Energy Efficient Data Transfer Techniques in Cloud Based Network

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Abstract- *Energy efficiency during data transfer is an important issue in cloud computing. Research has been carried out recently in power aware networking and efficient energy management in hardware and software systems. The power management between sender and receiver node plays a vital role in energy efficient management of data transfer in cloud. In this paper a survey of data transfer techniques in cloud based network is presented.*

Keywords- power consumption, data transfer.

I. INTRODUCTION

There are several issues in cloud computing namely security issue, data issue, performance issue, bandwidth issue, energy efficiency issue, fault tolerance. This paper focuses on energy related issue. During the recent years, the energy consumption due to a data transfer has increased rapidly due to the demands of the cloud users. There has no much related work on saving energy at the end to end systems. Several power models are developed on the power consumption of data centers in the wired network..These power models can be classified as follows.1. application based (ii) hardware and software based (iii)simulation based approach. In a simulation based approach, power consumption due to components like CPU, memory are taken into account. Most of the energy efficient techniques focused on power consumption in a data center. As the hardware monitoring of the devices is low, power management during data transfer plays an important role. Power meter is used to measure the power consumed by a server. It is not always a good metric as it is of no use when it is being controlled by other entities. In the case of mobile cloud battery power consumption is an issue.

II. SOURCES OF POWER CONSUMPTION

The main sources of power consumption in a wired network are CPU, memory and loss incurred due to the power inefficiency. The desktop and the CPU consumes power less than 30% at low active modes. The low power mode is only supported by the CPU whereas the other components should be switched off to reduce power consumption. If a server is completely inactive, the power consumption by that server is more than 70% during peak hour. The percentage of power consumed by each of the network component is as follows:

Table 1:Power consumption in a wired network

Component	Percentage of power consumption
Server	50
Air cooler	34
Conversion	7
Lighting	2

In the case of wireless network,70% of total power is consumed by wireless interfaces. The percentage of power consumed by each of the wireless network component in idle mode is as follows:

Table 2: Power Consumption in wireless interface

Component	Percentage of power consumption
CPU	47 m W
SDRAM	86 mW
Bluetooth	81 mW
WIFI	786 mW
Others(LED & power regulation)	251 mW

In the idle state LCD and backlight are turned off consuming zero power. In this paper survey of various techniques is presented.

III. LITERATURE SURVEY

The author [1] has proposed energy optimization techniques in which CDN(Content Delivery Network) Networks are turned off when the load is less. Optimization algorithms are proposed in the online and offline mode to reduce energy consumption. In the offline mode, when the sequence of load is known for each cluster, optimal algorithms are derived by changing the number of live servers. Using this technique, energy reduction of 59.5% is achieved. Using wear and tear technique for the servers,98.6% of energy reduction is achieved. In the online mode, hibernate load balancing algorithm is implemented using which increases the energy reduction to 56%.Asystem wide energy reduction of 51% is achieved followed by service availability of 99.9%.

In paper [2] the author proposed and explored cluster shutdown technique in which entire cluster of servers of a Content Delivery Network is shut down Power consumption is reduced using cluster shutdown technique. The authors propose a Global Load Balancer Algorithm to minimize energy consumption by routing traffic and switching off certain clusters. In this work, load balancing is done using two stages namely Global Load Balancing and Local Load Balancing. In Global Load Balancing scheme, the users request is sent to an optimum cluster whereas in the Local Load Balancing scheme, the user request is sent to a particular server within a chosen cluster. The load is arbitrary red vided and redistributed within a cluster and across the cluster. It is assumed that the incoming load is distributed evenly by the Local Load Balancer.GLB moves the traffic away from a cluster by setting its capacity to zero which is followed by turning off all the components. The contributions of this paper are as follows. (i) When inefficient servers and coolers are used, the cluster shutdown can enhance the energy reduction by 73 %.(ii) The cluster shutdown is better when CDN utilization is low and server shutdown is better when CDN utilization is high.(iii) If latency is low, server shutdown is the better option as energy savings is enhanced by 46%.

