Protecting Our Earth by Considering Various Methods with Special Reference to Microprocessor’s TDP

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ABSTRACT

Now-a-days humans are using many machines or equipments for their day-to-day activities. These devices create heat energy. This energy destroys the Ozone layer very much. Particularly the usage of computers by human being increases day-by-day. Computing devices such as motherboard, processor, monitor etc. create more heat energy. It increases the heat of our earth. Many researches are going on, how to reduce the heat generated by computers. This research paper analyzes this factor.

Keywords-- CO2, Data centers, Green computing

I. INTRODUCTION

Green Computing is the study and practice of eco-friendly devices and using the computing resources efficiently. It includes all the dimensions of environment sustainability, total cost disposal, cost of recycling and economics of efficient usage of energy. Green IT /Green Computing means "efficiently and effectively with minimal or no impact on the environment" designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems ". Green computing goal is to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. The goals of green IT include minimizing the use of hazardous materials, maximizing energy efficiency, reducing heating energies from hardware’s and encouraging recycling and/or use of biodegradable products — without negatively affecting productivity.¹

II. METHODOLOGY

We can improve green computing by implementing different methods. Some steps taken in software or hardware side will give better results.

III. SOFTWARE SIDE OPTIMIZATION

1. Algorithmic efficiency:
   The efficiency of algorithms has an impact on the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs. As computers have become more numerous and the cost of hardware has declined relative to the cost of energy, the energy efficiency and environmental impact of computing systems and programs has received increased attention. A study by Alex Wissner-Gross, a physicist at Harvard, estimated that the average Google search released 7 grams of carbon dioxide (CO2). However, Google disputes this figure, arguing instead that a typical search produces only 0.2 grams of CO2.²

2. Resource allocation:
   Algorithms can also be used to route data-to-data centers where electricity is less expensive. Researchers from MIT, Carnegie Mellon University, and Akamai have tested an energy allocation algorithm that successfully routes traffic to the location with the cheapest energy costs. The researchers project up to a 40 percent savings on energy costs if their proposed algorithm were to be deployed. Strictly speaking, this approach does not actually reduce the amount of energy being used; it only reduces the cost to the company using it. However, a similar strategy could be used to direct traffic to rely on energy that is produced in a more environmentally friendly or efficient way. A similar approach has also been used to cut energy usage by routing traffic away from data centers experiencing warm weather; this allows computers to be shut down to avoid using air conditioning.³ Larger server centers are sometimes located where energy and land are
inexpensive and readily available. Local availability of renewable energy, climate that allows outside air to be used for cooling, or locating them where the heat they produce may be used for other purposes could be factors in green sitting decisions. [4]

IV. HARDWARE SIDE OPTIMIZATION

Monitor: [5]

LCD monitors typically use a cold-cathode fluorescent bulb to provide light for the display. Some newer displays use an array of light-emitting diodes (LEDs) in place of the fluorescent bulb, which reduces the amount of electricity used by the display. LCD monitors uses three times less when active, and ten times less energy when in sleep mode. LCDs are up to 66% more energy efficient than CRTs, LCDs are also upwards of 80% smaller in size and weight, leading to fuel savings in shipping. LCDs produce less heat, meaning you'll need less AC to keep cool. LCD screens are also easier on the eyes. Their lower intensity and steady light pattern result in less fatigue versus CRTs. A newer LCD draws 40-60W maximum in a modest 19", 20", or 22" size. That number grows close to 85W or 100W, maximum for a 24" unit. Drop them down to standby or turn them off entirely when not using them to minimize power consumption. By comparison, a 21" CRT typically uses more than 120W, more than double the power of a typical 22" LCD. Networks, LCD screen and computer cluster should focus in energy consumption and emission of CO2.

Storage Devices:

Storage is necessary part of the computer, it hard disk drives often consume less power per gigabyte than physically larger drives. Solid-state drives store data in flash memory or DRAM. With no moving parts, power consumption may be reduced somewhat for low-capacity flash-based devices. Drive manufacturers have begun to focus on reduced power consumption, resulting in such features as the reduced RPM low-power idle mode with fixed rotation speed for reduced power consumption. [6]

Green Materials: [7]

Greener materials are being used to create hardware; instead of using materials such as ASB plastics, steel, aluminum, etc., more eco-friendly materials are used:

Cardboard: A company called “Recompute” creates computer cases using cardboard materials. The corrugated cardboard is recyclable and renewable, and the case is built using low-impact construction processes like gluing (with white glue that is nontoxic) and die cutting. Case can be easily disassembled when it comes time to recycle it.

Bamboo: Bamboo is the fastest growing plant in the world (thus making it one of the most renewable materials on earth) and “has a tensile strength comparable to steel,” it is a better option to use for building computer hardware than “traditional” materials. Bamboo is used to build hardware like keyboards, mice, computer cases, and many other accessories.

V. GREEN COMPUTING FUTURE

PROCESS

To improve the efficiency of our vast computing networks, solar cell technology is being developed to power computer components - shifting a large margin of our energy requirements to a renewable source.

