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Moore's Law Effect on Transistors Evolution

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Abstract-With respect to time increasing in the number of transistors has a great effect on the performance and the speed of processors. In this paper we are comparing the transistors evolution related to Moore's law. According to the Moore's law the number of transistors should be double every 24 month. The effect of increasing processors design complexity also increases the power consumption and cost of design efforts. In this paper we discuss the methods and procedures to scale the hardware complexity of processors.

Keywords: Hardware Complexity, Processor Design, Transistor Count, Moore's Law.

I. INTRODUCTION

The MOORE's law observations states that the number of transistors are doubling every two years. More precisely within the period of "18 months" is due to Intel executive David House, the increase in number of transistors and increase in speed of transistors give rise to the effect of increase in the performance of the transistors. Moore's law has its same effect during the history of semiconductor since the advent of computing devices to now mobile devices, a continuous improvement of silicon chips [1-6]. The two factors have made a great impact on the success of Moore's law, consumers demand for more functionality and the competition among the developers.
The technology has improved, better to call it as evaluated from mid-1970's 6800 processor with 5000 transistors to the today's multicore processors like reaching the limit of 3 billion. The fact about Moore's law is to improve those area that helps to achieve the more and more small sized transistors and with more better technology

II. BACKGROUND

Moore's law state that transistor numbers become two times in every 18 to 24 months in article. "Cramming more components onto integrated circuits", *Electronics Magazine* 19 April 1965: The transistor cost has become double in every 24 months and this is remaining increasing at least at this order, if no chance of increase more. For many years of gap the speed of increase became very low so we can say that there are no observable changes in period of 10 years. During the year of 1975 the transistor cost on each integrated circuit is atleast 65000. So clearly I am sure about that one wafer can adjust one integrated circuit [2]. The statement of Moore's that number of transistor on integrated circuit will becomes two times in a period of every 18 to 24 months. The statement is given by scientist named as Golden Moore in 1965. The law is still useful and applicable. It is the high demand of small sized, low Power consumption and higher processing speed transistors that have prolonged the life of Moore's Law, and until now Moore's Law is still used as the guideline for transistor manufacturing. The Moore's Law graph is shown in Figure 1.

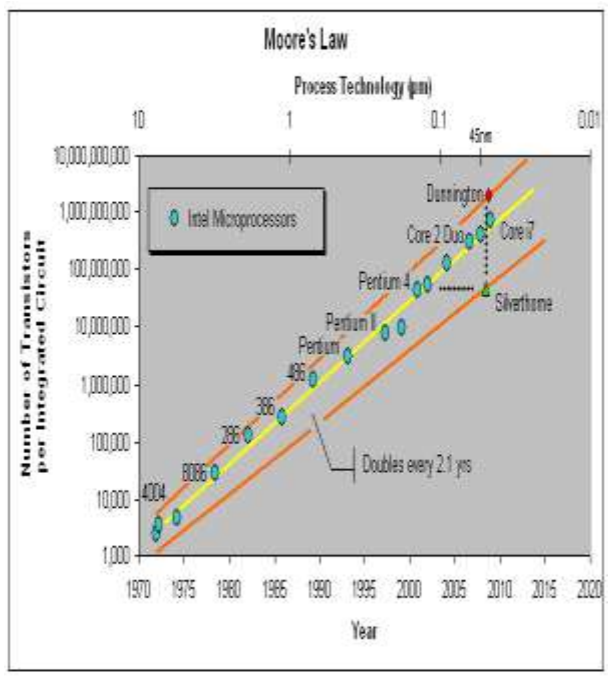


Figure 1.Moore's Law Graph

During the period of 1970s more electronics were built as compared to the previous years as industry was more than doubling the total number of transistors. The transistors capacity has continuously getting better. Moore's law rating has recently slowed but still on a good growth. Todays a number of transistors in one year is up to 10^18. According to a well-known naturalist Edward O. Wilson, at Harvard, had counted that they were approximately10^16 and 10^17 ants on earth. In 1990s then the semiconductor industry was producing a transistor for every ant. Now, the poor little ant has to carry a hundred of them [7-9] around if he is going to get his share.

Processor speeds from the 1970's to 2009 and then again in 2010, one may think [10-19] that the law has reached its limit or is nearing the limit. In the 1970's processor speeds ranged from 740 KHz to 8MHz; notice that the 740 is KHz, which is Kilo Hertz – while the 8 is MHz, which is Mega Hertz.

From 2000 – 2009 there has not really been much of a speed difference as the speeds range from 1.3 GHz to 2.8 GHz, which suggests that the speeds have barely doubled within a 10 year span. This is because we are looking at the speeds and not the number of transistors; in 2000 the number of transistors in the CPU numbered 37.5 million, while in 2009 the number went up to an outstanding 904 million; this is why it is more accurate to apply the law to transistors than to speed [20].

