REVIEW OF MULTICORE PROCESSING SYSTEM

Unnati N. Bhakare[1], Department of CSE, G.C.O.E, Amravati, India , unnatibhakare13@gmail.com

Pushpanjali Chauragade[2], Department of CSE, G.C.O.E, Amravati, India, pushpanjalic3@gmail.com

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Abstract— Microprocessor has completely revolutionized the world we live in and continuous efforts are being made to manufacture not only faster chips but also smarter ones. A number of techniques such as data level parallelism, instruction level parallelism and hype threading already exists which have dramatically improved the performance of microprocessor cores. Advances in IC processing allow for more microprocessor design options. As Chip Multiprocessor system (CMP) become the predominant topology for leading microprocessors, critical Components of the system are now integrated on a single chip. This enables sharing of computation resources that was not previously possible. In addition the virtualization of these computation resources exposes the system to a mix of diverse and competing workloads. On chip Cache memory is a resource of Primary concern as it can be dominant in controlling overall throughput. This Paper presents analysis of Multi-core Architectures like varying the number of cores, recovery and performance related study.

Keywords—microprocessor, IC, core, multiprocessor.

1. INTRODUCTION

"A Multi-core processor is typically a single processor which contains several cores on a chip". The cores are functional units made up of computation units and caches. These multiple cores on a single chip combine to replicate the performance of a single faster processor. The individual cores on a multi-core processor don't necessarily run as fast as the highest performing single-core processors, but they improve overall performance by handling more tasks in parallel. The performance boost can be seen by understanding the manner in which single core and multi-core processors execute programs. Single core processors running multiple programs would assign time slice to work on one program and then assign different time slices for the remaining programs. If one of the processes is taking longer time to complete then all the rest of the processes start lagging behind. However, In the case of multi-core processors if you have multiple tasks that can be run in parallel at the same time, each of them will be executed by a separate core in parallel thus boosting the performance.We have seen the trend towards CPUs with wider instruction issue and support for larger amounts of speculative execution but due to fundamental circuit limitations and limited amounts of instruction level parallelism, the superscalar execution model provides diminishing returns in performance for increasing issue width. Faced with this situation, building further a more the results show that on applications that cannot be parallelized, the superscalar micro-architecture performs better than one processor of the multiprocessor Architecture .complex wide issue superscalar processor was not at all the efficient use of silicon resources and a better utilization of silicon area. So researchers came up with a novel architecture which was constructed from simpler processors then super-scalar and multiple such processors are integrated on a single chip popularly known as chip multiprocessor or multi-core processors. To understand the performance tradeoffs between wide-issue processors and single chip multiprocessors in a more quantitative way, researchers had compared performance of a six-issue dynamically scheduled superscalar processor with a 4 by two-issue multiprocessor. Comparison has a number of unique features.

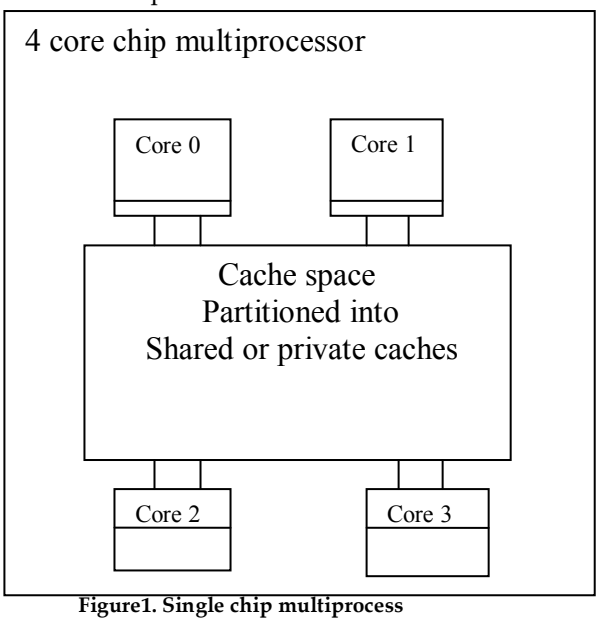

Figure1. Single chip multiprocess

2. ADVANTAGES OF MULTICORE SYSTEM

The good processing speed of the multicore processors is due to the multiple cores which operate simultaneously on instructions, at lower frequency than the single core[1]. At the same clock frequency, the multicore processor will process more data than the single core processor. In addition to this, multicore processors deliver high performance and handle complex tasks at a comparatively lower energy or lower power as compared with a single core, which is crucial factor in appliances such as mobile phones, laptop etc. which operate on batteries. Also, since the cores are fabricated close to each other on the same chip, the signals travel shorter distance between them due to which there is less attenuation of signals. Since the signals don't attenuate much, more data is transferred in a given time and there is no need of repeating the signals.