Solar power:

The process converts sun energy into electricity. Intel has designed a prototype CPU that is capable of running a Windows operating system off of a tiny solar cell about the size of a postage stamp. “The low power technology contained in the processor is very likely to find its way into an ultra book or tablet within the next couple of years.”

Computer Cooling: [8]

Computer cooling is necessary part in today's life. Cooling is the process which used less the heat produce by the system which includes integrated circuits such as CPUs,chipset, graphics cards, and drives. Cooling can done by using Cooling fans to reduce the heat produced from integrated circuits such as CPUs, chipset, graphics cards, and drives. Computers are widely used along with heat sinks to reduce temperature by actively exhausting hot air. Air Cooling, Liquid submersion cooling, Waste heat reduction, Heat-sinks, Liquid Cooling, Heat Pipe etc are some of Cooling process.

Other Ways In Optimization: [9]

Buy "Energy Star" labeled Monitors, desksops, laptops, and printers. The "Energy Star" devices can be programmed to "power-down" to a low power state when they are not in use, helping you save energy and run cooler which helps them last even longer. The Energy Star specification for computers was revised on October 20, 2006 and goes into effect July 20, 2007. The specification includes new performance requirements to qualify for the Energy Star rating for desktop and notebook computers, workstations, integrated computers, desktop-derived servers and game consoles.

Put laptops in "sleep" mode when not in use. Environment Protection Agency(EPA) introduce that this reduces their energy use by 60 to 70 percent – and ultimately could save enough electricity each year to power Vermont, New Hampshire, and Maine, cut electric bills by $2 billion, and reduces carbon dioxide emissions by the equivalent of 5 million cars.

Even better, turn OFF computers and other equipment when not in use. Despite the debate over whether it's better for your computer to be left on or shut off, the fact is it's better for the environment to shut it off.
Thermal design power (TDP): AMD. They are measuring the heat energy by the term TDP, which is the major goal of processor manufacturers like Intel, AMD. They are measuring the heat energy by the term TDP (Thermal Design Power).

**Thermal design power (TDP):** [10]

Thermal Design Power introduced by Intel Corporation to reduce the heat energy produced by processor chip while running the application or system in working condition. The thermal design power (TDP), sometimes called as thermal design point. The maximum amount of heat generated by the CPU that the cooling system in a computer is required to dissipate in typical operation. Rather than specifying CPU's real power dissipation, TDP serves as the nominal value for designing CPU cooling systems. The thermal design power is the maximum power a processor can draw for a thermally significant period while running commercially useful software. The constraining conditions for TDP are specified in the notes in the thermal and power tables. TDP does not produce the largest amount of heat that CPU could ever generate (peak power), such as by running a power virus and maximum amount of heat generate while running "real applications." The Thermal Design Power is the average maximum power a processor can dissipate while running commercially available software. TDP is primarily used as a guideline for manufacturers of thermal solutions (heat sinks/fans, etc) which tells them how much heat their solution should dissipate.

**VI. TDP FACTORS IN DIFFERENT PROCESSOR:**

**Microprocessor:** [11]

The microprocessor, also named as the Central Processing Unit (CPU), is the brain of all computers and many household and electronic devices. Multiple microprocessors, working together, are the "hearts" of data centers, super-computers, communications products, and other digital devices. The first microprocessor was the Intel 4004, introduced in 1971. The 4004 was not very powerful; it was primarily used to perform simple mathematical operations in a calculator called “Busicom”. A microprocessor, sometimes called a logic chip, is a computer processor on a microchip. A microprocessor is designed to perform arithmetic and logic operations that make use of small number-holding areas called registers. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that is part of the microprocessor design. When your computer is turned on, the microprocessor gets the first instruction from the basic input/output system (BIOS) that comes with the computer as part of its memory. After that, either the BIOS, or the operating system that BIOS loads into computer memory, or an application program is "driving" the microprocessor, giving it instructions to perform.

**64 Bit Microprocessor:** [12]

64-bit processors have been in active from 1992, and in the 21st century they have started to become, mainstream. Both Intel and AMD have introduced 64-bit chips, and the Mac G5 sports a 64-bit processor. Sixty-four-bit processors have 64-bit ALUs, 64-bit registers, 64-bit buses and so on. One reason why the world needs 64-bit processors is because of their enlarged address spaces. A 64-bit chip has none of these constraints because a 64-bit RAM address space is essentially infinite for the foreseeable future -- 2^64 bytes of RAM is something on the order of a billion gigabytes of RAM. The 64-bit processor is backwards compatible with older applications and operating systems; it detects whether an application or operating system is 16-bit, 32-bit, or 64-bit and computes accordingly. This is essential for enterprise situations where purchasing new software is not feasible. Intel, IBM, Sun Microsystems, Hewlett Packard, and AMD currently develop or offer 64-bit processors.

