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Issues and challenges of Energy Efficient Resource Management inCloud Datacenter

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***Abstract* - Cloud computing is a cost effective and highly scalable computing infrastructure. It provides heterogenous computing services such as processing of information, storage of information, allocation and deallocation of computing resources by using server, storage and network through dedicated building like cloud datacenter. However, the growing requirement of cloud infrastructure has expanded the risk of large amount of energy consumption which become a critical issue. Therefore, an efficient solution to reduce energy consumption required to minimize the energy dissipation.**

The aspects ofefficient solution for critical energy issues targets on reducing the consumption of energy in datacenter because the processed information and computing applications are emerging rapidly. The larger servers and storage disksare increasingly needed to provide the services quickly within the required time period. Thus, in datacenter, it is required to reduce the number of physical machines using virtualization by consolidating virtual machines on to shared resources and availing them to migrate according to migration policy. This paper extends the view on issues and challenges of energy efficient resource management in cloud datacenter.

Keywords: **cloud computing, energy consumption, virtualization, consolidation.**

I. INTRODUCTION TO CLOUD COMPUTING

Cloud computing has become a multimillion-dollar corporation from obscure service in the past decade to become an essential part of internet ecosystem. [1]Based on general market demands, the cloud computing is divided in to various segments relying on type of distinct services offered and the location.[2]

Based on the location:

1. Private cloud- In Private Cloud, the infrastructure for the network is used only by one customer or organization even though the hardware is still located at a remote location. It is possible to place the system on-premise which is noticeably more expensive which offers complete control over the physical infrastructure.
2. Public cloud- In Public Cloud, the entire computing infrastructure is located on the premises of the cloud service providing organization which offers the required services. The user has no physical control over the infrastructure and has to share resources.
3. Hybrid cloud- Hybrid cloud is a combination of multiple private and public clouds in the same system. In hybrid cloud service scenario, an organization can use a public cloud to interact with consumers while keeping their personal data secure on a private cloud.
4. Community cloud- It is used for sharing data between organizations. Some systems share data between a single entity and the public in general such as, any system that is run by the government of any country.

Based on Services offered:

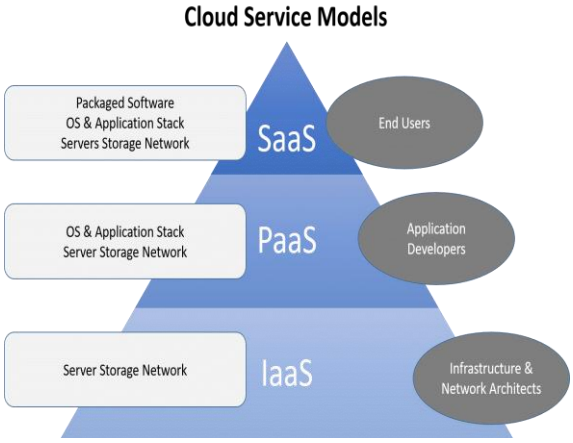

Fig. 1Types of cloud computing service models

IaaS (Infrastructure-as-a-Service)

IaaS offers storage solutions with the help ofcomputing resources such as data storage disks and virtual servers etc.services such as Amazon, Rackspace, Flexiscale are example for Infrastructure-as-a-Service (IaaS).

PaaS (Platform-as-a-Service)

PaaS offers a development platform, which includes a web server, programming tools, database, and mainly operating system whereclients can customize their cloud experiences based on the role of the service such as Google App Engine, Microsoft Azure, Salesforce etc.

SaaS (Software-as-a-Service)
These are developed by the organizations offering them. Auser can access them on a pay-per-use basis, which is inexpensive than creating your own. Many of these services are even offered for free to customers such as, popular applications such as Gmail, Google Docs, NetSuite etc.

II. INTRODUCTION TO ENERGY EFFICIENT COMPUTING:

Cloud computing is a rapidly growing consumption and virtualized service model for highly scalable computing infrastructures which provides reliable IT solutions through internet. [3]Cloud is growing aggressively with its most advanced cloud services such as Cloud Business Process Services (BPaaS), function as a service (FaaS), Backend as a service (BaaS) along with the advancement of foregoing Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS).

The novel cloud-based container system as service permits applications to be deployed in a fast and clear manner. It likewise delivers better infra security and permits quick release of new software modules and features to run comfortably. It's feasible for Cloud Service Providers to provide hosted container management services and in the meantime segregate the platforms from one another utilizing cloud container systems.[4]

The overall open cloud services market is anticipated to grow 17.3 percent in 2019 to total $206.2 billion, up from $175.8 billion of every 2018, as indicated by Gartner, Inc. In 2018. [5] The fastest emerging division of the market is cloud's infrastructure services (IaaS), which is predicted to grow 27.6 percent in 2019 to reach $39.5 billion, up from $31 billion out of 2018.

