizes Intel's proprietary software to enhance the computing capabilities of thread processing on each of the Intel Core™ i7 930's four cores.

[1] Results based on performance testing completed at AMD performance labs on 05/01/2010. Please see pages 9-11 for both AMD and Intel system configurations used in testing.

Performance Benchmarking

For the purpose of this exercise performance will be measured and based on benchmarking applications that will focus on threading.

Benchmarks Used:

Maxon® CINEBENCH™-
http://www.maxon.net/index.php?id=162

Persistence of Vision Raytracer (POV-Ray)-
http://www.povray.org/

Measuring Results

The results of the Maxon® Cinebench™ and Persistence of Vision Raytracer® (POV-Ray) on all four processors are recorded in Figure 2 below.

Figure 2

Model	# of real cores	Clock speed	CINEBENCH Raw score	POV-Ray Raw score
1090T	6	3.2GHz	5.65	4306
1055T	6	2.8GHz	5.0	3743
i7-930	4	2.8GHz	5.03	3634
i5-750	4	2.66GHz	3.75	2709

The AMD Phenom™ II X6 six-core processors excel at straight-forward threading exercises because they contain physical cores dedicated to performing the functions.

Individual core performance of both AMD processors in Maxon® Cinebench™ and Persistence of Vision Raytracer ® (POV-Ray) is calculated by dividing the total score of each benchmark by the number of physical cores contained on the processor used.

Cinebench: AMD Phenom™ II X6 1055T = 5.0/6 cores = 0.83

PovRay: AMD Phenom™ II X6 1055T = 3743/6 cores = 623.8

With the Intel Core™ i7 930 and Intel Core™ i5 750 processors, the calculation for performance is different. To examine the performance which can be attributed to Intel's Hyper-Threading™ Tehnology, performance is based on the difference in scores between the Intel Core™ i7 930 (4-core + 4-Hyper-threads) and the Intel Core™ i5 750 (4-core). Finally, the result is divided by four to isolate the performance attributable to the additional threads enabled by Intel Hyper-Threading™ technology.[2]

Cinebench®:

Intel Hyper-Threading™ Technology Performance

= Core™ i7 930 score less Intel Core™ i5 750 score

= (5.03-3.75)/4 = 0.321

PovRay®:

Intel Hyper-Threading™ Technology Performance

= Core™ i7 930 score less Intel Core™ i5 750 score

= (3436-2709)/4 = 231

[2] Isolated Intel Hyper-Threading results is a theoretical calculation constructed by AMD to estimate performace attributable to Intel Hyper-Threading software.

Comparing Results

When examining how much additional performance may be gained by an *increasing physical processor core count* versus *software that boosts the threading ability on existing cores*, we find based on our testing that physical processing cores have a direct performance advantage over enhanced threading software. When looking at the direct results of our testing we find:

Cinebench®:

The performance attributable to a core of the AMD Phenom™ II 1055T Six-Core Processor = 2.6 times faster than the threading enhancement achieved on the Intel Core™ i7 930 Processor
0.83/0.321 = 2.6

PovRay®:

The performance attributable to a core of the AMD Phenom™ II 1055T Six-Core Processor = 2.7 times faster than the threading enhancement achieved on the Intel Core™ i7 930 Processor
623/231 = 2.7

When we examine the AMD Phenom™ II X6 1090T Six-Core processor the performance advantage against enhanced threading software becomes even greater:

Cinebench®:

The performance attributable to a core of the AMD Phenom™ II X6 1090T Six-Core Processor = 2.9 times faster than the threading enhancement achieved on the Intel Core™ i7 930 Processor

0.942/0.321 = 2.93

PovRay®:

The performance attributable to a core of the AMD Phenom™ II X6 1090T Six-Core Processor = 3.1 times faster than the threading enhancement achieved on the Intel Core™ i7 930 Processor
718/231 = 3.1

Conclusion

Based on the results of the Cinebench® and PovRay® benchmark tests, we find that physical cores outperform enhanced threading software in certain applications. Although direct results will always vary upon the system configurations used, we find that a microprocessor's physical core count to not only be an important factor to consider in the purchase of a new PC, but also enhances its longevity.

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Testing Configurations Used

AMD System Specs:

AMD Processor-Based System Configuration Information	
AMD is required to identify hardware and software used in evaluation configurations that are NOT publicly available.	
Operating System	
Name:	Win7 64bit Ultimate
Processor	
	AMD Phenom II X6 1055T
	AMD Phenom II X6 1090T
Hardware	
Motherboard:	Talapia I (Reference Board)
BIOS Info:	A7640AMS.10i
Is BIOS publicly available?	Yes
Chipset:	RS880 + SB750
Memory	
Manufacturer & Type:	**Corsair CM2X2048-8500C5D**
Quantity & Size: (each)/(MB)	Qty (4) 2048MB DIMM Module
Total Memory Size: (MB)	8 GIG Total
Hard Drive	x1
Model Name:	Western Digital Raptor
Model Number:	**WD300HLFS WD VelociRaptor**
Hard Drive Size:	300GB

Transfer Mode:	SATA 10000 RPM
Other Info:	NTFS was used to format the hard disk
Network Card	Onboard
Sound Card	Onboard
Video:	
Graphics Adapter:	Sapphire ATI Radeon HD 5870
Memory Size (MB) and Type:	1GB DDR5

Intel System Specs

AMD Processor-Based System Configuration Information	
AMD is required to identify hardware and software used in evaluation configurations that are NOT publicly available.	
Operating System	
Name:	Win7 64bit Ultimate
Processor	
	Intel Core i7 930
	Intel Core i5 750
Hardware	
Motherboard:	Intel DX580SO
BIOS Info:	5020
Is BIOS publicly	Yes

available?	
Chipset:	RS880 + SB750
Memory	
Manufacturer & Type:	**Corsair CM2X2048-8500C5D**
Quantity & Size: (each)/(MB)	Qty (4) 2048MB DIMM Module
Total Memory Size: (MB)	8 GIG Total
Hard Drive	x1
Model Name:	Western Digital Raptor
Model Number:	**WD300HLFS WD VelociRaptor**
Hard Drive Size:	300GB
Transfer Mode:	SATA 10000 RPM
Other Info:	NTFS was used to format the hard disk
Network Card	Onboard
Sound Card	Onboard
Video:	
Graphics Adapter:	Sapphire ATI Radeon HD 5870
Memory Size (MB) and Type:	1GB DDR5