

An Approach to Make Data Centers Energy Efficient & Green

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ABSTRACT: Global warming, Use of Energy consumption and the increase of toxic waste generated by electronic devices are some of the issues that are being currently addressed through the use of the so-called “green technologies”. Data centers are the building blocks of IT business organizations providing the capabilities of centralized repository for storage, management, networking and dissemination of data. With the rapid increase in the capacity and size of data centers, there is a continuous increase in the demand for energy consumption. In this paper the issue some of these issues within the context of green data centers and why it is necessary to stimulate the creation of such centers to help us save the environment and the global community at large. In this respect green data centers can be both environmentally and financially efficient by reducing energy consumption.

KEYWORDS: Green technologies, toxic waste, global warming, energy consumption.

I. INTRODUCTION

Energy efficiency and low carbon strategies have attracted a lot of concern. The goal for 20% energy efficiency and carbon reduction by 2020 drove the Information Communication Technologies (ICT) sector to strategies that incorporate modern designs for a low carbon and sustainable growth.

The ICT sector is part of the 2020 goal and participates in three different ways. In the direct way, ICT are called to reduce their own energy demands (green networks, green IT), in the indirect way ICT are used for carbon displacements and in the systematic way ICT collaborate with other sectors of the economy to provide energy efficiency (smartgrids, smart buildings, intelligent transportations systems, etc.). ICT and in particular data centers have a strong impact to the global CO₂ emissions. The data center is the most active element of an ICT infrastructure that provides computations and storage resources and supports respective applications. Energy efficiency in ICT is defined as the ratio of data processed over the required energy (Gbps/Watt) and is different than power conservation where the target is to reduce energy demands without considering the data volume. Taking into consideration this ratio, green IT technologies have important benefits in terms of

- reduce electricity costs ;
- improve corporate image;
- provide sustainability;
- extend useful life of hardware;
- reduce IT maintenance activities;
- reduce carbon emissions and prevent climate change;
- provide foundations for the penetration of renewable energy sources in IT systems. The demand for high speed data transfer and storage capacity together with the increasingly growth of broadband subscribers and services will drive the green technologies to be of vital importance for the telecommunication industry, in the near future.

Objectives

- Green Data Centers
- Conversion to A Green Data Center (Prepare The Green Report)
- Field Currently Using Green Data Center

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 11, November 2016

II. RELATED WORK

Literature Review -In recent years the energy use and environmental impact of data centers has recently become a significant issue for both operators and policy makers. Global warming forecasts that rising temperatures, melting ice and population dislocations due to the accumulation of greenhouse gases in our atmosphere from use of carbon-based energy. Data centres represent a relatively easy target due to the very high density of energy consumption and ease of measurement in comparison to other, possibly more significant areas of IT energy use. Policy makers have identified IT and specifically data centre energy use as one of the fastest rising sectors. At the same time the commodity price of energy has risen faster than many expectations. This rapid rise in energy cost has substantially impacted the business models for many data centres. Energy security and availability is also becoming an issue for data centre operators as the combined pressures of fossil fuel availability, generation and distribution infrastructure capacity and environmental energy policy make prediction of energy availability and cost difficult . As corporations look to become more energy efficient, they are examining their operations more closely. Data centers are found a major culprit in consuming a lot of energy in their overall operations. Today's data, data centers have grown themselves significantly by continuous addition of thousands of servers. These servers are consuming much more power, and have become larger, denser, hotter, and significantly more costly to operate . data center electricity consumption will be doubled in next two years in data centers]. With the increase in infrastructure and IT equipment, there is a considerable increase in the energy consumption by the data centers, and this energy consumption is doubling every five years. . Data centers use nearly 10 to 30 times more energy per square foot than office space . Today's data centers are big consumer of energy and are filled with high density, power hungry equipment.

Problem faced -As some of the developing countries are facing huge energy crisis, the energy consumed by data centres have a great effect on their overall production of energy. This huge consumption of energy by data centers not only shortens the supply of power energy to other businesses International Journal , but also contributes towards the shortage for data centers themselves. This energy consumption also contributes towards waste of energy and environmental stewardship. There is a need to design a strategy that provides a solution to decrease the continuous demand and consumption of energy by data centers. This paper proposes a new technique that combines the workload of multiple servers onto fewer servers by properly utilizing their efficiencies i.e. hardware and software efficiencies. The proposed strategy uses a new technology called server consolidation a type of virtualization to achieve energy efficiency and at the same time reducing the effect of green house gases making data centers greener.

III. GREEN DATA CENTERS

One of the main objectives of "green technologies" is to reduce the "carbon footprint" required or generated by the computer technology. As we indicated earlier, power plants are highly responsible for the production of greenhouse gases. This is why it is necessary to reduce the demand of electricity required throughout the world, in particular, that required by computing data centers. Data centers alone consume as much power in a year as is generated by five power plants . Thus, for any data center to be energy efficiency is a must. A green data center (GDC) is similar to any other data center used as a repository for the storage, management and distribution of data. However, what makes a data center "green" is that the mechanical, electrical and computer systems are designed simultaneously to achieve maximum energy efficiency and minimum environmental impact .

