Green Computing-An Efficient Approach towards Energy Conservation

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***Abstract*—In recent years there has been a massive development in various technologies leading to their excessive use by various IT firms and huge multinational companies around the globe. Technology development has brought an ease in computing data and various complex transactions proving as a time-saver. However, with a rampant rise in the use of technology there has been a gradual increase in power and data consumption leading to some adverse effects on the environment such as carbon dioxide emissions, global warming and other environmental damages. To deal with such ecological sensitive issues Green computing was originated during 90s. Green computing is a global effort and an environment friendly approach to computing. The notion of green computing is to practice proper utilization of computers and disposal of electronic equipment with a negligible effect on the atmosphere. According to a study it would take at least 500 trees to balance a single, always on, computer. Hence various ways have been derived such as virtualization, energy efficient coding, cloud computing, re-use, re-cycling and proper disposals. With a small adaption of green changes, the effects can be reduced to almost 70 percent which is a major difference. By altering some daily technical habits and creating some more awareness towards the environment, the future of our planet can be changed for the betterment. Thus, green computing is an approach helpful for effective utilization of energy and power consumption.**

***Index Terms*—Virtualization, Cloud Computing, Power Management, Challenges.**

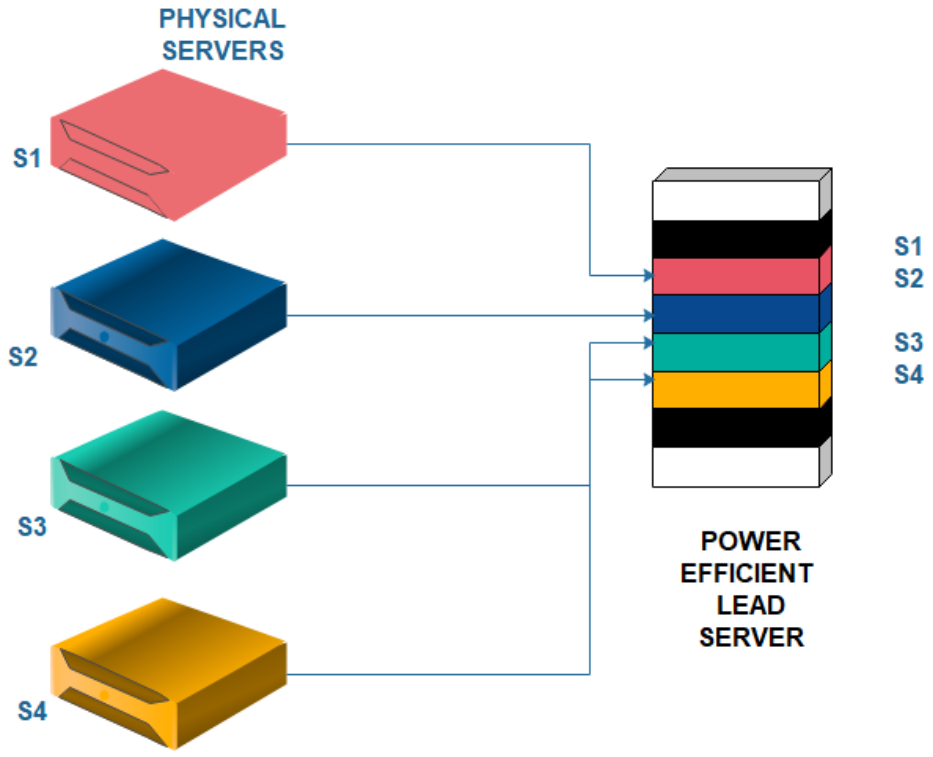
1.INTRODUCTION

Massive development in information technology sector is not hidden anymore. Moreover, in all ways manual work has now been shifted to automated work proving as a great time saver. Impressed by the efficiency and improved speed there was a gigantic demand for automated systems. The need for data storage centers also increased the energy consumption rates. The growth of data centers has been from nothing 10 years ago to using about 3 percent of global power supply and also contributingforabout2percentoftotalgreenhouseemissionsgivingthesameeffectas that of the airline industry. Considering the total shift and the extensive effect on the environment and technology various practices and approaches have been defined by green computing. According to the search done till now many approaches have been defined, some of the important ones are as follows:
• Virtualization • Cloud Computing • Green Data Centre • Power Management.