TABLE 1 : WORLDWIDE PUBLIC CLOUD SERVICE REVENUE FORECAST (Billions of U.S. Dollars)

	2017	**2018**	**2019**	**2020**	**2021**
Cloud Business Process Services (BPaaS)	42.2	46.6	50.3	54.1	58.1
Cloud Application Infrastructure Services (PaaS)	11.9	15.2	18.8	23.0	27.7
Cloud Application Services (SaaS)	58.8	72.2	85.1	98.9	113.1
Cloud Management and Security Services	8.7	10.7	12.5	14.4	16.3
Cloud System Infrastructure Services (IaaS)	23.6	31.0	39.5	49.9	63.0
Total Market	**145.3**	**175.8**	**206.2**	**240.3**	**278.3**

With the expansion in the computing resources as a service, there is an enormous need to deal with the energy consumption issues by the resources. Energy Consumption is the biggest operational expense of cloud environment. With the increase in the requirement of energy in the area of Information and communications. The cost of energy is expanding too and concurrently resulting in diminish in the natural resources. The presumption for the net energy consumption comprising of the net total energy utilization from all resources in future remarkably high. The Energy – Efficient computing performs the same tasks as earlier while consuming less energy, bringing about lower costs: It reduces the carbon emanations, to achieve a green solution. [3]

III. ISSUES AND CHALLENGES OF ENERGY CONSUMPTION:

Energy consumption issues has become a major and serious concern for the cloud service providers. The inefficient energy consumption issues can be considered as two groups such as power consumption due to disorganised sever operations and another is during network communications which are not optimal. [6]The cloud service users are made provisioned to access the resources from datacenter(DCs) on-demand through internet. The extensive utilization of cloud servicesmakesit important for datacenter to improve the capacity by extending of number of servers and develop a solution for cloud efficiency in operational costs. With the increased number of in-service servers, the universal expenditure of organization's energy consumption and cooling of server is evaluated to be considerably high. [7]

The overall expenses of cloud computing infrastructuresare eventually reduced because of the dynamic resource scaling of virtualization technologies, which makes the adaptability of load deployment more evident.VMware researchers have dissected genuine virtualization deployment scenario data, abridged management workflow in virtualized scene and assessed the effective utilization of resources in cloud computing datacenter.The shifting of virtual machine from one server to another server retains the virtual datacenter. Applications are need not to terminate or shut down while migrating. The rapid migration of virtual machine needs high performance network device at a specific cost. The datacentre can make some choices effectively to purchase a more steady and reliable hardware equipment to ensure good performance of datacentre. Hence, it is required to maintain the coordination and stability between Performance of the system and cost. [8] The below table shows each energy consumption conditionwhile carrying out various type of operations by virtual machine in cloud datacentre.

TABLE 2: COMMON OPERATIONS IN VIRTUALIZED CLOUD DATACENTER

Type of Operation	Average operations of different sites per day	Peak operations of different sites per day
Virtual MachineReconfiguration	2.3	699
Automatic online migration	51.0	3156
Virtual Computer Start	90.0	1576
Virtual computer turnoff	35.0	1535
Virtual computer	4.6	176
Package installer	5.3	250
Create snapshots	4.8	56
Snapshot restore	7.0	101
Snapshots submission	13.0	19
Virtual computer cloning	6.0	44

As a result of virtualization innovation, datacenter conveys new features to day by day operations management as well as new difficulties to energy consumption management activities. Virtual resources and physical resources are free from one another in virtualization platform management so the hidden physical resources and the virtual resources seen by computers are different, particularly during the time of migration. Therefore, the energy consumption management of client virtual computer turns into a central issue. Moreover, platform updates, debugging of errors and new node addition influence the inconsistency of datacenter. Accordingly, heterogeneity is increased so the virtual computer ought to be constant regarding the changeable isolation and independence.

The challenges in Energy consumption Managementfor datacenter operations include all automated and manual processes essential to keep the datacenter operational. [9] Typically, datacenter operations are distributed across several categories,for example,Infrastructure Operations- Installation, maintenance, monitoring, patching and server updating, storage and network resources, Security- physical and logical security in the datacenter premises ensured by Processes, tools and technologies.Power and cooling- All processes that ensure enough power is supplied to the datacenter facility and the cooling system is operationalManagement: Creation, enforcement and monitoring of policies and procedures within datacenter processes.

IV. POSSIBLE SOLUTIONS TO ACHIEVE ENERGY EFFICIENCY

The key solutions for reducing energy consumption at the datacentermust include:

