

A Review on Microprocessor with Multi-Core

Vivek Kumar Kashyap
Research Scholar
Amity University, Haryana

ABSTRACT

Microprocessor is a processor which can process the operation with in microseconds. As we move on to generation by generation the size of processors starts decreasing with the increase in efficiency. So many techniques which already do exist such as data, instruction and thread level parallelism and simultaneous multithreading (SMT) which enhance the performance of different cores present in microprocessor. This paper presents introducing the technologies and its advantages in modern world and also explain the currently challenges faced by multi-core processors and microprocessors and versions of processors and also future scope of microprocessor.

Keywords

Microprocessor, Core, Processors, multithreading technologies, High performance computing (HPC), SMT.

1. INTRODUCTION

For surviving in today's competition market, several industries started to focus on manufacturing faster and smarter chips. The trend of increasing a processor's speed to get a boost in performance is a way of the past. For increasing the speed several techniques were used clocking the chip at higher frequency is one of them. After this, parallel processing technique were used this includes data & instruction level parallelism. This technique was very beneficial as compared to previous one. Afterward Multi core processor came into consideration as a new technique. As the no. of cores was increased the performance starts to increase. It also uses the concept of parallel processing. It also provides several facilities. So, this is the most popular processor which is still in use.

2. MULTI CORE PROCESSOR

A multicore processor is a processor which contains many chips into a single processor. The main cause of its popularity is because of its performance is very high. It is due to having the parallel processing technique which was the drawback of single core processor. The input to a core of CPU is just the ordinary CPU instructions like add, sub, mul, div and mov. There are CPUs of different core levels – two cores, four cores, six cores, eight cores, ten cores and more.

There are two types of multi-core processors. They are Homogenous multi-core processors and Heterogeneous multi-core processors.

The processors in which all the cores manufactured with identical core are called Homogeneous multi-core processors. The processors that use different features are called Heterogeneous multi-core processors.

The main application of multi-core processors is found in embedded systems, data, web server or web commerce signal processing, CAD/CAM, image processing, networking and graphics.

Multiple cores which are present on processor combine themselves to give a great performance but it doesn't mean that each core has a same performance. They can be same may not be same. But overall they maintain their performance better. It can judge by executing the programs on a single core & multicore processor. 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. There are several benefits using the multicore. If execute the program on single processor then it will be done by time slicing of each process and if any one of them has consumed more time then rest will also be processed late but due to having a concept of parallel processing technique in multi core if one is late then also all other tasks will not be as shown in figure 1.

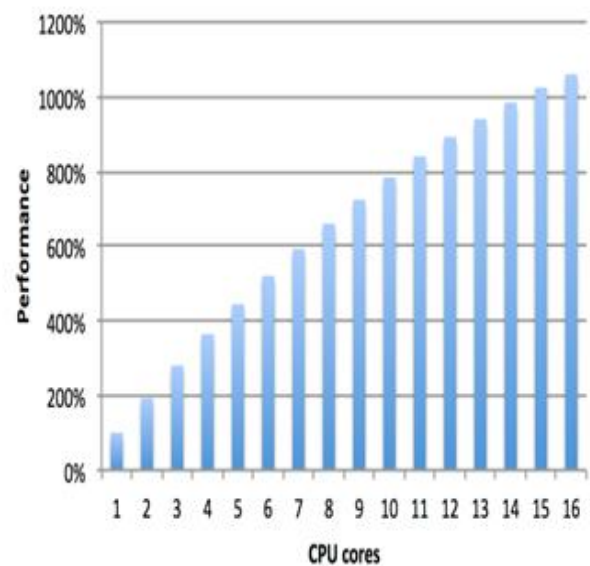


Figure 1: Performance of increasing no. of cores

2 key factor determining the power of processor

- Number of cores.
- Frequency.

A processor is able to execute multiple tasks simultaneously. For example music can be listened while surfing the web on y computer. Multi core processor has its own execution time for each process or task in milliseconds. It is so fast that it can't be recognized while the execution. It will be looked like all the tasks are performed at the same time. No. of cores will be the important key factor for their performance. This performance is totally depending upon the capability of cores to execute the programs which makes more energy efficient and low power cores as shown in the figure.

