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Towards The Adoption of Green Computing Techniques In Nigeria It Industries

Conference proceedings

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Abstract
Over the years, there has been a lot of academic and industrial interest on green computing and providing green solution to all aspects of computing through Green computing. Green computing provides a system with better performance and processing capabilities with lesser amount of energy consumption. Researches have shown that energy cost constitutes the highest percentage of the overall costs of managing Information Technology (IT) industries. In this paper, emphasis is made on the need, importance of green computing and its techniques in Nigerian Information Technology industries. Green computing promises better services, sustainable IT growth, environmental safety and reduced Overhead cost of running IT centers.

Keywords: Green Computing, Nigeria, Energy Conservation, Environmental Protection, ICT

1.0 INTRODUCTION

Green computing is the effective and efficient use of computer resources for reduction of overall energy consumption in order to minimize the cost running IT centers [1]. Major aims of green computing are to protect the environment and save power along with operational cost in increasingly competitive world. Nowadays, consumers and non-governmental organization are paying more serious attention to their electricity consumption. The amount spent on running IT centers has doubled over the last decade [2]. Today everyone is concerned and aware of green computing approaches and beginning to request and accept environmentally friendly systems in their various places of endeavors. This approach has also led to vehicular market; where automakers have experimented customers' feedback and produce cars with better fuel economy in addition to lowering emissions and including natural materials. The objectives of green computing are similar to that of "green chemistry" which is to minimize the use of hazardous materials and increase power efficiency during the system life cycle [1]. In this paper, we emphasize the need, importance of green computing and its techniques in Nigerian Information Technology industries.

2.0 NEED FOR GREEN COMPUTING IN NIGERIAN IT INDUSTRIES

The use of computer systems and information technology equipment has made life easy. The demand for this equipment is on the high, leading to large energy consumption in Nigeria. Large energy consumption means large emission of greenhouse gases like carbon dioxide. Most of the time, computer energy is wasted. This is because computer systems are left ON when not in use. The computer's central processing unit (CPU) and fan consume power and the screen saver consumes power when not in use as well. Most IT centers do not have enough cooling capacities and this has led to environmental pollution. This could also be as a result of defects in manufacturing techniques, packaging, disposal of computer systems which can enter in to food and water line[5] [3].

Nigeria as the most populous nation in Africa and one of the leading consumer markets for computer systems and electronics has continued to witness environmental degradation as a result of dumping obsolete equipment in the environment. Lagos state and other major cities in Nigeria are witnessing these environmental effects as a result of dumping of these electronic in the environment has which lead to increase in pollution, contamination of food and water chain and also making the soil unfertile as a result of presence of chemical and hazardous materials from which these products are made [4].

Although Nigeria Government has several agencies like: Federal Environmental Protection Agency (FEPA); National Environmental Standards and Regulations Enforcement Agency (NESREA); National Emergency Management Agency (NEMA); National Space Research and Development Agency (NASRDA); Nigeria Customs Service (NCS) .These agencies are looking at the direction of protecting the environment and E-waste but nothing serious has been done [5]. There is need for government at all levels to implement strong legislation on the power rating and level of hazardous material equipment imported into the country. There is need for the stakeholders in IT services to adopt green computing practice in Nigeria. This will allow them to save the environment and reduce the overall cost of running IT centers. Some of these green computing methods are highlighted below.

3.0 GREEN COMPUTING APPROACHES

There are many ways of reducing the environmental effect of computing. These include decreasing power consumption, energy efficient coding, manufacturing of low power hardware, recycling of computing material. Some of key approaches are discussed below:

3.1 Virtualization

Virtualization is the use of two or more logical computers on a physical hardware. With the aid of virtualization, an IT administrator can combine many physical systems into virtual machine on a single big system. Thereby, reducing the original computer hardware and cost of cooling and energy consumption. One of the major goals of all virtualization schemes is the efficient use of available system resources [6].