Virtualization is the process of running a virtual instance of a computer system in a layer abstracted from the actual hardware. To simplify, it can be said as running multiple operating systems on a computer system. Though the operations running on virtual machine may seem as their own dedicated machine, the operating system, libraries and other programs are unique to the virtualized system and not connected to host operating system. Also, isolation in provided keeping programs running inside of a virtual machine safe from the processes taking place in another virtual machine on the same host. In green computing virtualization is categorized into three types: • Server virtualization • Desktop virtualization • Storage virtualization

Cloud computing has become a very promising paradigm for both consumers and providers in various areas including science, engineering and not to mention business. A Cloud typically consists of multiple resources possibly distributed and heterogeneous. Although the notion of a Cloud has existed in one form or another for sometime now, recent advances in virtualization technologies and the business trend of reducing the TCO in particular have made it much more appealing compared to when it was first introduced. There are many benefits from the adoption and deployment of Clouds, such as scalability and reliability; however, Clouds in essence aim to deliver more economical solutions to both parties that is the consumers and providers. Moreover, Cloud applications require movement of large data sets between the infrastructure and consumers, thus it is essential to consider both compute and network aspects of energy efficiency. Energy usage in large-scale computing systems like Clouds also yields many other concerns including carbon emissions and system reliability. Reduction in energy consumption by more effectively dealing with resource provisioning may be obtained. Large profit-driven Cloud service providers typically develop and implement better power management, since they are interested in taking all necessary means to reduce energy costs to maximize their profit. Most important advantage offered by Clouds is in terms of economics of scale; that is, when thousands of users share same facility, cost per user and the server utilization. To enable such facilities, Cloud computing encompasses many technologies and concepts such as virtualization, utility computing, pay as you go, no capital investment, elasticity, scalability, provisioning on demand, and IT outsourcing.

2. ARCHITECTURE
Server Virtualization



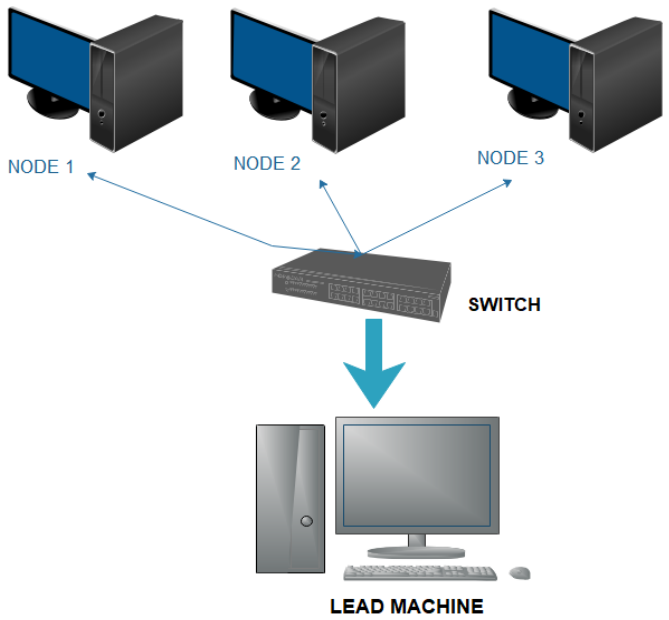
Server Virtualzation

Why Server virtualization?
Computer network administrators usually dedicate each server to a specific application or task. Many of these tasks don't play well with others – each needs its own dedicated machine. One application per server also makes it easier to track down problems as they arise. It's a simple way to streamline a computer network from a technical standpoint. There are a couple of problems with this approach, though. One is that it doesn't take advantage of modern server computers' processing power. Most servers use only a small fraction of their overall processing capabilities. Another problem is that as a computer network gets larger and more complex, the servers begin to take up a lot of physical space. A data center might become overcrowded with racks of servers consuming a lot of power and generating heat.

How does it work ?
By using specially designed software, an administrator can convert one physical server into multiple virtual machines. Each virtual server acts like a unique physical device, capable of running its own operating system (OS). In theory, you could create enough virtual servers to to use all of a machine's processing power, though in practice that's not always the best idea. Virtualization was firstly use din super computers, but now it is widely used in IT infrastructure. The single physical servers using limited processing powers out of available are just transferred to a single special powerful and power efficient server. This method reduces the power consumption, accesses the machines full processing power and is very cost effective.

