International Journal of Scientific Engineering and Research (IJSER)
www.ijser.in
ISSN (Online): 2347-3878
Volume 2 Issue 3, March 2014

Energy Balancing in Data Centre Networks through Green Cloud Computing

Rajasekar R[1], Mohammed Ansar Ali M. A[2]

[1, 2]Assistant Professor, Department of Information Technology, SKP Engineering College, Tiruvannamalai, Tamil Nadu, India

Abstract: N*owadays consumption of energy leads to large slice of operational expenses. Most of the existing approaches for job scheduling in data centers focus exclusively on the job distribution between computing servers. In this paper, we introduce a framework for designing energy efficient cloud computing services over core networks. First, we develop a model to optimize cloud content delivery services by replicating content into multiple clouds. Second, we extend the content delivery model to optimize Storage as a Service (StaaS) applications through migrating content according to its access frequency to yield network power savings compared to serving content from a single central location. Third, we optimize the placement of Virtual Machines (VMs) to minimize the total power consumption that slicing the VMs into smaller VMs and placing them in proximity to their users saves the total power compared to a single virtualized cloud scenario.*

Keywords: energy-efficient, data center, cloud computing, Virtual Machine.

1. Introduction

Data centers are becoming increasingly popular for the provisioning of computing resources. The cost and operational expenses of data centers have skyrocketed with the increase in computing capacity. Energy consumption is a growing concern for data centers operators. It is becoming one of the main entries on a data center operational expenses (OPEX) bill. The Gartner Group estimates energy consumptions to account for up to 10% of the current OPEX, and this estimate is projected to rise to 50% in the next few years.

The slice of roughly 40% is related to the energy consumed by information technology (IT) equipment, which includes energy consumed by the computing servers as well as data center network hardware used for interconnection. In fact, about one-third of the total IT energy is consumed by communication links, switching, and aggregation elements, while the remaining two-thirds are allocated to computing servers. Other systems contributing to the data center energy consumption are cooling and power distribution systems that account for 45% and 15% of total energy consumption, respectively.

The first data center energy saving solutions operated on a distributed basis and focused on making the data center hardware energy efficient. There are two popular techniques for power savings in computing systems. The Dynamic Voltage and Frequency Scaling (DVFS) technology, adjusts hardware power consumption according to the applied computing load and the Dynamic Power Management (DPM), achieves most of energy savings by powering down devices at runtime. To make DPM scheme efficient, a scheduler must consolidate data center jobs on a minimum set of computing resources to maximize the amount of unloaded servers that can be powered down (or put to sleep). Because the average data center workload often stays around 30%, the portion of unloaded servers can be as high as 70%.

Most of the existing approaches for job scheduling in data centers focus exclusively on the job distribution between computing servers [1] targeting energy-efficient or thermal-aware scheduling. To the best of our knowledge, only a few approaches have considered data center network and traffic characteristics for developing energy-efficient data center schedulers.

Ref. [2] identifies the problem associated with existing multi-path routing protocols in typical fat tree network topologies. Two large traffic flows may be assigned to share the same path if their hash values collide leaving other paths under-loaded. The problem is solved with the introduction of a complex central scheduler that performs flow differentiation and analysis of flow traffic demands across the data center network. Traffic-aware virtual machine placement is proposed in [3]. Relying on the knowledge about network topology, virtual machines are placed to optimize traffic flows inside a data center network. The approach presented in [4], also allows job migration control during runtime with a specifically designed network-aware scheduler. The migration scheduler is aware of the migration delays and bandwidth resources required. As we may see, most of the existing solutions leave the networking aspect unaccounted for in an energy-efficient optimization setting.

This paper presents a data center scheduling methodology that combines energy efficiency and network awareness. The methodology is termed DENS, which is an acronym for **d**ata center **e**nergy-efficient **n**etwork-aware **s**cheduling. The DENS methodology aims to achieve the balance between individual job performances, job QoS requirements, traffic demands, and energy consumed by the data center. Data intensive jobs require low computational load, but produce heavy data streams directed out of the data center as well as to the neighboring nodes.

2. System Modules

Cloud Computing infrastructure is housed in Data Centers. US Data Centers consume 1.7%~2.2% of the total electricity consumed in the country (61 billion kWh in 2006, doubled in 2007)Worldwide data centers consume 1.1%~1.5% of all electricity consumed in the world Proper Power Management in the data centers can lead to significant energy savings.

