

Otis Brower

ODB234

Prof. Dickerson

CS429

Homework 4 Problems & Why Multicore Processors Are Important Steps For Computer Architecture

There has been much advancement in processor architecture since the advent of microprocessors. One of the most important developments has been the introduction of multicore processors that have become the standard processor architecture over the past decade. There are many advantages that multicore processors have over traditional single processors, the primary of these being computing performance. But the multicore architecture also allows for more efficient processors in terms of power consumption and multithreaded processes in smaller computer systems. Due to advances in circuit technology and performance limitation in wide-issue, super- speculative processors, Chip-Multiprocessors (CMP) or multi-core technology has become the mainstream in CPU designs [2].

As the demand for computerized systems has increase so has the requirement of ever increasing performance to accommodate a wider range of applications, typically fitting into the same physical space or smaller. Multi-CPU systems have been standard on servers for a long time but these systems used single-core processors linked together to increase performance. Whereas multicore processors have the processing cores on the same CPU die. Having the computing

cores on the same die has advantages over separate dies, principally in terms of locality [1]. The main advantage of locality is time, since the distance signals within the system need to travel are much less with multiple cores are combined onto a single die, compared to the distance traveled for separate processor dies. This decrease in time to transfer signals results the processor being able to be set to higher clock speed for increased performance. Locality also plays a role in the efficiency of a multicore processor. This is because as distance increases, so does the power required to send data signals when processing cores are working in parallel.

Parallelizing processes has been the best way to increase performance of computer system. In single-core processor parallel computing was not possible without linking several separate processors together. Again, since power requirements increase to send data a greater distance the combining of multiple core on to a single die, allows for more efficient transfer of data. Efficiency can also be compared internally when considering single-core to multi-core processors. A typical method for increasing performance on single-core processors is to increase the clock frequency. This increase frequency requires an increase in power to run the processor for incremental performance increases. But there is a limit to the clock frequency and power that can be run through a processor before heat and power leakage becomes an issue. As an example, the Intel Pentium 4 processors increased from 1.3 GHz to 3.8GHz over the course of their production, ultimately reaching a thermal limit for what the processors could tolerate [3]. Multicore processor have the advantage of being able to increase performance without

increase power and heat dissipation requirements by spreading work loads over multiple cores running at lower clock frequencies.

Multicore processors have also made it possible to decrease the size of higher performance computer systems. A clear example of this is the vast increase of computing power on smaller devices like smartphones and tablets. Since multicore processors can be manufactured to run lower clock frequencies and require less power and generate less heat that must be dissipated, small multi-core computers have changed the landscape for many computer users. With the introduction of quad-, hexa-, and octa-core mobile processor in recent years, the advancement of mobile computing would not be possible without multi-core processors.

These few examples illustrate how important the introduction of multi-core processing has been in computer architecture. As the demand for digital devices increase, the requirements for better performance, efficiency, and portability will undoubtedly also increase. And for the near future multi-core processors offer the best solution for meeting these demands.

- [1] Pawe and Micha F. Kowalik. "Multi-Core Processors: New Way to Achieve High System Performance." Intel Corporation, 2006.
- [2] L. Peng et al, "Memory Performance and Scalability of Intel's and AMD's Dual-Core Processors: A Case Study", IEEE, 2007
- [3] W. Knight, "Two Heads Are Better Than One", IEEE Review, September 2005

Homework Problems

Problem 6.26

Cache	m	C	B	E	S	t	s	b
1.	32	1024	4	4	65	24	6	2
2.	32	1024	4	256	1	30	0	2
3.	32	1024	8	1	128	22	7	3
4.	32	1024	8	128	1	29	0	3
5.	32	1024	32	1	32	22	5	5
6.	32	1024	32	4	8	24	3	5

Problem 6.31

A: 128

B: CT CT CT CT CT CT CT CT CI CI CI CO CO