Green Computing Future of Liveliness

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Abstract:
Green computing is a effective and efficient way for designing, manufacturing and using of computers and computer related products that would help preserve natural resources and reduce the harmful impact on the environment.

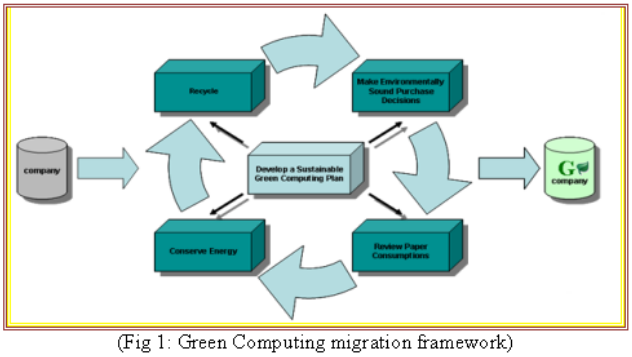
I. Introduction:

Green computing is the environmentally responsible use of computers and related resources. Such practices include the implementation of energy-efficient central processing units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste).

One of the earliest initiatives toward green computing in the United States was the voluntary labelling program known as Energy Star. It was conceived by the Environmental Protection Agency (EPA) in 1992 to promote energy efficiency in hardware of all kinds. The Energy Star label became a common sight, especially in notebook computers and displays. Similar programs have been adopted in Europe and Asia.

"Greening" your computing equipment is a low-risk way for your business to not only help the environment but also reduce costs. Making a conscious decision to go green in the workplace, not only improves your bottom line, but also reduces your carbon footprint. It's a win-win no matter how you look at it",

In addition to saving companies in ongoing power consumption costs, thin client devices have a number of additional energy saving benefits when compared to traditional PCs. Because they have no moving parts, such as disc drives or fans, and emit very little heat, organizations also save in cooling costs; actual savings vary based on facility. Producing thin clients also requires significantly less energy and resources, as they contain fewer parts; are cheaper to transport because they are approximately 40 percent lighter; and last 50 percent longer, greatly reducing computer disposal costs.



(Fig 1: Green Computing migration framework)

Need for Green Computing:
The following points would clear why should a company promote green, or energy efficient computing?

- *Climate Change***:** First and foremost, conclusive research shows that CO2 and other emissions are causing global climate and environmental damage. Preserving the planet is a valid goal because it aims to preserve life. Planets like ours, that supports life, are very rare. None of the planets in our solar system, or in nearby star systems have m-class planets as we know them.
- *Savings***:** Green computing can lead to serious cost savings over time. Reductions in energy costs from servers, cooling, and lighting are generating serious savings for many corporations.
- *Reliability of Power***:** As energy demands in the world go up, energy supply is declining or flat. Energy efficient systems helps ensure healthy power

- *Computing* **:** Computing Power Consumption has Reached a Critical Point: Data centres have run out of usable power and cooling due to high densities.

II. Activities Of Green Computing:

Here's is some basis for green computing which shows how designers plan to make future computer more eco-friendly across its entire life span, from manufacture to recycling:

- Energy-intensive manufacturing of computer parts can be minimized by making manufacturing process more energy efficient.
- Landfills can be controlled by making best use of the device by upgrading and repairing in time with a need to make such processes (i.e., upgradation and repairing) easier and cheaper.
- Avoiding the discarding will not only control e-waste out of dumps but also save energy and materials needed for a whole new computer.
- Power-sucking displays can be replaced with green light displays made of OLEDs, or organic light-emitting diodes.
- Use of toxic materials like lead can be replaced by silver and copper.

III. Green Computing Groups:

Currently, one of the popular green computing groups is tactical incrementalists. This group applies and uses green computing philosophies mainly to save up on costs rather than save the environment. This green computing concept emerged naturally as businesses find themselves under pressure to maximize resources in order to compete effectively in the market. This movement arose mainly from economic sentiments rather than political pressure.

Strategic Leaders take into account the social and environmental impacts of new and emerging technologies. Aside from minimizing costs, this particular movement also takes into account other factors such as marketing and branding. Unlike the position held by tactical incrementalists, strategic leaders recognize the need to overhaul some existing policies or structural makeup of the organization. This can be seen in recent efforts to make IT personnel directly responsible for managing, minimizing and ensuring efficient energy expenditures.

