Effective Energy Efficient Allocation Policy for Virtual Machine in Cloud Computing – A Review

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Abstract
The cloud computing system requires computation power energy 24x7, which consumed by host (supercomputer) and data center. Many of researcher and industry have proposed various policies for optimize or curb energy utilized by IT resources. In this paper, we have various techniques and algorithm that provide effective energy efficient cloud computing and virtual machine allocation. These techniques have various methods, which are detailed discussed and evaluated for utilization energy by various resources. This work will help to researcher for analyze various policy used energy efficient virtual machine provisioning.
Keywords—Virtual Machine, VM Migration, energy efficieny, Networking;

I. INTRODUCTION

The most common problem in cloud computing were to design an effective method for VM allocation with considering energy efficiency. Most of research and development community mainly concern about performance of system and amount of energy consumed by that process commonly ignored. As Report [Gupta and Singh 2003] U.S. had deployed 95000 LAN switches and 3257 routers in 2000, which consumes 3.2 Tera Watt hours. Typically purchasing cost of computing server was super passed by price of energy consumed by computing server over time [Barroso 2005]. Energy also wasted in idle condition of server and networking equipment. In U.S., 188 data centers in 2010 and estimated that 12% of energy never been utilized analyzed by the Green Grid consortium [Green Grid 2010]. These can saved by turning off server when they are not in use or turned them to low power mode.

In general, energy consumed by server or host are classified in two parts: In general, energy consumed by server or host are classified in two parts:

A. Static Part

This part defines size of system and type of component, such as computing, data storage and network elements, and this include leakage of any powered system.

B. Dynamic Part

This part includes usages of network resources, storage, and computation where system activity changes with in clock rates. For better energy utilization can done by diminishing static part and make dynamic consumption have more effective, is an open challenge for research.

In this analysis we provides various techniques and algorithm which main concern to is provides energy efficient cloud virtual machine allocation in cloud computing. This work will help to researcher for analyze various policy used energy efficient virtual machine provisioning.

In section 2, we analyses about Energy efficient computing resources. In section 3, various approaches and technique for energy efficient allocation of virtual machine in cloud computing. In section 4, we analyses various challenges and issues in present scenario. In section 5, we evaluated various challenges that used for research work in present scenario.

II. ENERGY EFFICIENT COMPUTING RESOURCES

Energy efficiency of large scale cloud computing system can enhance by optimization of energy in different level. For every individual component need of measuring and modeling of energy consumption for reduces energy utilization of entire system. There also need to optimize energy in different level [Orgerie 2014] of infrastructure in cloud computing environment.

A. Modeling and measuring

There are various energy estimation models which determine energy consumption of computing resources. The power distribution units (PDUs) and temperature sensor is an external component which used for measurement of different parameter. These components are deployed with infrastructure. Most energy consume components are computing resource which contain processor, CPU and ALU.

B. Level optimization of nodes

In any computing system there are several computing nodes, each node can be energy efficient by optimization. Every node varies in different state of energy consumption. In this section, we discuss about various node level techniques, constructing

different frequency and voltages for CPU and enhance more energy efficient of hardware and software.

1. Hardware energy-ware capability
   Hard disk drive (HDD) is commonly used in high performance computing system, where platter rotation can optimize and can save energy in sleep state.
2. Sleep state
   Techniques called suspend to disk, makes energy saving during booting up system. This is a process in which file from main memory is been stored in disk, when system again turn on it make available boot file disk to ram.
3. Dynamic voltage and frequency scaling (DVFS)
   This technology is common in high performance computing nodes, which adjust frequency and voltages to preserve energy in system. DVFS technique has performance state (also called p-state), which provide proper frequency under that processor can be operated [Nedevschi 2008].
4. Software improvement
   In software, there are some loops for waiting and active pool which waste the energy. Research had analysis that different version of OS consumes different energy in system [EcoInfo 2011] [LessWatts 2010].

C. Cloud computing and virtualization

The Cloud computing, a breakthrough of computing environment, which enables on-demand accessibility to shared computing resources appropriate. Virtualization is part of IaaS service model in the cloud that is providing a framework of isolating resource of a computer into multiple execution environments.

III. LITERATURE REVIEW

In cloud datacenter, there are many server associated with same datacenter which processes the user request. The [Goudarzi 2012] have improved the virtual machine replication to different server in such a way that reduces the energy consumption. Multi-dimensional Energy-efficient Resource Allocation (MERA) problem have been introduced in this policy, where they proof that general assignment problem (GAP) and bin package problem (BPP) are reduced to MERA problem. In Energy efficient VM Replication and placement algorithm (EVRP) algorithm, VM are assign with energy cost of ram and bandwidth to server where these VM are replicated to dynamically on to those active server that handles the active user request. This approach has 20% less energy consumption than prior VM placement technique.

The technique proposed by [Moreno and Solis 2013] is improved energy efficiency with interference aware, main objective is to select best workload server by internal interference level to enhance energy utilization. In this technique, selection of server implemented by decision making algorithm which following parameter energy efficiency, interference ratio and workload energy efficiency. The proposed algorithm reduces performance interference by 27.5% and increase energy efficiency up to 15% more than previous allocation policy.