- Virtualization of computing resources
- Sleep scheduling
- Shared Servers and Storage Units
- Energy savings possible if users migrate IT services towards remote resources
- Increase in the network traffic and the associated network energy

An easy way to comply with the journal paper formatting requirements is to use this document as a template and simply type your text into it.

2.1 Multiple Cloud Services

In this module we develop a model to optimize cloud content delivery services by replicating content into multiple clouds.

3 Main types or Personalities:

- Software as a Service (SaaS): A wide range of application services delivered via various business models normally available as public offering.
- Platform as a Service (PaaS): Application development platforms provide authoring and runtime environment.
- Infrastructure as a Service (IaaS): Also known as elastic compute clouds enable virtual hardware for various uses.

Microsoft cloud platforms provide the necessary features and APIs to enable developers to create services and applications that expose Simple Management Interfaces as outlined by the TM Forum SES Management Solution.

- On-Premise Cloud - Microsoft Windows Server with Hyper-V together with System Center enable the creation and deployment of manageable mission critical business and consumer applications.
- Off-Premise Cloud – Microsoft Windows Azure also provides the necessary APIs that can be used to create and expose Simple Management Interfaces for any service hosted on Windows Azure. In addition, there is a Monitoring Pack for Windows Azure Applications and a Monitoring Pack for SQL Azure for System Center to help manage cloud and hybrid cloud hosted business applications and consumer services end-to-end.

2.2 Job Management in data centre

(a) Power Aware (PA) computing/communication:
The objective of PA computing/communications is to improve power management and consumption using the awareness of power consumption of devices. Power consumption is one of the most important considerations in mobile devices due to the limitation of the battery life.

(b) System level power management:
Recent devices (CPU, disk, communication links, etc.) support multiple power modes. Resource Management and Scheduling Systems can use these multiple power modes to reduce the power consumption.

Table 1: Dynamic VM consolidation significantly reduces energy consumption compared to non-power aware allocation and static allocation policies, like DVFS, NPA (non-power aware)

Policy	**ESV** ($\times10^{-3}$)	**Energy** (kWh)	**SLAV** ($\times10^{-5}$)
NPA	0	2419.2	0
DVFS	0	613.6	0
THR-MMT-1.0	20.12	75.36	25.78
THR-MMT-0.8	4.19	89.92	4.57
IQR-MMT-1.5	4.00	90.13	4.51
MAD-MMT-2.5	3.94	87.67	4.48
LRR-MMT-1.2	2.43	87.93	2.77
LR-MMT-1.2	1.98	88.17	2.33

2.3 Storage Optimization

In this module we extend the content delivery model to optimize Storage as a Service (StaaS) applications through migrating content according to its access frequency to yield network power savings compared to serving content from a single central location.

Dynamic VM consolidation algorithms significantly outperform static allocation policies. Heuristic-based dynamic VM consolidation algorithms substantially outperform the optimal online deterministic algorithm (THR-1.0) due to a vastly reduced level of SLA violations. The MMT policy produces better results compared to the MC and RS policies, meaning that the minimization of the VM migration time is more important than the minimization of the correlation between VMs allocated to a host. Dynamic VM consolidation algorithms based on local regression outperform the threshold-based and adaptive-threshold based algorithms due to better predictions of host overload, and therefore decreased SLA violations and the number of VM migrations.

