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Performance And Architecture Of Cloud Computing For Energy Consumption And Task Scheduling

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ABSTRACT

Energy saving and "green" technologies that can be applied to data centers and networks in order to address these concerns are surveyed in this article. In this section, we'll go through the latest approaches to building more energy-efficient data centers, and we'll focus on the hardware, power supply specifications, and cooling infrastructure that make up the majority of a data center's overall architecture and energy use. Taking a closer look at network energy use, we analyze numerous techniques to reducing power consumption in access and core networks. In addition, we shed light on current advancements in energy-efficient virtual machine deployment and dynamic load balancing technologies. A fresh research effort for establishing energy-efficient light routes in computational grids is presented at the end of this chapter.

KEYWORDS: Cloud Computing, Task Scheduling, Architecture, Performance

INTRODUCTION

An Internet or Intranet connection is often used to connect the front end of a cloud computing system to its back end. The primary goal of a cloud computing environment is to make best use of the computer resources that are readily available. Algorithms for scheduling are critical in the optimization process. Because of this, user tasks must be scheduled using an efficient method. Scheduling algorithms typically aim to disperse the workload across the available processors and maximize their usage while reducing the overall execution time to the absolute minimum. In the world of NP-complete problems, one of the most well-known is task scheduling. The primary goal of task scheduling is to arrange tasks in such a way that they may be completed within the limits of a given situation. Over the years, a slew of heuristic optimization techniques have been created to help with cloud-based job scheduling. Special class of Artificial

Immune System that utilizes AIS's clonally selection process as its primary mechanism is known as Clonally Selection Algorithm (CSA). In 2000, De Castro and Van Zuben devised this approach for solving nonlinear functions.

LITERATURE REVIEW

KRISHAN TULI A, AND DR. AMANPREET KAUR B (2021) Many IT services have been transformed into virtualization, which is made available as a utility service, and scheduling plays an important role here in order to maximize the utilization of diverse physical resources. Pay-as-you-go access to virtual resources and services has been a hallmark of cloud computing from its inception. It is thus becoming a fundamental part of many industries and academic institutions, offering the storage backups, load balancing and most significantly the real-time resource scheduling on a real time basis. Additionally, we examined an overview of the algorithm under investigation in addition to conducting a comparison. As a last step, we do a literature review on various factors and techniques. All three authors' claims are supported by the same review of the relevant literature that led us to this identical conclusion in each case.

ADAM KOZAKIEWICZ (2021) Research on energy efficiency in the context of cloud computing is the focus of this study, which aims to map the research field's intellectual structure. The following research questions guided our work: (1) what are the most cited papers in the scientific literature? And, secondly, what are the main research areas in the field? Direct citation analysis was used in the study. The VOS viewer science mapping software was used to evaluate the data, which was taken from the Scopus database. Accordingly, we looked for and examined the most influential research articles (i.e., original research papers or rather "context" papers e.g., surveys, reviews, frameworks, challenges and studies) in order to answer the first question. Furthermore, a comparison of the most referenced "traditional" publications and "rising stars" was carried out to see how they differed in the types of papers they published.

DEVASIS PRADHAN (2021) The breakthroughs in dispersed enrollment, which have resulted in significantly increased energy consumption and climate effect in terms of carbon impressions, can be related to improvements in worker ranches. To ensure the long-term viability of the green cloud, a number of essential techniques must be taken. These models are being used to create green cloud architecture (GCA) that is not only focused on energy efficiency but also on the distribution of carbon dioxide. Greener climates are seen as a way to reduce energy consumption. The data correspondence headway (ICT) industry is obviously responsible for the most noticeable advances in overall energy use across the many associations. By reducing the use of hazardous materials and increasing energy consumption over the course of a product's lifetime, this chapter aims to improve the biodegradability and recyclability of dead matter and current office waste.