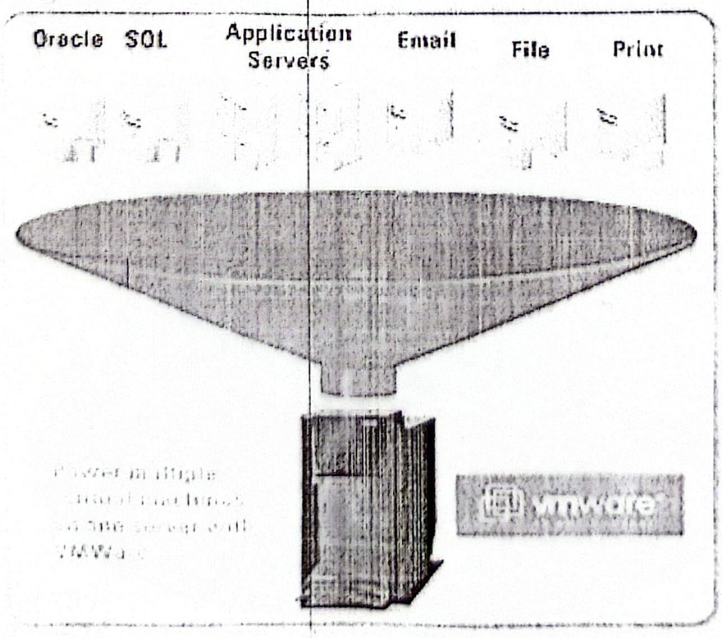

Figure 1: VIRTUALIZATION OS SERVERS (Source [7])

Virtualization in "Green Computing" makes it possible to consolidate servers and maximize CPU processing power on other servers. Virtualization storage makes it possible for systems to access a shared storage subsystem. This method would reduce the number of storage facilities required, amount of energy required, heats produced and, also reduce overhead cost of running the system [8].

3.2 Cloud Computing

Cloud computing is a computational paradigm whereby processing power, application software and artificial intelligence are accessed over the internet. One of the benefits of cloud computing is to access the environmental benefits of virtualization. Most of the servers in IT centers run at 30 percent capacity, while cloud vendor server run at 80 percent capacity or more than this capacity. Using cloud computing and adopting online processing in the form of PaaS (Platform as a Service) or IaaS (Infrastructure as a service) data centers will reduce the carbon footprint. In order to run server capacity at optimal energy efficiency, cloud computing will minimize the need for users to run high capacity computer systems. By using cloud computing SaaS (Software as a Service) Software application, lower hardware power costs will be achieved and people can collaboratively work together without the need to physically move around, thus minimizing the environmental effect of such activities [3].

3.3 Recycling of Computer and Electronic Materials

Material recycling in computer context refers to the reuse of computer or electronic waste materials. These include finding another use of such systems or its components or dismantling the system in a manner that allows safe removal of its components for reuse in other production process.

These electronic waste materials includes: phone, computers systems and others communication gadgets. Which contain recyclable elements like copper, gold and lead. These elements contain plethora of toxic substances, such as dioxin, chromium, cadmium, mercury and radioactive isotope. Recycling these electronic equipments can keep hazardous materials such as mercury, hexavalent chromium and leads out of the environment. Computing components like printer cartridges, batteries and papers can also be recycled.

Figure 2: WASTE RECYCLING (source [8])

3.4 Teleconferencing

Teleconferencing, telework or working from home (WFH) is a method whereby the employees enjoy easy working from any location in any time. The daily movement to central working place will be replaced by communications links. Teleconference approaches are also implemented in green computing technology. There are many benefits of teleconference, namely; it reduces greenhouse gas emissions resulting from travelling and arguments profit margins by lowering the total cost for running IT centers.

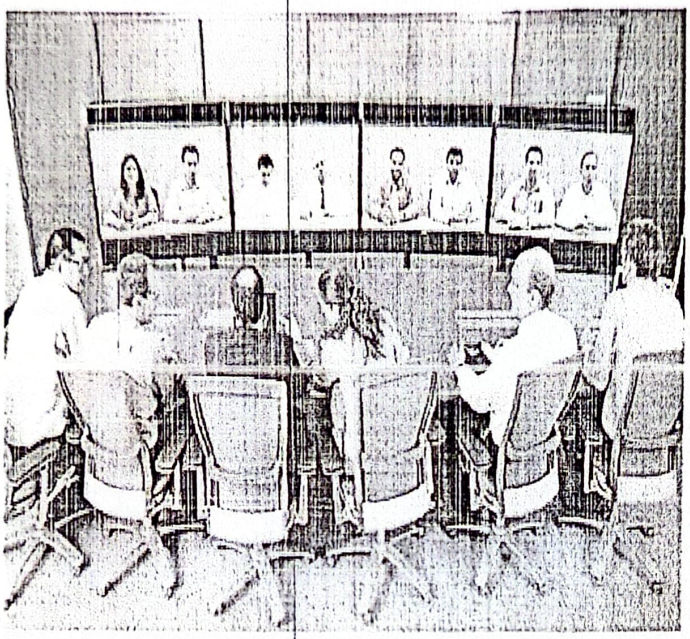

Figure 3: TELECONFRENCING (source [8])

3.5 Manufacturing of Less Pollutant Products

Computer Systems and electronic components are made from many hazardous materials like beryllium, mercury, lead, polyvinyl chloride (PVC) and bromine flame (BFR). By lowering the use of such materials, manufacturers of hardware component will prevent people from exposing themselves to harmful chemicals and also enable electronic waste to be recycled safely. Producing computing equipment with lesser pollutant materials is a great responsibility that should be carried out by manufacturers of hardware. Individual companies can also play a very important role by their choice or demand for these products which reduces the amount of hazardous chemicals present in the purchased computing products.