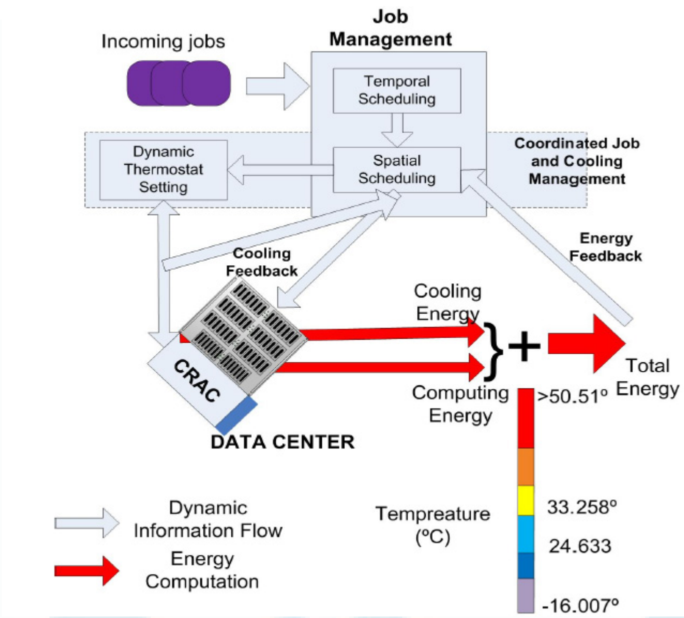

Figure 1: Architecture Diagram

2.4 Virtualization

A logical storage pool which is independent of the physical location of the disks unused storage segments can be consolidated in logical storage units increasing the storage efficiency. Servers are connected to the physical resources through SAN switches; hence a global storage pool is available to each server. Whenever a storage block is required to be allocated, a logical unit number is assigned to the allocated virtual space

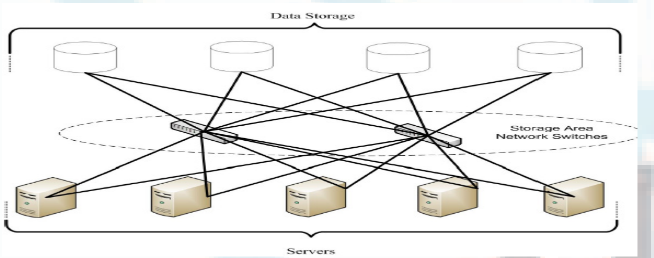

Figure 2: Virtualization

3. Conclusions

This paper underlines the role of communication fabric in data centre energy consumption and presents a methodology, termed DENS, that combines energy-efficient scheduling with network awareness. The DENS methodology balances the energy consumption of a data centre, individual job performance, and traffic demands. The proposed approach optimizes the tradeoffs between job consolidation (to minimize the amount of computing servers) and distribution of traffic patterns (to avoid hotspots in the data center network).DENS methodology is particularly relevant in data centers running data-intensive jobs which require low computational load, but produce heavy data streams directed to the end-users.

4. Future Scope

This system provides the role of communication fabric in data center energy consumption and DENS that combines energy efficient scheduling with network awareness of data center this system effectively perform individual job performance and traffic demands DENS methodology is particularly relevant in data centers running data-intensive jobs which require low computational load, but produce heavy data streams directed to the end-users and also enhancing system the future work for used other different type of data center methodology.

References

[1] X. Fan, W.-D. Weber, and L. A. Barroso, "Power Provisioning for a Warehouse-sized Computer," In Proceedings of the ACM International Symposium on Computer Architecture, San Diego, CA, June 2007.

[2] R. Raghavendra, P. Ranganathan, V. Talwar, Z. Wang, and X. Zhu, "No "Power" Struggles: Coordinated Multi-level Power Management for the Data Center," APLOS 2008.

[3] Gartner Group, available at: http://www.gartner.com

[4] J. Liu, F. Zhao, X. Liu, and W. He, "Challenges Towards Elastic Power Management in Internet Data Centers", in Proceedings of the 2nd International Workshop on Cyber-Physical Systems (WCPS 2009), in conjunction with ICDCS 2009., Montreal, Quebec, Canada, June 2009.

[5] Bo Li, Jianxin Li, Jinpeng Huai, Tianyu Wo, Qin Li, and Liang Zhong, "EnaCloud: An Energy-Saving Application Live Placement Approach for Cloud Computing Environments," IEEE International Conference on Cloud Computing, Bangalore, India, 2009.

[6] Li Shang, Li-Shiuan Peh, and Niraj K. Jha, "Dynamic Voltage Scaling with Links for Power Optimization of Interconnection Networks," Proceedings of the 9th International Symposium on High-Performance Computer Architecture table of contents, 2003.

[7] Ying Song, Hui Wang, Yaqiong Li, Binquan Feng, and Yuzhong Sun, "Multi-Tiered On-Demand Resource Scheduling for VM-Based Data Center," IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGRID), pp. 148 – 155, May 2009

Author Profile

Rajasekar R received the B.Tech. Degrees in Information Technology from Anna University Chennai in 2009 and M.E degrees in Software Engineering from Anna University Trichy in 2011, he published paper in the topics Wireless Sensor networks.

Mohammed Ansar Ali M.A received the B.Tech Degree in Information Technology from Anna University Chennai in 2009 and MTech in Computer Science and Engineering from VEL TECH Technical University in 2013. He has published paper on MRMC wireless System, Localization of Wireless networks, Credit Card fraud detections in 2012-2013, and Cloud Based video system in 2014.