In paper [3] the authors have analyzed several factors namely level of parallelism, simultaneousness pipelining, and CPU recurrence level that increases power consumption in end-to-end data exchanges. Two models are developed to estimate server power consumption based on the access privileges. The first one is the fine grained power model whose access to information utilization depends on four components namely CPU, Memory, disk, NIC.The second one is CPU based power model that depends on the utilization information of the CPU. In the proposed model a building phase is developed to extract information about the power consumption in the system components. The power consumption is measured for varying levels of load for each and every system components. For each component the coefficients are derived using linear regression. Then the total power consumption of data transfers is predicted using proposed model. The advantage of the system is that cluster shutdown can reduce power consumption by 67%..The advantage of the system are experimental results demonstrate that noteworthy amount of vitality savings (up to 60%) can be accomplished toward the end-frameworks during data exchanges with no or insignificant execution penalty if the event that the right parameter combination is utilized.

In paper [7] the authors have proposed a novel energy proficient data exchange procedure called link rate controlled Data Transfer (LRCDT). The idea of this paper is to schedule transmission capacity in a link rate controlled pattern. By doing so LRCDT lessens the energy utilization particularly for data exchange in which extreme transfer speed is not necessary. Based on the reservation scheme, bandwidth is scheduled to each data transfer using LRCDT.Data Transfer is classified into two tasks namely lazy data transfer and eager data transfer. Bandwidth is scheduled by means of LRCDT based on lazy data transfer and eager data transfer. In the case of eager data transfer bandwidth is allocated based on the maximum speed and in the case of lazy data transfer bandwidth is allocated based on the minimum speed. Thus, energy consumption is reduced in this case.LRCDT schedules bandwidth only on the links that are active. Two parameters namely start time and deadline is set for each data transfer task. These parameters specify how long the link should be kept occupied and bandwidth is allocated depending on the size of the data file .The advantages of the system is that the information passes from one end to the other end at a speed of 10 Mbps to 1 Gb and this technique reduces the energy utilization from 27.6% to 33.7% when contrasted with the minimum speed strategy .Compared to extreme speed strategy the energy utilization is diminished from 37.8% to 63% .

In paper[10] authors presented an analysis of energy consumption in cloud computing. The analysis considers both public and private clouds and incorporates energy utilization in exchanging and transmission as well as data handling and data storage. Cloud computing can empower more energy proficient utilization of computing force, particularly when the processing assignments are of low intensity or infrequent. It is further inferred that the total proportion of power consumption plays a significant role during transport of cloud storage devices. Delivering cloud services in public cloud storage is of the order of three to four times higher than private cloud storage. As the number of file downloads increases per hour, the energy consumption due to transport becomes higher. In the case of Software as a Service the energy consumption is very small at low screen refresh rates.

In paper[4] the authors have presented power models at the application software level by considering network transfers by taking into consideration various network components. An energy consumption model is designed for VM Migration by considering the impact of CPU and memory intensive workloads. Energy consumption of Ethernet and Infiniband Network Interface cards are examined. network intensive benchmarks are designed by taking into account the various parameters for energy consumption namely transfer size, number of simultaneous transfers, payload size, communication time, traffic patterns. Energy consumption model for VM Migration is developed focusing on source host, destination host and the virtual machine that is to be migrated. A model is built based on the architectures of two sets of machine on the private cloud. Based on the energy consumption of CPU and memory an acceptance criterion for Normalized Root Mean Square Error is set and the proposed model is tested on different machine sets and change of up to 24% in precision is obtained.

In paper [5]all the components involved in data transfer is modeled as a graph. Maximum throughput during data transfer is achieved by means of parallel data flows by taking into consideration CPU ,disk I/O.A cluster wise data transfer algorithm is proposed to determine the number of hosts in the cluster such that maximum throughput is achieved when the hardware configuration is homogenous. Efficient data transfer is achieved by means of data compression. A framework is proposed using different data flow for each layer using node determination algorithm. A s data compression technique is applied, the data transfer rate is four times faster compared to normal cluster data transfer.