IV. Green revolution:

IT vendors also are applying green standards to their own operations. The reasons are ::

- New revenue opportunities
- Fear of a customer backlash
- Desire to act like good corporate citizens

The awareness programme may include the following major issues:

- Green computing minimizes the energy consumption of the organization i.e. minimizes the power bill.
- Use of non-toxic material in the equipments makes the worker safe from health problem and occupational hazards.
- It saves the resource of the country as a whole.

V. Approaches To Green Computing:

the field of green computing as "the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment.Murugesan lays out four paths along which he believes the environmental effects of computing should be addressed: Green use, green disposal, green design, and green manufacturing.

Modern IT systems rely upon a complicated mix of people, networks and hardware; as such, a green computing initiative must cover all of these areas as well. A solution may also need to address end user satisfaction, management restructuring, regulatory compliance, and return on investment (ROI). There are also considerable fiscal motivations for companies to take control of their own power consumption; "of the power management tools available, one of the most powerful may still be simple, plain, common sense."

A. Developing a Green Machine:

Activating the power management features on your computer saves energy and money while helping the environment. Your computer's SLEEP and HIBERNATE settings are two of the most effective ways for you to make your computer more

environmentally friendly. You can activate these functions manually or through your operating system's pre-set power management settings.

- **Sleep Mode:** Sleep or standby mode conserves energy by cutting off power to your display, hard drive, and peripherals. After a pre-set period of inactivity, your computer switches to a low power state. When you move your mouse or press any computer key, you exit sleep mode and your computer takes you back to its previous operating state. Sleep mode is an especially effective way to conserve battery power in a laptop computer.

- **Hibernate Mode:** Hibernate mode saves energy and protects your work by copying system data to a reserved area on your hard drive and then completely turning off your computer. It also reduces wear and tear on your components. When you turn power back on, your files and your documents appear on your desktop just as you left them. Be sure to set your system to automatically go into hibernate mode any time your battery power reaches a critically low level.

B. Product longevity :

Gartner maintains that the PC manufacturing process accounts for 70 % of the natural resources used in the life cycle of a PC.Therefore, the biggest contribution to green computing usually is to prolong the equipment's lifetime. Another report from Gartner recommends to "Look for product longevity, including upgradability and modularity." For instance, manufacturing a new PC makes a far bigger ecological footprint than manufacturing a new RAM module to upgrade an existing one, a common upgrade that saves the user having to purchase a new computer.

C. Software and deployment optimization

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. While algorithmic efficiency does not have as much impact as other approaches, it is still an important consideration. A study by a physicist at Harvard, estimated that the average Google search released 7 grams of carbon dioxide (CO_2).However, Google disputes this figure, arguing instead that a typical search produces only 0.2 grams of CO_2.

- **Resource allocation:**

Algorithms can also be used to route data to data centres 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.

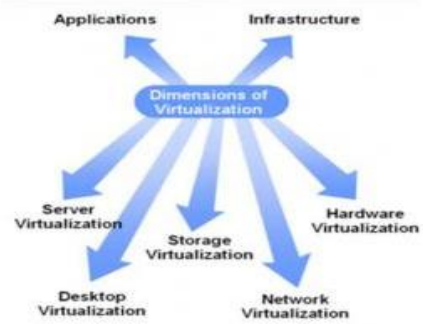
Larger server centers are sometimes located where energy and land are inexpensive and readily available. Local availability of renewable energy, climate that allows outside air to be used for cooling, or locating them where the heat they produce may be used for other purposes could be factors in green siting decisions.

D. Virtualization

Instead of having one computer for each service or set of services, you can instead consolidate each server onto a larger virtualized system that uses its resources to the fullest, and has a much smaller energy footprint.

This benefits in several ways:

a) It reduces the total amount of hardware used in your environment
b) Idle Virtual servers can be powered off
c) The virtualized server will have much less idle time and waste less
d) The total volume of space, air, and rent will be reduced. Data centers can use up to 100 times the energy per square foot of typical office space.
e) Some power companies pay rebates for conversion to virtualized systems.



(Fig 3: Virtualization : The key to Green Computing)

E. Power management :

- **Data center power**

Data centers, which have been criticized for its extraordinary high energy demand, are a primary focus for proponents of green computing.The federal government has set a minimum 10% reduction target for data center energy usage by 2011.With the aid of a self-styled ultra efficient evaporative cooling technology, Google Inc. has been able to reduce its energy consumption to 50% of that of the industry average.