3. MAJOR CHALLENGES FACED BY MULTI-CORE PROCESSORS.

There are a few major challenges the technology is facing. One main issue seen is with regard to software programs which run slower on multi-core processors when compared to single core processors. It has been correctly pointed out that "Applications on multi-core systems don't get faster automatically as cores are increased"[3]. Programmers must write applications that exploit the increasing number of processors in a multi-core environment without stretching the time needed to develop software. Majority of applications used today were written to run on only a single processor, failing to use the capability of multi-core processors. Although software firms can develop software programs capable of utilizing the multi-core processor to the fullest, the grave challenge the industry faces is how to port legacy software programs developed years ago to multi-core aware software programs. Redesigning programs although sounds possible, it's really not a technological decision in today's environment. It's more of a business decision where in companies have to decide whether to go ahead redesigning software programs keeping in mind key parameters such as time to market, customer satisfaction and cost reduction .

on-chip interconnects are becoming a critical bottle-neck in meeting performance of multi-core chips. With increasing number of cores comes along the huge interconnect delays (wire delays) when data has to be moved across the multi-core chip from memories in particular [3]. The performance of the processor truly depends on how fast a CPU can fetch data rather than how fast it can operate on it to avoid data starvation scenario. Buffering and smarter integration of memory and processors are a few classic techniques which have attempted to address this issue. Network on a chip (NoCs) are Intellectual Property being developed and researched upon which are capable of routing data on a SoC in a much more efficient manner ensuring less interconnect delay.

Increased design complexity due to possible race conditions as the number of cores increase in a multi-core environment. "Multiple threads accessing shared data simultaneously may lead to a timing dependent error known as data race condition". In a multi-core environment data structure is open to access to all other cores when one core is updating it. In the event of a secondary core accessing data even before the first core finishes updating the memory, the secondary core faults in some manner. Race conditions are especially difficult to debug and cannot be detected by inspecting the code, because they occur randomly. Special hardware requirement implementing mutually exclusion techniques have to be implemented for avoiding race conditions.

Another important feature which impacts multi-core performance is the interaction between on chip components viz. cores, memory controllers and shared components viz. cache and memories where bus contention and latency are the key areas of concern. Special crossbars or mesh techniques have been implemented on hardware to address this issue.

4. DIFFERENTIATING PROCESSORS

By using the following basic characteristics we can differentiate microprocessors:

1) Instruction set: The set of instructions that the microprocessor can execute.

2) Bandwidth: The number of bits processed in a single instruction.

3) Cores: number of cores varies depend on the type of processor, dual core contains 2 cores and quad core contains 4 cores, octa core contains 8 cores etc.

4.1 Architecture

As far as we concern about the architecture of a computer processor, there are only a few key factors to be think about. Whether the processor has a 32-bit or 64-bit core determines the capability of the processor that run your software suitably or not [2]. The size of cache memory on die processor is also of importance, as this integrated memory space is used to hold the processor instructions before execution. While multi-core processors do have their advantages, there is still a lack of Software able to utilize multi-core processors.

4.2 Clock speed

The clock speed of a computer processor determines the rate at which a processor executes instructions on data [2].
This rate of execution is expressed in billions of instructions per second. Though having a computer processor with a high clock speed is gainful, it alone is not the only factor that dictates overall system performance. If we consider processors run at different clock speeds, a faster dual-core processor can perform better than a slower quad-core processor.

4.3 Performance

The largest boost in performance will likely be noticed in enhanced response time while running CPU-intensive Processes like antivirus scans, ripping/burning media (requiring file conversion), or searching for files/folders[2].

For example if the automatic virus scan initiates while the movie is being watched, the application running the movie is far less likely to be starved of processor power, as the antivirus program will be assigned to different processor core than the one running the movie playback. Again, the processor's performance is dependent on hardware and software limitations. A dualcore processor will not be twice as fast as a single-core that has the same clock speed; the two cores work on one task, as opposed to one core that does a task twice as fast. Additionally, software needs to be programmed to take advantage of the multiple cores, otherwise only one core will handle the task. Video-editing software, 3-Drendering software, and games can get a significant performance boost from multi-core processors when they are programmed to take advantage of the hardware.

5. CONCLUSION

Thus from the above paper we have reviewed and studied the multicore processor systems. Here we are gone through the basic design of multicore system. Also advantages and the challenges faced by the system are mentioned in this paper. So the paper describes the overall study of multicore processor systems.

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