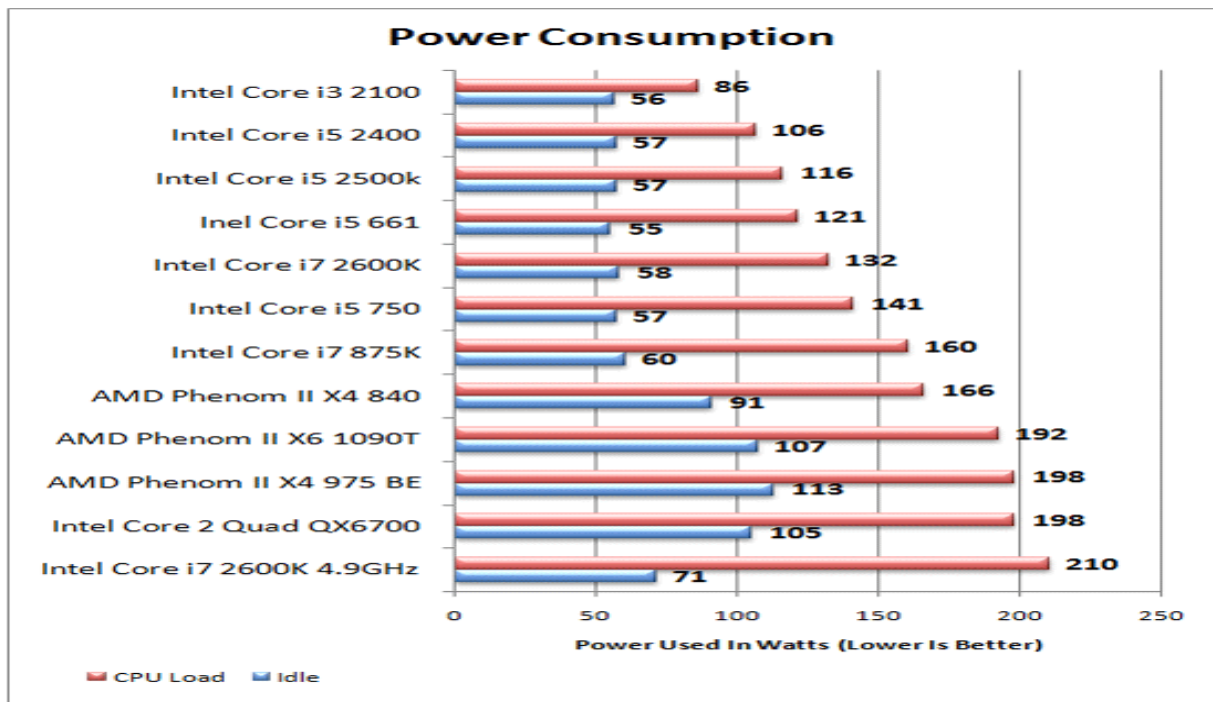


Figure 2. Power Consumption

Multicore processor has been designed in pattern of separation so that unused cores can be powered on or off according to the need so that to control power dissipation. It can use homogenous or heterogeneous core according to the application requirement. In the case of homogenous microprocessor all the cores present in CPU are identical in nature. This type of processors use the partitioning and applying different methodology so that huge applications can be managed as small-small applications which can be execute further using parallel processing technique. It includes the features like cache, message passing system, threading, share memory and resources, reduces design complexity, reusability, reduces verification effort and it makes easier to fulfill the requirement of the market. In the case of heterogeneous cores, it consists of focused application specific processor cores which would perform the aimed tasks so that issue of different variety of applications running on the computer can be easily executed. In case of sequential program multi core processor can't be a beneficial because their compilers develop to use parallel processing so that multiple tasks can be performed on different cores.

2.1 Single Core VS Multicore Processor

Multicore processor is an advance technology which is developed to overcome the drawbacks of single core processor. Now, a day's multicore processor is used in any format. The reason of using multicore processor is defined in the table below.

Table1: Single Core VS Multi Core Processor

| | SINGLE CORE | MULTICORE |
|-------------------------------|-------------|-------------|
| Power | 429.78W | 107.39W |
| Vdd | 1.0V | 1.0V |
| I/O Pins | 1280 | 3000 |
| Operating Frequency | 7.8Gb/s | 4Gb/s |
| Bandwidth | 125GByte/s | 1TeraByte/s |
| Total no. of pins on chip | 3840 | 9000 |
| Number of Pins On The Package | 2480 | 4500 |

3. MEMORY

In uncore processor there will be only one core and this core can contain one or more cache which is fitted in single processor. While in multicore will contain more than one core and we know that every core has several cache having a different level which is a component of main memory, that clearly shows that it uses parallel processing which can fetch data & instruction that leads to rise in performance. All the cores are introduced in a single socket then it is connected with main memory. Each core uses the memory. And the memory is used like a unanimous array that can be shared between all cores available in multi-core chip as shown below. SMT is a technique complementary to multicore; it can have one large and superscalar core and great performance in single thread as compared to the multi-core which is great with the TLP. In the memory hierarchy SMT shared all caches [6].

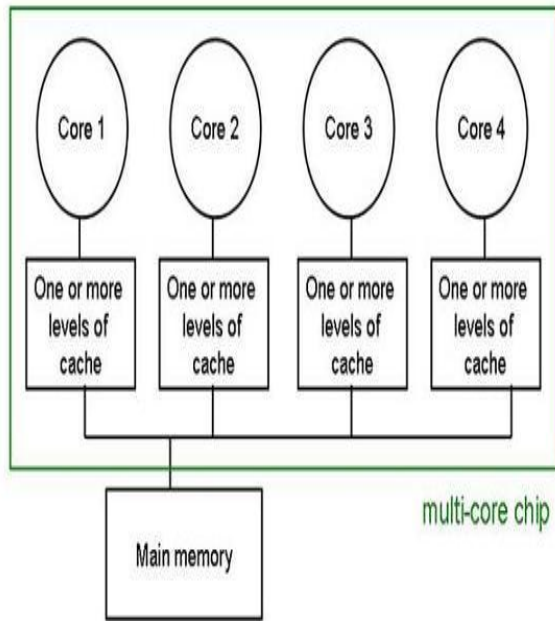


Figure 3: Different cores with their Level of cache with main memory.