Many technologies have evolved for server consolidation, where virtual machine placement algorithm has main issue for improving energy consumption. The genetic algorithm technique implement by [Wu and Grant 2012] for virtual machine allocation with seeing energy consumption in both server and communication network. In this technique, GA algorithm always gives best result than the FFD (First fit decreasing) based algorithm for virtual machine placement problem. The GA algorithm is independent of energy consumption, so it can be enhance for more accurate result in future.

In [Bagheri and Zamanifar 2014], proposed a methodology for minimizing energy efficiency for cloud services and also includes deadline miss rate. In this technique, resources are optimized before allocation in order to decrease missing rate of real time task. This technique have scheduling policies contains two main part, first one VM selection policy and second VM allocation policy. The VM selection policy includes maximum processing power policy and random selection policy. The VM allocation policy uses LFPE (Least Free Processing Element) which is based on total utilization of host to reduce energy consumption.

In [Ghribi 2013], C. Ghribi and D. Zaghlache had implemented an algorithm which is extracted from two algorithms for Virtual machine scheduling in cloud data center. This technique considers optimization algorithm for energy aware allocation and consolidation algorithm for migration VM in cloud data center. Bin package allocation algorithm provides 90% energy saving, while combined migration algorithm gives 95% energy saving in simulation environment.

The [Florence and Shanti 2014] introduces a model for minimize energy consumption with load balancing over cloud data center named as EALB (energy aware load balancing). This technique maintains pattern history table (PHT) which contains record of classified job requested according the purpose either for I/O bound or CPU bound.

EnaCloud model was introduced by B. Li and L. Zhong [Li 2009], which enables live application

placement with energy efficiency consideration. It contains application encapsulated with VM, which includes scheduling of application with live migration. This application placement adopted the bin package problem and energy-aware heuristic algorithm.

Many of virtual machine allocation policy is implemented for energy efficiency as main concern, it also degrade performance of computing system. X. Ruan and H Chen [Ruan and Chen 2015] have implemented a virtual machine allocation namely "PPRGear", which maintain the power and performance ratios for heterogeneous host. This approach is able to reduce 69.31% energy for heterogeneous host with minimum number of migration and little performance degradation for cloud computing data center.

IV. FUTURE CHALLENGES

This section includes various challenges and research issues in energy efficient allocation and provisioning of virtual machine in cloud computing.

A. Virtual Machine Migration and Replication

Cloud provider make available demanded resources by a virtual machine of a user, this virtual machine created in host. Hosts can multiple virtual machines only when it has available resource (RAM, BW and Processor) are under loaded. In [Goudarzi 2012], techniques increase the energy efficiency of cloud datacenter by reducing number VM migration and also increase resources availability in datacenter. Whereas decision making method for energy efficiency also may enhanced by considering secondary storage and communication network are still research issues.

B. Virtual Machine allocation

In EnaCloud [Li 2009], has make use of application live placement dynamically in virtual machine. The energy efficient application placement for large scale computing have applied appropriate heuristic algorithm. This technique not considers load balancing and performance factor in cloud data center. Optimization algorithm implement in [Bagheriand and Zamanifar 2014], optimize number of active host with considering their deadline provide energy efficient virtual machine allocation. But many host which have less priority will delayed through technique which can be future challenge for researchers.

C. Interfrence-aware VM placement

Interference occurred in high performance computing may occur, when any host are over loaded. Interference originated due workload and processor already engaged with other processes, so there need of scheduling process for different work in virtual machine.

In [Moreno and Solis 2013], approaches implement for classification workload from cloud computing environment and also identify the performance interference. This mechanism provides 27.5% performance interference and increase 15% energy efficiency better than current allocation policy. Hardware architecture and hypervisors not consider which can research challenge.

D. VM Scheduling

Energy consumption in cloud data center will cut back by effective virtual machine planning. An efficient allocation virtual machine can take place by bin package problem whose main goal is to have minimum number of migration.

An optimal allocation adopted in [Ghribi 2013], which is combination of energy aware allocation and consolidates in cloud data center. This technique include linear integer programing which results reduction in energy consumption than VM migration algorithm. This methodology is good when load is high and less effective in low load. There is a future issue to design an algorithm which compatible in all modes.

E. Load Balancing

For effective utilization of host many algorithm make host full utilized which defiantly affect performance of host and have more energy consumption. To improve energy efficient virtual machine allocation, must think load parameter.

Effective load balancing (EALB) implement in [Florence and Shanthi 2014], which minimize energy unnecessary utilization with load balancing. It maintain pattern history table that contains workload present in different host and select virtual machine dynamically by considering BFD algorithm. Researcher can have more accurate result if they consider job classification through neural network.

F. Power and Performance Ratio

Many algorithms have been made for VM allocation and consolidation with energy efficient, but they compromise little with performance. So there should be an algorithm that will consider power and performance ratio for effective virtual machine allocation.

The PPRGear model implemented in [Ruan and Chen 2015], have consider power and performance ratio with level optimization. This approach provides balance between host utilization and energy consumption, which give most prominent power efficiency level. That insures less energy consumption with little performance sacrifice but still have other parameter to be considering which act as future issues.

V. CONCLUSION

High performance computing always effected by energy consumption because it require more power and processor. Our analytical study will provide a researcher to recent energy efficiency virtual machine allocation and migration issues.

In this various approaches, we must consider communication and data transfer processes consumes more power than processing any task. However, dynamic virtual machine provisioning and allocation with energy-aware and interference aware become a challenging issue for control interference occurring in hardware or software resource. That also maintains QoS without violating SLAs (service level agreement).

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