- **Operating system support:**

The dominant desktop operating system, Microsoft Windows, has included limited PC power management features since Windows 95.These initially provided for stand-by (suspend-to-RAM) and a monitor low power state. Further iterations of Windows added hibernate (suspend-to-disk) and support for the ACPI standard. Windows 2000 was the first NT based operating system to include power management. This required major changes to the underlying operating system architecture and a new hardware driver model. Windows 2000 also introduced Group Policy, a technology which allowed administrators to centrally configure most Windows features. However, power management was not one of those features. This is probably because the power management settings design relied upon a connected set of per-user and per-machine binary registry values,effectively leaving it up to each user to configure their own power management settings.

This approach, which is not compatible with Windows Group Policy, was repeated in Windows XP. The reasons for this design decision by Microsoft are not known, and it has resulted in heavy criticism Microsoft significantly improved this in Windows Vista by redesigning the power management system to allow basic configuration by Group Policy.

There is a significant market in third-party PC power management software offering features beyond those present in the Windows operating system. Most products offer Active Directory integration and per-user/per-machine settings with the more advanced offering multiple power plans, scheduled power plans, anti-insomnia features and enterprise power usage reporting.

- **Power supply**

Desktop computer power supplies (PSUs) are generally 70–75% efficient, dissipating the remaining energy as heat. An industry initiative called 80 PLUS certifies PSUs that are at least 80% efficient; typically these models are drop-in replacements for older, less efficient PSUs of the same form factor.As of July 20, 2007, all new Energy Star 4.0-certified desktop PSUs must be at least 80% efficient.

- **Storage**

Smaller form factor (e.g. 2.5 inch) hard disk drives often consume less power per gigabyte than physically larger drives. Unlike hard disk 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.

In a recent case study, Fusion-io, manufacturers of the world's fastest Solid State Storage devices, managed to reduce the carbon footprint and operating costs of MySpace data centers by 80% while increasing performance speeds beyond that which had been attainable via multiple hard disk drives in Raid 0. In response, MySpace was able to permanently retire several of their servers, including all their heavy-load servers, further reducing their carbon footprint.

As hard drive prices have fallen, storage farms have tended to increase in capacity to make more data available online. This includes archival and backup data that would formerly have been saved on tape or other offline storage. The increase in online storage has increased power consumption. Reducing the power consumed by large storage arrays, while still providing the benefits of online storage, is a subject of ongoing research

- **Video card**

A fast GPU may be the largest power consumer in a computer.Energy efficient display options include:

- No video card - use a shared terminal, shared thin client, or desktop sharing software if display required.
- Use motherboard video output - typically low 3D performance and low power.
- Select a GPU based on low idle power, average wattage or performance per watt.

Display

CRT monitors typically use more power than LCD monitors. They also contain significant amounts of lead. 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.Fluorescent back-lights also contain mercury, whereas LED back-lights do not.

Green Computing: Applications in Use

Blackle:

Blackle is a search-engine site powered by Google Search. Blackle came into being based on the concept that when a computer screen is white, presenting an empty word page or the Google home page, your computer consumes 74W. When the screen is black it consumes only 59W. Based on this theory if everyone switched from Google to Blackle, mother earth would save 750MW each year. This was a really good implementation of Green Computing. The principle behind Blackle is based on the fact that the display of different colors consumes different amounts of energy on computer monitors.

Fit-PC: a tiny PC that draws only 5w:

Fit-PC is the size of a paperback and absolutely silent, yet fit enough to run Windows XP or Linux. Fit-PC is designed to fit where a standard PC is too bulky, noisy and power hungry. If you ever wished for a PC to be compact, quiet and green – then fit-PC is the perfect fit for you.

Sunray thin client:

Sun Microsystems is reporting increased customer interest in its Sun Ray, a thin desktop client, as electricity prices climb, according to Subodh Bapat, vice president and chief engineer in the Eco Responsibility office at Sun. Thin clients like the Sun Ray consume far less electricity than conventional desktops, he said. A Sun Ray on a desktop consumes 4 to 8 watts of power, because most of the heavy computation is performed by a server.

The Asus Eee PC and other ultra portables:

The "ultra-portable" class of personal computers is characterized by a small size, fairly low power CPU, compact screen, low cost and innovations such as using flash memory for storage rather than hard drives with spinning platters. These factors combine to enable them to run more efficiently and use less power than a standard form factor laptop.

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