From all of the above discussion about transistors ,every computer literate person can't drawn result from it easily [21-25] so we say that earlier processors used one CPU while todays processors are multicore technology using more than one CPU,s.

In example above the speed of the CPU during many years of gap increase from 1.3 to 2.8 which is speed of a single CORE , QUAD CORE processsors.in conclusion we can say that power of 2.8 is obtain if multiply it with four which is 11.2 this is very large from 1.3.

III. CHALLENGES INCURRED

There is an inflection point to the technology of semiconductors. Table 1 below, shows some serious challenges faced by semiconductor technology .More and smaller transistors are not always "better". Second denard scaling also has ended, power per transistor is not good [26-33]. Third, challenge is fabrication variations subject to the reliability of transistors (nano-scale features e.g., gate oxides only atoms thick). Fourth, communication among computation elements must be managed through locality to achieve goals at acceptable cost and energy with new opportunities (e.g., chip stacking) and new challenges (e.g., data centers). Fifth, for achieving high performance, costs to create, design, verify, fabricate, and test are growing, making them harder to afford.

Table 1: Technology's Challenges to Computer Architecture

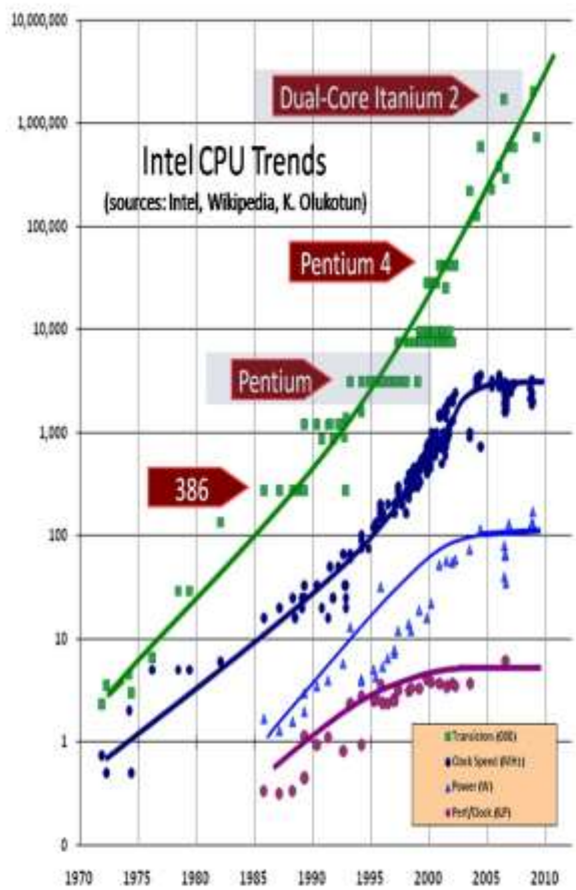
1970s	Newer trend
Double transistors per chip_ in every 18-24 months	Transistor count still 2× every 18-24 months,
Dennard Scaling(power per transistor) — near-constant power/chip	Not viable for power/chip to double (with 2× transistors/chip growth)
The modest levels of transistor unreliability easily hidden (e.g., via ECC)	Transistor reliability is going to be effected
Focus on computation over communication	Restricted communication communication more expensive than computation
One-time creation of very high performance and reliability is difficult	Expensive to design, verify, fabricate, and test

IV. INCREASING THE NUMBER OF TRANSISTORS

Many limitations are still there, such as increasing the density size, the die size, physical size decrement, the voltage [34].

Since the surface area of a transistor determines the transistor count per square millimeter of silicon, and as the feature size is decreasing transistors density increases quadratically. And as the surface area of a transistor determines the transistor count per square millimeter of silicon [35]. The increase in transistor performance is more complicated As the physical size is decreased. A reduction in operating voltage to maintain correct operation and reliability of the transistor is required in the vertical dimension shrink. This combination [36-39] of scaling factors leads to a complex interrelationship between the transistor performance and the process feature size and it makes difficult to apply Moore's Law in the future. Some studies have shown that physical limitations could be reached by 2018 [7] or 2020-2022[8, 9, 10, 11].

Processor's hardware complexity is caused by doubling the number [40-47] of transistors every two years (see Table 2), which will be limited after a few years [12, 13, 14, 15].



V. CONCLUSION

Although clock speeds and transistors per circuit have not kept pace with the original exponential forecast known as Moore's Law, doubling every year, computing performance and cost efficiencies continue to advance at a remarkable pace. Competition among the major processor manufacturers, Intel, AMD, IBM, Sun, and Texas Instruments can be expected to push the industry down the long-run average total cost curves described by Gordon Moore in 1965. As he predicted, the result will be dramatic improvements and much lower prices for computing performance. While clock speeds may continue to be a standard measure of performance.

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