Multi-Core Processors and Where We're Headed

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Abstract—In today's world everything is being computerized, which in other words means that all the data is being put on to a machine or some other gadget which further does the job its asked to do. And that job is done by processing the data fed to the machine. This processing part is done by processors and in this research paper I'll be trying to explain how the processor has evolved till now and where the future takes us. I'll also be discussing the merits and demerits of multiple-core processors, and how these chips have changed the world so far and how they're going to shape our future.

Index Terms: **Multi-core Processor, Software Complexity, Instruction level parallelism, performance and power efficiency, better society**

I. INTRODUCTION

A processor or CPU is a small chip on a computer or any other electronic device which requires computing of some data. This chip is the place where all the data is processed and then the output is returned back from. I've divided this research paper in mainly four sections. First section will be related to the history. In the second section I'll be discussing about how multi-core processors actually work and what their applications are. In third section I'll discussing about the advantages and disadvantages of these chips. In the fourth section I'll be discussing about how these chips will shape our future and in the final and fifth section I'll give my personal thoughts which will be followed by references.

II. HOW IT ALL STARTED

Early Central Processing Units (CPU) were specially-designed as a part of a larger, sometimes one-of-a-kind, and computer. However gradually, this method of designing special CPUs for a particular application has largely given way to the development of mass-produced processors that are made for many purposes. This standardization began in the era of discrete transistor mainframes and minicomputers and has rapidly accelerated with the popularization of the integrated circuit (IC). The IC has allowed increasingly complex CPUs to be designed and manufactured to tolerances on the order of nanometres. Both the miniaturization and standardization of CPUs have increased the presence of digital devices in modern life far beyond the limited application of dedicated computing machines. Modern microprocessors appear in everything from automobiles to cell phones and children's toys.

But you must be asking by now, how did the trend of multi-core processors start. Processors were originally developed with only one core in mind. In the mid-1980s Rockwell International manufactured versions of the 6502 with two 6502 cores on one chip. These were the R65C00, R65C21, and R65C29, and they were sharing the chip's pins on alternate clock phases. Other multi-core processors were developed in the early 2000s by Intel, AMD and others.

III. WORKING AND IMPLEMENTATION

A multi-core or multiple-core processor is a single computing component with two or more independent central processing units also called "cores", which are the units that read and execute program instructions. The instructions are ordinary CPU instructions such as add, move data, and branch, but the multiple cores can run multiple instructions at the same time, increasing overall speed for programs which is basically the concept of parallel computing. Manufacturers typically integrate the cores onto a single integrated circuit die (known as a chip multiprocessor or CMP), or onto multiple dies in a single chip package.

Multi-core processors may have two (dual) cores, four (quad) cores, six (hexa) cores, eight (octa) cores, ten cores or even more. Example of every type would be, AMD Phenom II X2 and Intel Core Duo are dual core, AMD Phenom II X4, Intel's i5 and i7 processors are quad core, AMD Phenom II X6 and Intel Core i7 Extreme Edition 980X are hexa-core, Intel Xeon E7-2820 and AMD FX-8350 are octa-core and Intel Xeon E7-2850 has ten cores. Further processors belonging to Intel Xeon family even have more number of cores.

IV. ADVANTAGES AND DISADVANTAGES

A. Advantages

Having multiple CPU cores on the same component allows the cache coherency circuitry to operate at a much higher clock-rate than is possible if the signals have to travel off-chip. Combining equivalent CPUs on a single die significantly improves the performance. Put simply, this means that signals between different CPUs travel shorter distances, and therefore those signals degrade less. These higher-quality signals allow more data to be

sent in a given time period, since individual signals can be shorter and do not need to be repeated as often.

Assuming that the die can physically fit into the package, multi-core CPU designs require much less printed circuit board (PCB) space than do multi-chip SMP designs. Also, a dual-core processor uses slightly less power than two coupled single-core processors, principally because of the decreased power required to drive signals external to the chip.

Multi-core chips also allow higher performance at lower energy. This can be a big factor in mobile devices that operate on batteries. Since each and every core in multi-core is generally more energy-efficient, the chip becomes more efficient than having a single large monolithic core. This allows higher performance with less energy. The challenge of writing parallel code clearly offsets this benefit.

B. Disadvantages

Maximizing the utilization of the computing resources provided by multi-core processors requires adjustments both to the operating system (OS) support and to existing software. Also, the ability of multi-core processors to increase application performance depends on the use of multiple threads within applications.

V. WHAT'S NEXT?

The general trend in processor development has moved from dual-, tri-, quad-, hex-, octa-core chips to ones with tens or even hundreds of cores. In addition, multi-core chips mixed with simultaneous multithreading, memory-on-chip, and special-purpose "heterogeneous" cores promise further performance and efficiency gains, especially in processing multimedia, recognition and networking applications. There is also a trend of improving energy-efficiency by focusing on performance-per-watt with advanced fine-grain or ultra-fine-grain power management and dynamic voltage and frequency scaling (i.e. laptop computers and portable media players).

VI. SO TO SUM IT ALL UP

The development of processors has gone through various phases and now has arrived at a somewhat consistent phase which will last for the near future. Only more and more and cores are going to be added to increase the overall performance till we see a major change in the technology which will entirely replace the processors of today as we know them. Now the main motive of all the software developers would be to efficiently use the available number of cores on the CPU. As the performance now is only limited by the inefficiency in code of the application software.

Devices containing these multi-core processors have invaded our lives and they've invaded for the betterment of the society. Such devices have increased the productivity to such an extent that imagining life without them seems like a nightmare. But why should we imagine so? The future looks completely filled with such devices which will help us accomplish our smaller to smallest tasks that today we think are only able to be done by us. These devices are only for the betterment of the humankind and they should be welcomed in our lives for a greater quality of life.

VII. REFERENCES

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