AISHWARYA T (2021) Large data sets and sophisticated calculations benefit greatly from cloud computing, a well-known technology. Data storage and management for scalable, real-time, and internet-based applications and resources has been revolutionized by this technology. Increased energy consumption and power dissipation is caused by the increasing number of distant host machines that are created for cloud services. Power consumption has been a significant cost element in computer resources over the years. In order to reduce cloud computing energy consumption, we recommend examining the most important variables and taking them into account as part of our plan to boost speed. Increase throughput, reduce reaction time, and maximize resource use to achieve this goal. There will be an increase in power consumption (PC) when a data centre (DC) grows larger or has more data centers to meet data storage, processing, and hosting needs. In order to combat global warming, Green Cloud computing provides an eco-friendly atmosphere. In our research, we found that when energy usage rises, so do heat emissions.

PRIYANKA NEHRA; A. NAGARAJU (2021) There are a wide range of applications that can benefit from cloud computing, including those in the scientific and business fields. Initial adoption of this technology focused primarily on increasing system performance. However, as the number of applications hosted in cloud data centers grew, the need to build a long-term data centre became increasingly important. Other performance metrics, such as operational costs and cooling system maintenance, are influenced by energy use. A number of issues and architectural components are discussed in this paper, which deals with energy usage. Data centre infrastructure (such as the resources and hardware used in processing) has been taken into account when estimating energy consumption in order to design more sustainable data centers. Our goal in writing this study was to highlight the factors that influence energy consumption and to provide formulas for evaluating energy use with more precision.

DATA CENTER MODEL

Data center network

There are hundreds or thousands of servers and storage devices housed in a data centre, which are linked together by a network of switches and routers in a topology similar to a Close network or fat tree. The architecture of the data centre taken into account in this work. We assume that the network infrastructure provides sufficient bandwidth to eliminate queuing delays in intermediate network nodes.

The data centre network distributes its resources among a wide number of customers via cloud computing. It is possible for a single tenant to run a huge number of apps in the data centre. Because of this, the number of servers (and virtual machines) rented by each customer is quite considerable. Cloud data centre resource provisioning is a complex process that requires matching a big number of requests with a huge quantity of software and hardware while maintaining the SLA. In this research, we examine the impact of task scheduling algorithms on the energy efficiency of a data centre by focusing on resource supply at the SaaS level. In this paper, we look at the task of creating and allocating virtual machines (VMs) in cloud data centers, which necessitates the use of certain server resources like CPU, memory, and storage.

Data center workload

Servers in data centers come in a variety of flavors, each of which is optimized for a particular set of functions. There may also be a difference in the amount of time and computing power required for different sorts of tasks. Over a period of about a month, in May 2011, Google published the first batch of one of its cluster-workload traces to the public, providing data from a 12K-machine data-center cell. Studies on trace analysis have been able to quantify data centre workload thanks to the data. Several recent studies have demonstrated the very variable and varied nature of data centre activity. There is a wide range of labor to be done, ranging from short-duration, high-volume tasks to lengthy, resource-intensive ones. To evaluate the energy consumption of cloud-computing data centre’s, we consider task deadlines, resource requirements, and server energy profiles when assessing the total energy consumption.

Task scheduling and energy consumption

If you have a big number of jobs that require varied computational resources, such as memory and CPU power, you'll need a data centre. Servers can perform a wide range of functions with varying levels of responsiveness and energy consumption. The goal of this work is to reduce the number of active servers in a data centre, hence reducing the energy usage.

ENERGY EFFICIENCY AT THE DATA CENTRE LEVEL

For cloud computing data centers, we've included the most recent advancements in IT infrastructure design. The most energy is consumed by computers and other electronic devices. Included in this category is power used by computational processors, as well as server energy usage, and lastly network communication infrastructure. The cooling infrastructure consumes about 40% of the data center's overall power. Power supply, transformer use, and lighting make up the rest of the contributions. It is apparent that in order to drastically reduce data centre power usage, proper action must be taken primarily to improve the energy efficiency of IT equipment and develop more efficient cooling systems.