4.0 SELECTED METRICS FOR GREEN COMPUTING

The power-related metrics discussed in this section can help computing organizations to analyze and optimize the power consumption of the company.

4.1 Effective Power Usage

Power Usage Effectiveness (PUE). This is a metric focused on the computing centers' infrastructure.

PUE = Total Facility Power / IT Equipment Power ..... (1)

IT equipment power can be defined as the load associated with network equipment, computers, storage, and peripherals. Total facility power is the total power measured at the utility meter. The PUE can range from 1.0 to infinity. Ideally, a PUE value tending towards 1.0 would indicate 100% efficiency [9].

4.2 Data Center Infrastructure Efficiency

Data Center infrastructure Efficiency (DCiE). As IT equipment uses less energy per unit of performance, lesser energy is needed for cooling. This will lead to an improvement in DCiE.

DCiE = IT Equipment Power / Total Facility Power ..... (2)

4.3 Data Center Performance Efficiency

Data Center Performance Efficiency (DCPE) is a refined version of the PUE metric. It is adopted for all major power-consuming subsystems in the data center. Total Facility Power is measured at or near the facility utility meter in order to accurately reflect the power entering the data center. IT Equipment Power would be measured after all power conversion, switching, and conditioning is completed and before the IT equipment itself.

DCPE= Useful Work /Total Facility Power..... (3)

4.4 Energy Reuse Effectiveness

Energy Reuse Effectiveness (ERE) is a metric that is used to measure the energy efficiency of data centers that re-use waste energy from their data centers.

ERE = (Cooling + Power + Lighting + IT-Reuse) / IT .....(4)

ERE = (1- ERF [ERF or ERE? If ERF, × PUE [9].

4.5 Server Compute Efficiency

The Server Computing Efficiency (ScE): ScE percentage over any time period is calculated by summing the number of samples where the server is found to be providing primary services (p) and dividing this by the total number of samples (n) taken over that time period and multiplying by 100. Any server with a ScE of 0% over a prolonged period is not being used and can be decommissioned [9].

4.6 Compute Power Efficiency

Compute Power Efficiency is a metric that quantifies the overall efficiency of a data center while taking into account the fact that not all electrical power delivered to the IT equipment is transformed by that equipment into useful work product. Some of the equipment within IT center consumes power while left on idle. Other equipment can be in use but not at 100% of its capacity.

CPE = (Equipment Utilization × Equipment Power) /Total Facility Power [9] ..... (5)

4.7 DATA CENTER ENERGY PRODUCTIVITY

Data Center energy Productivity (DCeP) is a metric that quantifies the useful work that a data center produces based on the amount of energy it consumes.

DCeP = Useful Work Produced / Total Data Center Energy Consumed Producing this Work [9] .....(6)

4.8 PARTIAL POWER USAGE EFFECTIVENESS

The Partial PUE (pPUE) is a new conceptual metric where a PUE value for a subsystem can be measured and reported.

pPUE = Total Energy within a boundary / IT Equipment Energy within that boundary [9].....(7)

4.9 WATER USAGE AND CARBON USAGE EFFECTIVENESS

The Green Grid recently released Carbon Usage Effectiveness (CUE) and Water Usage Effectiveness (WUE).

CUE = Total Carbon dioxide Emissions from Total Data Center Energy / IT Equipment Energy [9] ..... (8)

WUE = Annual Site Water Usage / IT Equipment Energy.

5.0 GREEN COMPUTING: PROSPECTS FOR NIGERIA IT

As an awareness and demand for IT continue to increase in Nigeria, IT industries are witnessing substantial growth and development over the last decade which makes Nigeria IT industry a uniquely large market in Africa. Nigeria also continues to witness the environmental effects of some of these computing components. This has also led to increased energy consumption in Nigeria especially in major cities like Lagos, Abuja, and Port Harcourt. Due to the increasing Nigerian population, the Nigerian Government has continued to struggle to end erratic power supply woes in the country. For Nigeria computing industries to be relevant in IT business and ensure profitability, there is need to lower the cost of operation by adopting sustainable green computing methods.

