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Multi-core Processors– A New Approach Towards Multiprocessing

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Abstract: ***A multi-core processor is a single computing component with two or more independent processing units also called as cores, which are the units that read and execute programming instructions. Addition of parallelism, Concurrency, Synchronization, Hyperthreading have enormously increased processing power of computer system [1, 2] This paper gives briefing upon evolution of multi-core processors and its performance over single core processors.***

Keywords: Microprocessor, Multi core, multi threading technology.

I. INTRODUCTION

The microprocessor industry continues to have great significance in the course of technological improvements ever since their coming to existence. The growing market and the demand for faster performance drove the industry to manufacture faster and smarter integrated chips. One of the most classic and approved techniques to improve performance is to clock the chip at higher frequency which enables the processor to execute the programs in a much quicker amount of time.

Additional techniques have also been introduced to improve performance including parallel processing, data level parallelism and instruction level parallelism, synchronization which have all proven to be very effective[1]. One such technique which improves significant performance improvement in multi-core processors. Multiprocessor are present since last few decades and existence of Multicore processors have been improved performance and efficiency of machine.

II. SINGLE-CORE PROCESSOR

Single core processor means an integrated chip with one **CPU** (one processing unit). Microprocessors have been **single core** since their inception in the early 1970s. After the turn of the century, chips with two or more CPUs emerged. A processor or microprocessor is a small chip that resides in computer and other electronic devices. It is considered as the intellect of a computer. Its basic job is to receive the input and provide the appropriate output. While this may seems like to be a simple task, modern processors can handle trillions of calculations per second.

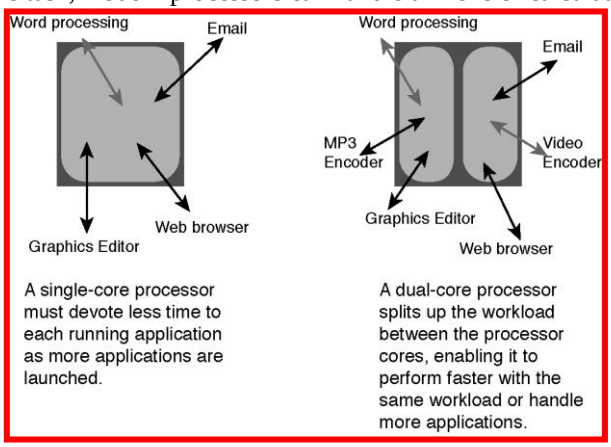

Fig.1 Single and Multicore CPU.

III. MULTI-CORE PROCESSORS

"A Multi-core processor is typically a single processor which contains several cores on a integrated chip" [7]. Integration of multiple processor cores on a single chip to provide a cheap parallel computer solution and to increase the computation power to Personal Computer platform. Multi-core processor is a special kind of multiprocessors: also called Chip— All processors are on the single chip . MIMD: Different cores execute different programming codes (threads or processes) operating on different data. A shared memory multiprocessor: all cores share the same memory using cache memory organization.

Because the cores act independently in a multi-core processor, they are better prepared to perform multiple tasks at the same time when compared to single-core processors. The variation between dual-core processors and other multi-core

processors is most noticeable when multitasking. Multicore processors can perform multiple tasks at the same time better than single core processors. When you have a single task that needs to be done right away, multiple cores can help you by breaking the task into smaller sub modules, working on each chunk in parallel, and thus you'll get your work done faster.

IV. COMPARISION BETWEEN SINGLE CORE AND MULTICORE PROCESSOR

A. Processor Tasks Analysis

In today's computing world modern operating systems such as Windows XX, Linux or Mac OS X consists of many running processes at the same time. For example, one process manages memory resources, another sends documents to a printer for printing, and a third checks for interrupt which thorough different attached input and output devices. In addition to operating system tasks, the processor also runs Web browser, video player, real time clock and other application programs.

B. Memory Bandwidth Utilization

Although a multi-core processor has multiple CPUs, they share other components, such as random access memory. Memory bandwidth, the speed at which the processor chip accesses data in RAM, can become a bottleneck when all the processors need to read information and store results.

V. MAJOR CHALLENGES FACED BY MULTI-CORE PROCESSORS

A. Power and Temperature management

If two cores were placed on a single chip without any modification, the chip would, in theory, consume twice as much power and generate a large amount of heat.

Run the multiple cores at a lower frequency to reduce power consumption integrating lots of smaller cores. Each individual core delivers lower performance than a large complex core instead of integrating multiple complex cores on a die include a power management unit that has the authority to shut down unused cores or limit the amount of power. The chip is manufactured so that the number of hot spots doesn't grow too large and the heat is spread out across the chip.

The processor consists of a common trend to build temperature monitoring into the system, with its Temperature management unit.

B. Cache coherence

Cache coherence is a factor in a Multicore environment because of distributed L1 and L2 cache. Since each core has its own cache, the copy of the data in that cache may not always be the most up-to-date version as per modification due to various transactions.

If a coherence policy wasn't in place garbage data would be read and invalid results would be generated, possibly crashing the program or the entire computer system.

In general there are two schemes for cache coherence, a snooping protocol and a directory-based protocol.

The snooping protocol only works with a bus-based system implementations. The directory-based protocol can be used on an arbitrary network and is, there-fore, scalable. In this scheme a directory is used that holds information about which memory locations are being shared in multiple copies.

Directory based protocols are alternatives to snoopy based protocols which achieve low latencies and high bandwidth because of broadcasting and this protocol is implemented in present day technologies like in Intel Core2Duo processors.

C. Multithreading

The most important, issue is using multithreading or other parallel processing techniques to get the best performance out of the Multicore processor.

Rebuilding applications to be multithreaded means a complete rework by programmers in most cases to write applications with subroutines able to be run in different cores.

Applications should be balanced. If one core is being used much more than another, the programmer is not taking full advantage of the Multicore system.

VI. CONCLUSIONS

Power and frequency limitations observed on single core implementations have paved the gateway for multi-core technology and will be the trend in the industry moving forward. However the complete performance throughput can be realized only when the challenges multi-core processors facing today are fully addressed. A lot of technological breakthroughs are expected in this area of technology including a new multi-core programming language, software to port legacy software to "multi-core aware" software programs. Although it has been one of the most challenging technologies to adopt to, there is considerable amount of research going on in the field to utilize multi-core processors more efficiently.

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