- Energy utilization can be primarily reduced by optimal CPU utilization and tasks scheduling.
- Step by step instructions to decide when, which Virtual Machines, and where to migrate in order to limit energy consumption by the system framework, while reducing migration overhead and ensuring Service Level Agreements.
- Developing an Energy Efficient Decentralized and Scalable resource allocation algorithms and a universal solution by combining several allocation policies to reach different objectives. [10]
- Usage of Energy Efficient Hardware to reduce energy consumption at a datacenter and at host side by choosing existing mechanism like SpeedStep®, PowerNow!™, Cool'n'Quite™ and Demand Based Switching® which results in the ability to sense the absence of machine interaction and then different hardware parts can incrementally be hibernated or put in sleep mode to save energy.
- Developing an Energy Efficient Resource Management and Scheduling algorithm to meet the innovation incloud services with many aspects like Energy Consumption, reliability, response time etc
- Cluster component like memory, storage discs, network peripherals etc which consumes considerable amount of energy when CPU is idle. Developing an approach to reduce energy consumptionas a complete cluster of servers is needed.
- Developing a better approach like storage and computation algorithms, to reduce energy consumption in network infrastructure with more energy efficient algorithms by considering the different types of Cloud Network Environment. [11]
- SaaS providers should focus in deploying software on suitable and compatible infrastructure which can execute the software product most efficiently to achieve energy efficiency at application level. [12]
- Datacenter efficiency can be improved by utilizing Consolidation at the server level to streamline and cut costs by reducing redundancy in physical servers through Virtualization.
- Strategic phase in datacenter have high levels of virtualization over their servers, storage, and network environments and are progressed in the utilization of software and automation tools to achieve greater efficiency by following key practices that operate Strategic datacenter such as, Optimizing the server, storage, network and facilities resources to maximize capacity and availability, Design

for flexibility to support changing business needs, Utilization of automation tools to improve service levels and availability and have an arrangement that lines up with the business objectives and keep it current. [13]

V. CONCLUSION AND FUTURE WORK

As the world is constantly changing with its continuous innovation in Information Technology, cloud computing services also growing with enormous prospects but with equal number of issues and challenges. One of the biggest challenges with the cloud computing model is the Energy Efficiency. In this paper, we discussed about various issues and challenges of energy consumption due the advancement and deployment of novel services to the cloud environment which are causing problems to environment sustainability.

Due to the complexity of the cloud, it is hard to accomplish end-to-end solution. It is important to rectify these problems and formulate strategies for reducing power consumption in cloud environment. New Energy Efficiency techniques need to be developed and more established efficiency procedures should have been profoundly changed to have the capacity to work with the cloud's architecture. We hope our work will give a better comprehension of the design challenges of cloud computing, and clear the way for further research in this area.

REFERENCES

[1] Buyya, Rajkumar & Yeo, Chee Shin & Venugopal, Srikumar&Broberg, James &Brandic, Ivona. (2009). Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering Computing as the 5th Utility. Future Generation Computer Systems.2008.

[2] Neeru Jain, Current Status of Cloud Computing Industry, August 7, 2018, https://www.whizlabs.com/blog/cloud-computing-trends/

[3] Shveta, Asmita Pandey "Energy Conservation and Security Issues in Cloud Computing: A Review" International Journal of Advances in Computer Science and Cloud Computing, ISSN: 2321-4058 Volume- 2, Issue- 1, May-2014.

[4] Cloud Computing Trends Driving Growth in 2018 by ESDS June 27, 2018, https://www.esds.co.in/blog/cloud-computing-trends-driving-growth-2018/

[5] STAMFORD, Conn"Gartner Forecasts Worldwide Public Cloud Revenue to Grow 17.3 Percent in 2019" Newsroom, Press Releases September 12, 2018. https://www.gartner.com/en/newsroom/press-releases/2018-09-12-gartner-forecasts-worldwide-public-cloud-revenue-to-grow-17-percent-in-2019

[6] S. Vakilinia, B. Heidarpour and M. Cheriet, "Energy Efficient Resource Allocation in Cloud Computing Environments," in *IEEE Access*, vol. 4, pp. 8544-8557, 2016.

[7] Andreas Berl, Erol Gelenbe, Marco Di Girolamo, Giovanni Giuliani, Hermann De Meer, Minh Quan Dang and Kostas Pentikousis "Energy-Efficient Cloud Computing" *The Computer Journal*, Volume 53, Issue 7, Pages 1045–1051, 2009

[8] Li, L.: Energy consumption management of virtual cloud computing platform. In: 2017 IOP Conference Series Earth and Environmental Science, vol. 94, p. 012193 (2017)

[9] **Techopedia** "Data Center Operations"https://www.techopedia.com/definition/29871/data-center-operations

[10] A. Beloglazov and R. Buyya, "Energy Efficient Resource Management in Virtualized Cloud Data Centers," *2010 10th IEEE/ACM International Conference on Cluster, Cloud and Grid Computing*, Melbourne, VIC, 2010, pp. 826-831.

[11] Arindam Banerjee, Prateek Agrawal and N. Ch. S. N. Iyengar "Energy Efficiency Model for Cloud Computing" International Journal of Energy, Information and Communications Vol.4, Issue 6 (2013), pp.29-42.

[12] Rajinderpal Kaur Aulakh "Energy Efficiency in Cloud Computing" International Journal of Recent Advances in Engineering and Technology, ISSN (Online): 2347 – 2812, Volume-2, Issue -8, 2014.

[13] IBM Global Technology Services, Research Report on "Data center operational efficiency best practices", https://www-935.ibm.com/services/multimedia/IBM_Global_Data_Centre_Study.pdf.