4. CHALLENGES FACED BY MULTICORE PROCESSOR

This Multicore processor technologies is leading at the present time but it need some improvement in the programming model so that it can be used in the scientific and engineering application according to their environment in the future. System software for multicore processors should use all the core capabilities and also should deal with non-uniform memory hierarchies in deep. The necessity of changing the platform on which multicore processor is based is raised. Due to increasing number of cores the density of multi core processor is also being increased which increases the need of energy awareness which become odd with high performance. It can be removed by a nice distribution of temperature in this processor which can optimize the target.

In spite of many advantages of multicore processor there are many challenges which are faced by this technology. If we talk regarding with execution speed, multi core processor has slower speed for execution of software programs as comparison with single core processor. It can be correctly pointed out that "As cores are increased, then the application on multi-cores systems don't get faster automatically" [1]. Programmers can write applications that make use of the increasing number of processors in case of a multi-core environment without stretch the time needed to software developing [3]. Now a days, many of applications are executed on a single processor only, which is failed to use the capability of multi-core processors. But many of the software companies develop their software program which only uses the capability of the multicore processor but port birthright software programs becomes a great issue for the companies. At present Re-design can't be a great decision for any issue. But there is less chance to get on a decision of re-designing or it can also be a last option for the company to handle the situation.

For resolving this issue the compiler is designed in such a way so that the single core processor can be able to work as a multi core processor. The compilers could be perform "reordering code", where the compilers will generate, reordering code instructions such that instructions that can be run in parallel are close to each other [2]. It will improve the performance of parallel processing through the execution of the instructions. It is also developed to generate parallel threading or processing automatically for processing the application using parallel process. Open Multiprocessing, an application programming interface which supports multiprocessing programming in "C" and "C++" provides directives for much type of threaded codes [4]. When the application code is ready for the execution in multicore processor then the energy efficiency and the performance can be fully realized.

These second, on-chip interconnections are becoming a crucial bottleneck in meeting performance of multi-core chips [7]. The performance is totally depending upon the rate of sensing the data by CPU and how fast it is operated. As the number of core is increased the transfer of data to the core or interconnection between the data & the core can also become an issue for delay. Smarter integration and Buffering of memory and processors are a few classic techniques which have attempted to present this issue [5]. Another important feature which impacts multi-core performance is the interaction between cores, memory controller's viz. on-chip components and cache and memories viz. shared components where bus latency and contention are the key area of concern. Mesh techniques or Special crossbar have been implemented on hardware to present this issue [1]. One main major challenge is multithreading i.e. the use simultaneous multithreading (SMT). It allows another thread to process on same core on which a thread is already running. For example if one thread is waiting for floating point operation to complete it then another thread can cause the integer units. But without SMT only a single thread can run at any given time. SMT is not a true parallel processor because it can only enable better thread utilization up to 31% if we compare it with multi core each core has its own copy of resources. In case of multi core threads can run on separate cores. Threads or processors must be used during the programming so that workload can be divided and then write parallel algorithm.

5. VERSIONS OF PROCESSORS

- CORE DUO
- CORE SOLO
- CORE 2 SOLO
- CORE 2
- CORE 2 QUAD
- CORE 2 EXTREME
- CORE i3
- CORE i5
- CORE i7

6. FUTURE SCOPE

There is a bright future in multiprocessor performance. But optimizations are still needed in order to get most out of the current advances in technology. In order to increase the performance to its maximum, it was shown that the serial and parallel phase of a software programs must be equal. The future lies in the careful and intelligent design of Heterogeneous Chip Multiprocessors. The advantages of

Heterogeneous Chip Multiprocessors clearly outweigh that of Homogeneous Chip Multiprocessors. It will just take a matter of time before the microprocessor architecture move to a new direction in microprocessor design, just like the jump from uniprocessor to multiprocessors. Maybe soon, the term “transistor count” previously used to measure the microprocessors will become “processor count”.

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8. CONCLUSION

After having this review paper, it creates depth to study on multi core processor. It gives to a conclusion that this processor will be a beneficial in the case of big applications which will deal with a huge amount of data & instructions. This processor uses a parallel processing technique which is helpful for increasing the performance during the execution of software program. This processor made a radical change in the architecture of application programs. According to the application several multicore processor has been designed. Here, the concept of multithreading is also been introduced for using the same core at the time processing. Power and frequency limitations observed on single core implementations. In spite of various advantages we have seen what are the several challenges faced by this microprocessor during the use of this processor. And lots of steps were taken for removing the issues but most of them

were left. The research is going on let's see what happens in the future.

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