Standards for assessing data centre energy use are being proposed by members of the Green Grid consortium (The Green Grid). The Power Usage Effectiveness (PUE) is a widely used metric that may be summarized as follows:

$$PUE = \frac{E_{TOT}}{E_{IT}} = \frac{E_C + E_L + E_P + E_{IT}}{E_{IT}},$$

Data centre ETOT includes the IT infrastructure's energy consumption, as well as cooling infrastructure (EC), lighting (EL), and power supply use (EP). Since the IT infrastructure's energy usage is included in the total energy consumption of the data centre, the minimal PUE is 1. Using the PUE measure to rank data centres and high-performance computing systems (e.g., Google claims a PUE of roughly 1.1 for the operation of its data centre's) has grown increasingly common in recent years. If any energy is being recycled in the data centre, the PUE can be further optimized. ERE (Energy Reuse Effectiveness) takes into account the value of energy reuse and is defined as:

$$ERE = \frac{E_{tot} - E_R}{E_{IT}} = \frac{E_C + E_L + E_P + E_{IT} - E_R}{E_{IT}},$$

In this case, ER is the energy that has been repurposed, The Energy Reuse Factor (ERF), on the other hand, is defined as the ratio of energy reused in the data centre to the overall energy consumption of the data centre, that is

$$ERF = \frac{E_R}{E_{TOT}} \Leftrightarrow ERE = (1 - ERF) \times PUE.$$

Finally, the Green Grid has recently included the Carbon Usage Effectiveness (CUE) and the Water Usage Effectiveness (WUE) metrics to its energy efficiency measures in order to link carbon emissions and water consumption to IT energy use (The Green Grid Consortium, 2012).

ENERGY-EFFICIENT HARDWARE DESIGN

Optimizing the design of CPUs, storage devices and interconnects can help data centre's save energy. Fast processors with high computational capability per watt have been the focus of many manufacturers in recent years in order to improve the energy efficiency of their devices. Recently, "multi-core" and "multi-core" CPU architectures, low voltage chips, and sophisticated chip manufacturing have been introduced to help reduce leakage currents in the chips, as well as other advancements.

Architectures based on "multi/many-core" technology have multiple cores in a single processor, allowing the computer's processing power to be adjusted based on the workload. Allows an increase in performance per watt without increasing power consumption Additionally, new efficient core designs have reduced the need to rely on CPU frequencies. It takes less energy to use newer technologies like solid state discs than it does to use current local hard disc drives. It can also be utilized for code that can't take full advantage of high system processor frequencies by running them at lower voltage and CPU frequencies (Herbert & Marculescu, 2007). (Hsu & Fang, 2005) and (Hsu & Feng, 2005) have shown that substantial savings in energy can be gained in this manner (Etinski, Corbalan, Labarta, & M., 2010). Many low-voltage chips are now capable of delivering reasonable processing performance and good energy efficiency (Slivka, 2012). As the density of computing packages rises, heat losses and leakage currents may occur, but substantial attempts have been made to limit these effects by using new materials for chip production, such as strained silicon (Sharan & Rana, 2011).

The use of concurrency throttling may be an alternate method for reducing energy consumption (Li, De Supinski, Schulz, Nikolopoulos, & Cameron, 2012). The use of dynamic concurrency throttling (DCT) in software-controlled power-aware execution of shared memory applications provides energy savings. In order to optimise power and performance, DCT regulates the number of active threads that execute parallel regions at the same time (Curtis-Maury, Blagojevich, Antonopoulos, & Nikolopoulos, 2008). It is common for DCT to minimize execution time and power consumption because of system limitations (such as memory bandwidth) or lack of parallelism (Curtis-Maury, Blagojevich, Antonopoulos, & Nikolopoulos, 2008).

CONCLUSION

In this chapter, we've taken a look at the best ways to construct an energy-efficient cloud computing architecture. Significant energy savings are possible through the implementation of various solutions at both the data centre and network levels. First, there are a variety of approaches to hardware design and power supply that are energy-efficient. In order to keep the data center's power usage to a minimum, it is critical that the cooling infrastructure be properly implemented. There are a number of other options available at the network level as well. Green routing, light path-bypass, machine virtualization and dynamic load balancing are just a few of the energy-saving technologies that may be implemented in both the access and core networks. We ended the chapter by offering a fresh study work that proposes distributed management of energy-efficient light channels with the use of power-saving modes in the core network nodes of the system.

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