Desktop virtualization

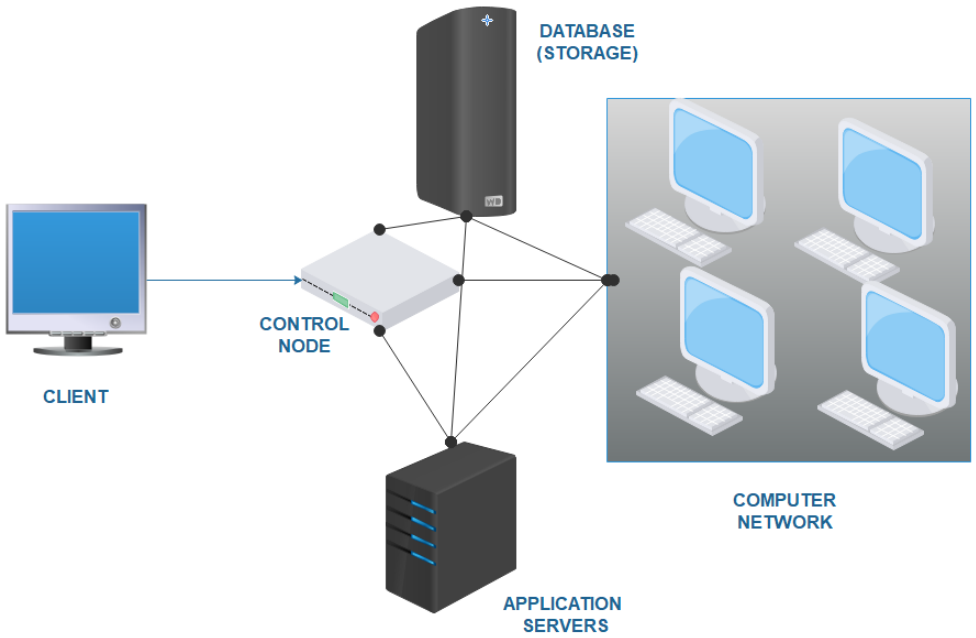
Desktop virtualization, often called client virtualization, is a virtualization technology used to separate a computer desktop environment from the physical computer. Desktop virtualization is considered a type of client-server computing model because the "virtualized" desktop is stored on a centralized, or remote, server and not the physical machine being virtualized. The main property of desktop virtualization is it appears as though you are accessing a dedicated single machine, although the data is stored on the main server. In easy words with full security of data and operations performed ,your data is stored on main server as well as hidden from other thin clients. Desktop virtualization guarantees full data security even in case of hardware loss as the data is stored virtually.



Desktop Virtualization

Cloud Computing

Cloud computing is typically provided by a third party as a software service, or is sometimes built in-house using DIY techniques and ad hoc hardware. Cloud computing usually eliminates or reduces the need for on-site hardware and/or software.For example anyone if a person buys a hard drive backup service that relies on cloud computing, he or she could transfer his or her files through an internet connection so they are stored on servers that may be located in another state, or even in another country. Typically,the files would be stored in multiple places offering added security and redundancy that is impossible with standard hardware solutions.



•Control node: The control node in the mega data center, is necessarily one of the first entry points into the cloud data center and must itself be secure. Network security, protocol security, transport layer security, and application security should be prime candidates for implementation at the edge of the cloud, in the control node.
•Database: A cloud database is a collection of content, either structured or unstructured, that resides on a private, public or hybrid cloud computing infrastructure platform. In a cloud database environment, the cloud computing provider of servers, storage and other infrastructure is responsible for maintenance and availability. The organization that owns and operates the database is only responsible for supporting and maintaining the database software and its contents.
•Application Servers: An application server is a server program in a computer in a distributed network that provides the business logic for an application program. The application server is frequently viewed as part of a three-tier application, consisting of a graphical user interface server, an application (business logic) server, and a database and transaction server.
•Computer network: Depending upon the requirements of the client the network is chosen.

3. ADVANTAGES AND LIMITATIONS

• Reduced energy usage from green computing techniques translates into lower carbon dioxide emissions, stemming from a reduction in the fossil fuel used in power plants and transportation.
• Reduce the risk existing in the laptops such as chemical known to cause cancer, nerve damage and immune reactions in humans.
• For companies with fewer than1,000 employees, upto 40 percent of an IT budget is spent on hardware. Purchasing multiple servers is often a good chunk of this cost. Virtualizing requires fewer servers and extends the lifespan of existing hardware. This also means reduced energy costs.
•Going to a virtual environment can make everyones job easier especially the IT staff. Virtualization provides an easier route for technicians to install and maintain software, distribute updates and maintain a more secure network.
• Disasters are swift and unexpected. In seconds, leaks, floods, power outages, cyber-attacks, theft and even snow storms can wipe out data essential to your business. Virtualization makes recovery much swifter and accurate, with less manpower and a fraction of the equipment its all virtual.
• Through cloud system you can avoid emailing files to individuals and instead send a web link to recipients through your email.
• Businesses and organizations can often reduce annual operating costs by using cloud storage; cloud storage costs about 3 cents per gigabyte to store data internally.