In paper[11], the authors have introduced three algorithms namely Minimum Energy Algorithm, High Throughput Energy Algorithm and SLA based Energy Efficient Algorithm. In the Minimum Energy algorithm, data is transferred into chunks of different sizes namely small, medium, large along with Bandwidth Delay Product(BDP)which calculates the best parameter value for the chunks of file to be transferred. In this algorithm chunks with sufficient file size are merged and the following parameters are taken into account namely BDP,average file size and TCP buffer size are taken into account. Pipelining values are set to the maximum, and multiple packets are transferred back to back due to which the network is kept always busy which in turn reduces power consumption. High Throughput algorithm is similar to Minimum Energy algorithm which focuses on maximizing the performance and low power consumption. In this algorithm weights are calculated for each chunk which determines the number of channels to be allocated for each chunk. The maximum channel count is specified by the user. This algorithm only uses one active channel till the user defined channel count is reached. Concurrency level is increased by two each time which is executed for second time intervals. The throughput and power consumption for each interval is calculated. SLA based Energy efficient algorithm focuses to obtain desired output. Initially concurrency level is set to one and if the obtained throughput is less than the SLA Agreement, then the concurrency level is set based on current and target throughouts.If the situation remains the same, The concurrency level is increased by two till the target limit is reached. This algorithm gives priority to small chunks when transferring through channels till the target throughput is achieved. By implementing three power aware data transfer algorithms 50% of energy is saved using high throughput.

In the case of wireless cloud based network. networks, energy efficiency is achieved as follows:

The author [6] has proposed a energy effective multipath data transfer to overcome false data injection attack. It is possible by identifying false data injection attack.Multi-path data transfer technique prevents the direct access of false data by a compromised transit in node. The proposed technique will increase flexibility against node compensation and data compromising. The advantages of the proposed system are

(i) dropping of false data as early as possible which results in energy consumption as compromised data is dropped.
(ii) An alternate path is chosen if the current path is compromised among the paths available to provide expert data delivery service.
(iii) The level of computation and communication required for verification is high.
(iv) One time key is utilized and every node have their individual key for encryption and authentication. All the nodes maintain a separate key for encryption and authentication.

In paper[8] the authors have introduced eTime, in which energy efficient data transmission between cloud and mobile devices is achieved by means of Lyapunov optimization. Frequently utilized data are prefeteched by seizing the timing of good connectivity while delay-tolerant data is postponed due to bad connectivity. To adapt to the irregularities in the wireless network, eTime just depends on the present status data to make a worldwide energy delay trade off choice. Using Lyaponav optimization technique,20-35% of energy saving can be achieved.

In paper[9], the authors have proposed Optimal Path Selection Model(OPSM) the high power ratio link routes are found out such that the frequency of failure in the selected path is less. A disjoint path is selected based on energy and hop data transfer. The other paths are stored in the cache. The paths stored in the cache are selected based on priority if the efficient disjoint path is not selected. The energy consumption is reduced to 64% compared to Dynamic Source Routing and 50% compared to multipath dynamic source routing. The frequency of path failure is 11 times lesser than Dynamic Source Routing and 5.5 times less. than Multipath Dynamic Source Routing.

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IV. CONCLUSION

This paper provides information about the energy efficient power consumption models due to data transfer in cloud based wired and wireless network. Some of the energy efficient data transfer strategies proposed take the following parameters into consideration namely level of parallelism, CPU recurrence level, pipelining, cocurrency level, bandwidth, memory, impact of CPU,BDP, average file size, TCP buffer size in the case of wired cloud based network .In the case of wireless network, energy efficient data transfer is achieved by dropping of false data, Lyapunov optimization, disjont paths and hop data transfer.

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