IV. CONVERSION TO A GREEN DATA CENTER

The construction of a GDC is a large investment. Several steps need to be taken when a government or business entity considers the conversion of an existing data center to a GDC. The first and the foremost step is the evaluation of your data center in terms of energy efficiency. This step includes monitoring and measuring the consumption of energy for the entire enterprise . This initial step of monitoring the energy consumption allow the enterprise to estimate where energy consumption can be reduced and what equipment or hardware needs replacement. This activity obviously helps in the consideration to redesign or start a new data center.

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There are metrics that can help in analyzing the “greenness” of an existing data center. Two of the most popular metrics that can measure the “greenness” of an existing data center are Power Usage Effectiveness (PUE) and Data Center Efficiency (DCE). These metrics are calculated based on the following equations:

$$\text{PUE (power use effectiveness)} = \frac{\text{Total power used by the data center building}}{\text{Power used of IT equipment}}$$
$$\text{DCIE (data center infrastructure efficiency)} = \frac{1}{\text{PUE}}$$

As an aid to the analysis of an existing data center, there are tools such as The Green Report created by RACKWISE™ which calculates the PUE and DCIE from an organization’s model of the data center. The report produced by this tool also breaks down resources consumption by type such as servers, network, storage equipment, or other. The Green Report is an excellent tool as it can provide the organizations with measures that can help the existing data center to become a GDC.

Estimating the energy consumption of a data center can help us to determine the enterprise baseline energy. Based on this measurement, corrective measures can be taken to transition to a GDC. Without measuring the current consumption and setting target goals it is impossible to determine if the enterprise is benefitting from the green measures. This is the reason energy consumption should be monitored after green measures have been put in place as it affects all areas of an enterprise. Some additional considerations that deserve our best attention are presented next. They will help in maximizing the efficiency of a data center and at the same time convert it to an environment-friendly center. One of the first and most vital aspect to consider is the evaluation of the current cooling system, and, if necessary, to redesign it or replace it altogether. Cooling systems are often overlooked in this transition process. A cooling system needs to be redesigned or replaced whenever it is not being used to its maximum capacity and/or it is using more energy than what was originally required. Another aspect of the cooling system that needs consideration is the unnecessary redundancy that may be present due to the dual nature of the system as a cooling and heating system. A basic rule of thumb for this type of system is to have a backup system that guarantees the functioning of the system 24/7. It is interesting to observe that, although most businesses have the acumen of projecting their future needs in terms of a cooling/heating system, they often neglect to evaluate their current one and how it is performing. In terms of energy consumption, it is important to concentrate on the current needs and not create unnecessary backup systems. In the area of IT, and related to cooling and heating system, an important aspect to consider in the transition-to-green process is that of using adjustable equipment. Among this type of equipment, it is necessary to consider scalable blade servers. Servers of this type have a great computing power while occupying a small area and taking less time to cool. In addition to scalable it is recommended that modular systems be used based if necessary. Still within the IT area other suggestions to upgrade to a GDC are the use of energy-efficient servers and the use of high-efficiency power supplies.

V. FIELD CURRENTLY USING GREEN DATA CENTER

It needs to focus on reducing energy demands and thus improve the environment impact. In the process they need to help the students and community by making them aware of the earth-friendly practices that can be practiced at home and in offices. The educational institution itself can create a green data center by using the following practices,

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 5, Issue 11, November 2016

- Regaining power and cooling capacity - As the energy costs are increasing, there is more emphasis on the power and cooling infrastructure. The power scheme being used currently in the enterprise will change with the increase and decrease in usage of energy. We need to regain the best possible balance for power and cooling capacity as the energy demands of the institution change.
- Recapturing resiliency – The increase in energy costs can lead to operating resiliency, thus raising the issue of reliability and performance. We need to use measures that do not affect the performance uptime and, at the same time, help to save energy.
- Reducing energy costs – Apart from the benefit of reducing the operating costs by reducing energy costs, the companies are being offered incentives from local utilities and state energy funds for using practices that reduce consumption of energy. According to a survey, fewer than half the computer users take advantage of the power management settings on their workstation.
- Recycling end-of-life equipment – Recycling has both financial and environmental benefits. A somewhat slow Fax or a printer machine may not fit into a busy IT office environment but can work for a Non-profit organization office. The other largest consumer of energy is the industry sector. Various companies such as IBM™ and Dell™ have taken initiatives to create a GDC and are also trying to follow the earth friendly practices. IBM has taken some measures to cut the energy consumption and in the process it has launched a project known as “Big Green Innovations”. The skills of the business consultants in energy and utilities industry can be combined with the power of its supercomputers. Experts can devise models to measure the usage of energy in the supply chain of a company and use the supercomputers to figure out alternate methods to save the consumption of energy and how to restructure the company’s network. IBM™ launched the standard-size building blocks that use a modular design that cuts the energy consumption of the center into half as compared to the other data centers .

VI. CONCLUSION

The primary concern before and after converting to a green data center should be power management. Most of the administrators are not comfortable monitoring power usage because the main concern is performance. The administrators are more concerned about performance uptime and not the power usage. This practice needs to change and power usage should be measured and monitored where needed. Even after converting to a GDC, the enterprise needs to monitor the usage to reap the benefits of the transition-to-green process. The vendors can also help in power management by selling energy efficient hardware or recyclable hardware. Based on the growth of the industry, the power needs are increasing and thus there is a need to monitor the power usage. As the power needs increase, more earth-friendly measures can be taken to help the environment. Also, the management and administrators need to discuss the increasing needs of the data centers. The power scheme currently used in a data center will change with the growth of industrial as well as the educational sector.

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