Limitations

• Rapid technology change hence some computers that are green may be considerably underpowered.
• Green computing could actually be quite costly at early stages due to a total transformation in configurations and equipments.
• The investment in the virtualization software, and possibly additional hardware might be required to make the virtualization possible. This depends on your existing network. Many businesses have sufficient capacity to accommodate the virtualization without requiring a lot of cash. This obstacle can also be more readily navigated by working with a Managed IT Services provider, who can offset this cost with monthly leasing or purchase plans.
• Software licensing considerations. This is becoming less of a problem as more software vendors adapt to the increased adoption of virtualization, but it is important to check with your vendors to clearly understand how they view software use in a virtualized environment to a possible learning curve.
• There are concerns with the safety and privacy of important data stored remotely. The possibility of private data commingling with other organizations makes some businesses uneasy. • If you have no internet connection, you have no access to your data. Although it is not a major limitation nowadays, however under certain circumstances it may be a great problem.

5. LITERATURE SURVEY

[1] **Fatima Shakeel, Seema Sharma [1]** "*Green Cloud Computing: A Review On Efficiency Of Data Centres And Virtualization Of Servers"* The Authors have demonstrated the various effects and limitations occurring due to carbon emissions generated by datacentres. The main objective is to analyze the various techniques that have been implemented so far to reduce the consumption of energy by cloud computing systems.
[2] **Ashish Chopra,Saurabh Sharma,Virender Kadya ,[2]** "*Need of Green computing to improve environmental condition in current era"*. Authors discussed the need of green computing. The major focus is done on the analysis of power consumption and Electronic-waste management.
[3] **Nitin S. More, Rajesh B. Ingle,[3]** *"Challenges in Green Computing for Energy Saving Techniques"* Authors have presented the various power saving technique along with virtualization for supporting green computing. Based on
the literature survey done various research issues are identified along with novel methodologies, parameters relevant to power awareness of distributed systems and interrelationship between them are identified.
[4] **Rubyga. G, Dr. Ponsy ,R.K SathiaBhama,[4]**" *A Survey Of Computing Strategies For Green Cloud Computing"* The Authors specified the close connectivity between virtualization and cloud computing. Various researches done to provide best Quality of service, are also specified in detail. Examples such as Dynamic Voltage Scaling and Adaptive Link Rate for proportional computing are given. Algorithmic strategies like round-robin, Min-Max are also discussed for efficient computing.
[5] **Muhammad Anan ,Nidal Nasser,[5]** "*SLA-based Optimization of Energy Efficiency for Green Cloud Computing*" The authors has discussed a dynamic migration algorithm to minimize the cost of energy in consideration of service level agreements. The proposed approach utilizes one of the most promising technologies in the areas of server virtualization research area, namely Software Defined Networking using Open Flow technology.
[6] **Janet Light,[6]** "*Energy Usage Profiling for Green Computing"*. Author has justified choosing effective green computing hardware and software resources can reduce carbon footprint, save money and improve the reuse cycle.

CONCLUSION

In this Paper, We study the most important green approaches like virtualization and cloud computing along with their architecture. Virtualization and Cloud computing are the most important approaches towards green computing. Although it may seem a bit difficult to adapt with the change for old users, however it is worthwhile. Use of virtualization is a revolutionary change as it has increased the processing power and cloud computing has led to maximum and efficient utilization of data storage and energy. Some basic practices and utilization of custom changes available in various operating systems and devices our computer can become quite

environment-friendly. Reduce, reuse and recycle are also the motives of green computing which are now achieved by various leading IT companies .Green Computing is a rapidly developing approach due to its enormous effects in maintenance cost, revenue and power consumption. In the next coming years, green computing will be adopted right from personal computers to larger companies leading to a greener change

FUTURE-SCOPE

Green computing will ensure a reduction in carbon emissions due to the increasing IT sector trends and practices. With an improvement in efficiency and power consumption ,green computing will not only be a greener change but also provide a raise in the economy.

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