TABLE 1: COUNTRY STATISTICS ON ELECTRICITY GENERATION AND PER CAPITAL CONSUMPTION [10]

S/N	CONTINENT	COUNTRY	POPULATION (MILLION)	ELECTRICITY GENERATION CAPACITY (MW)	PER CAPITAL CONSUMPTION (KW)
1	NORTH AMERICA	USA	250	813,000	3.2
2	SOUTH AMERICA	CUBA	10.54	4,000	0.38
3	EUROPE	UK	57.5	76,000	1.1
4	EUROPE (EASTERN)	UKRAIN	49	54,000	1.33
5	MIDDLE EAST	IRAQ	23.6	10,000	0.42
6	FAR EAST	SOUTH KOREAN	47	52,000	1.10
7	AFRICA	NIGERIA	140	<4,000	0.03
8		EGYPT	67.9	18,000	0.27
9		SOUTH AFRICA	45,000	1.02	

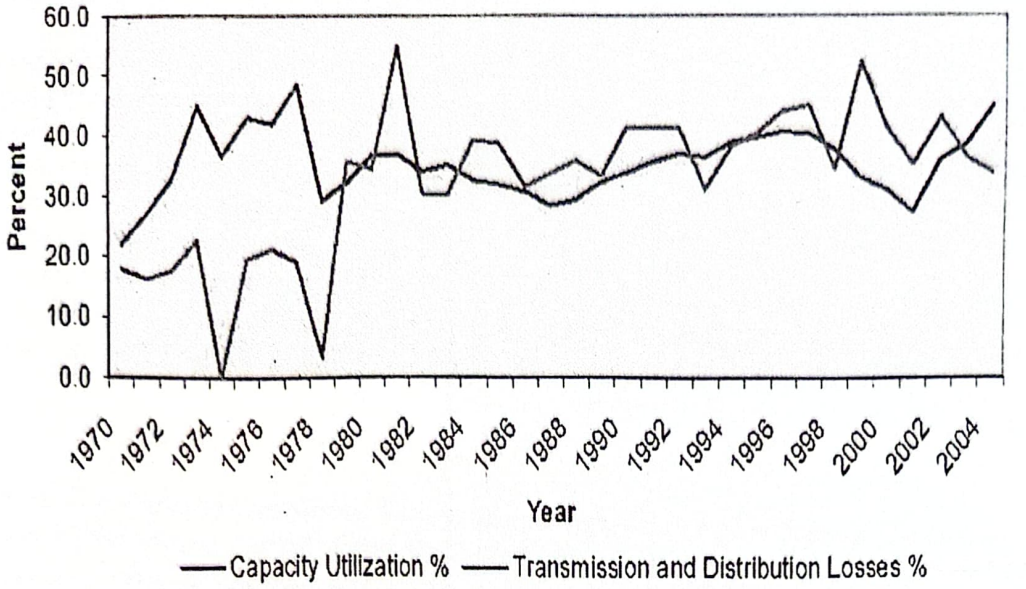

Figure 4 ENERGY CRISES IN NIGERIA FROM 1970 TO 2004 [10]

As the demand for computing equipment continues to increase in Nigeria, the challenge of computing industries remains energy to power computing equipment when the need for such equipments arise. As shown in Figure 4, from 1970 to 2004 and even up till date, Nigeria energy crises continues to be on the increase, therefore power to run these computing equipment continues to be a mirage for the computing industries. As shown in table 1 above, Nigeria with more than 140 million people [11]has the least megawatt generating capacity and the least per capital consumption kilowatt (KW) compared to other African countries and the world in general. Most Nigerian computing companies are running on diesel engine to run data centers. Running on diesel engine Increases the overall cost of the organization.

Apart from the organizational cost of diesel engine, there is also environmental pollution from running such independent power supply. There is also environmental impact as a result of dumping these computing equipments as evident in the major cities. With the advent of another raining season, if this trend is not checked, hazardous chemicals from computing equipments can be washed into food and water chain with devastating repercussions. The presence of chemicals in the soil can lead to unfertile soil which will lead to famine.

The demand for some chemical elements for making computing equipment's like lead has led to increasing illegal mining activities which are endangering lives such as the case of lead mining activities in of Zamfara State Nigeria [12]. There is need to adopt a green computing approach like recycling of materials to solve this menace and save our lives and environment.

6.0 CONCLUSION

With the increasing demand for energy to power computing equipments, its resultant cost, and the recent global economic recession, in order for Nigeria computing industries to increase the profit margin, there is need to lower the energy consumption rate thereby reducing overall cost and saving the environment from pollution by adopting green computing approaches raging from virtualization, cloud computing and teleconference. As presented in this paper there is no doubt lesser power generating capacities in the country at the moment to supply the energy need of the country; therefore IT industries' in Nigeria should adopt green computing methods in order to reduce power consumption, increase profit margin and saves our environment from hazardous material of computing equipments.

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