**64 Bit Microprocessor Architecture:** [13]

A 64-bit processor is a microprocessor with a word size of 64 bits, a requirement for memory and data intensive applications such as computer-aided design (CAD) applications, database management systems, technical and scientific applications, and high-performance servers. 64-bit computer architecture provides higher performance than 32-bit architecture by handling twice as many bits of information in the same cycle. The Elxsi architecture has 64-bit data registers but a 32-bit address space. Intel introduces the Intel i860 RISC processor. Marketed as a "64-Bit Microprocessor", it had essentially a 32-bit architecture, enhanced with 3D Graphics Unit capable of 64-bit integer operations.

**VII. DIFFERENT ARCHITECTURES**
NEHALEM ARCHITECTURE: [14]

Intel Developed the new type of processor called Nehalem microarchitecture, which is the successor to the older Core microarchitecture. A preview system with two Nehalem processors was shown at Intel Developer Forum in 2007, and the first processor released with the Nehalem architecture was the desktop Core i7, which was released in November 2008. The first generation of the Intel Core series of processors, Nehalem designs led to the introduction of Core i7 and i5 models (no Core i3 is based on Nehalem). The subsequent Westmere and Sandy Bridge designs would include Core i3 processors.

SANDY BRIDGE ARCHITECTURE: [15]

Intel developed the Sandy Bridge microarchitecture at beginning in 2005 for central processing units in computers to replace the Nehalem microarchitecture. Intel demonstrated a Sandy Bridge processor in 2009, and released first products based on the architecture in January 2011 under the Core brand. Primarily developed by the Israeli branch of Intel, the codename was originally "Gesher" (meaning "bridge" in Hebrew).

IVY BRIDGE ARCHITECTURE: [16]

Intel developed line of processors based on 22nm manufacturing process named Ivy Bridge. The name is also applied more broadly to the 22 nm die shrink of the Sandy Bridge micro architecture based on FinFET (“3D”) tri-gate transistors, which is also used in the Xeon and Core i7 Ivy Bridge-EX (Ivy town), Ivy Bridge-EP and Ivy Bridge-E microprocessors released in 2013. Ivy Bridge processors are backwards compatible with the Sandy Bridge platform, but such systems might require a firmware update (vendor specific).

HASWELL ARCHITECTURE: [17]

Intel developed Haswell microarchitecture processor as the successor to the Ivy Bridge micro architecture. Intel announced CPUs based on this micro architecture officially on June 4, 2013 at Computex Taipei 2013, while a working Haswell chip was demonstrated at the 2011 Intel Developer Forum.

BROADWELL ARCHITECTURE: [18]

Intel introduces the 14 nanometer die shrink of its Haswell micro architecture is named as Broadwell. It is a "tick" in Intel's tick-tock principle as the next step in semiconductor fabrication. Its works like previous tick-tock iterations, Broadwell will not completely replace the full range of CPUs from the previous micro architecture (Haswell), as there will be no low-end desktop CPUs based on Broadwell.

SKYLAKE ARCHITECTURE: [19]

Intel launched Skylake microarchitecture in August 2015 as the successor to the Broadwell microarchitecture. Skylake is a micro architecture redesign using an already existing process technology, serving as a "tock" in Intel's "tick-tock" manufacturing and design model. According to Intel, the redesign brings greater CPU and GPU performance and reduced power consumption. Skylake uses the same 14 nm manufacturing process as Broadwell.

VIII. RESULT AND DISCUSSION

Comparison of Average TDP in Microprocessor Architecture

Comparison of Average TDP in Microprocessor Architecture is about the Intel Processor’s, which reduce the heat energy produced by the CPU. The Average TDP is calculated using the data’s are collected of TDP, where the different Architecture and some of its Processor. Nehalem, Sandy Bridge, Ivy Bridge, Haswell, Broadwell, Skylake are the 64 bit Microprocessor which is used here for comparison.

The graph shows the graphical representation of the above table.

Here Figure1 shows that x axis - the average TDP produce by the processors, y axis - the different core models of the different Architecture. It shows the Increasing and Decreasing rate of the TDP value at different levels of the Microprocessor Architecture.
The following observations are found from the above result table and graph.
* The TDP is increasing when we go from low model to higher model
* The architecture determines the TDP
* The SKYLAKE architecture gives optimized TDP

IX. CONCLUSION

This research paper shows the importance of reducing the Heat Energy produced by computer processor to protect our environment. We should understand the need of TDP Processor and Cooling the Processor as shown in research paper necessary steps for healthy environment. If not it may create some pollution on air by heating. So with a little sense of understanding the importance and need of Green computing over TDP Processor and we should take less consuming TDP like Skylake Architecture which gives the average TDP value other than that Nehalem Architecture, SandyBridge Architecture, IvyBridge Architecture, Haswell Architecture, Broadwell Architecture. Skylake Architecture is more consistent Architecture which gives less TDP value when it using in high power processor Intel core i7 processors. Thus, here we should use less heat producing Architecture to save our environment from Global Warming.

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