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Resource Management and Efficiency in Cloud Computing Environments

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A volume in the Advances in Systems Analysis, Software Engineering, and High Performance Computing (ASASEHPC) Book Series

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Published in the United States of America by
IGI Global
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Library of Congress Cataloging-in-Publication Data

Names: Turuk, Ashok Kumar, 1963- editor. | Sahoo, Bibhudatta, 1967- editor. | Addya, Sourav Kanti, 1985- editor.
Title: Resource management and efficiency in cloud computing environments / Ashok Kumar Turuk, Bibhudatta Sahoo, and Sourav Kanti Addya, editors.
Description: Hershey, PA : Information Science Reference, 2017. | Includes bibliographical references and index.
Identifiers: LCCN 2016043916| ISBN 9781522517214 (hardcover) | ISBN 9781522517221 (ebook)
Subjects: LCSH: Cloud computing.
Classification: LCC QA76.585 .R3785 2017 | DDC 004.67/82--dc23 LC record available at https://lccn.loc.gov/2016043916

This book is published in the IGI Global book series Advances in Systems Analysis, Software Engineering, and High Performance Computing (ASASEHPC) (ISSN: 2327-3453; eISSN: 2327-3461)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Advances in Systems Analysis, Software Engineering, and High Performance Computing (ASASEHPC) Book Series

Vijayan Sugumaran
Oakland University, USA

ISSN:2327-3453
EISSN:2327-3461

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Preface

OVERVIEW

Cloud computing is an emerging computing technology that uses Internet and central remote servers to maintain data and applications. It allows consumers and businesses to use applications without installation and access their personal files at any computer with the help of Internet. It can be defined as anything that provides hosted service over the Internet. Further, it facilitates to collaborate on business activities of multiple organizations across geographic locations. This technology is expected to be much more efficient than the presently available technology by centralizing the storage, memory, processing and bandwidth. Technologies, that made cloud computing feasible are virtualization, cyber-infrastructure, and service orient infrastructure. Apart from cloud computing, big data is another cutting edge technology for global data storage and data handling. These two new technologies are evolving across the globe. Now- a-days, IT organizations are moving towards a concept of seamless computing and real-time processing of data with high degree of resource scalability. Collaboration of these two technologies, enable the scope of another emerging technology Internet-of-Things (IoT). With the help of cloud and big data networking, today it is possible to envision pervasive connectivity, storage and computation which in turn, gives rise to different IoT solutions. In the present globalization scenario cloud services can provide speed and cost effective solutions. These benefits will enable enterprises to become competitive in the market.

Cloud Providers offer services that can be grouped into three service model:

1. **Software as a Service (SaaS):** In this model, a complete application is offered to the customer, as a service on demand. A single instance of the service runs on the cloud and multiple end users are serviced. On the customers' side, there is no need for upfront investment in servers or software licenses, while for the provider, the costs are lowered. Since, only a single application needs to be hosted and maintained. Today SaaS is offered by companies such as Google, Salesforce, Microsoft, Zoho, etc.
2. **Platform as a Service (Paas):** In this service model, a layer of software environment is encapsulated and offered as a service. Other higher levels of services can be built upon it. Customers have the freedom to build his own applications, which runs on the provider's infrastructure. To meet scalability requirements of the applications, PaaS providers offer a predefined combination of OS and application servers. Google"s App Engine, Force.com, etc are some of the popular PaaS examples.
3. **Infrastructure as a Service (Iaas):** This service model provides the basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment, data centre space etc. are pooled and made available to handle workloads. The cus-

the sensitive data securely and effectively. This chapter examines cyber-security concerns with cloud computing, both from perspective of cloud service providers and end-users using small-to-medium enterprise in developing economies as a case study. The author noted that it is impossible to eliminate threat. Therefore, protection against them without disruptively business innovation and growth should be the utmost priority.

Paul and Sahoo in their chapter titled "Dynamic Virtual Machine Placement in Cloud Computing" have built an energy consumption model to calculate total energy consumption of physical machines, taking into account different states of virtual machines. They approach the decision making process for dynamic virtual machine placement in a decentralized manner. Two scenarios are considered; one when the physical machines cooperate with one another as in the case of private cloud and the other when they act in a selfish manner in case of hybrid cloud. The authors use cooperative and non-cooperative game theory for the two scenarios respectively for optimal placement of virtual machines onto physical machines to minimize energy consumption.

Mishra et al. in their chapter titled "Metaheuristic Approaches to Task Consolidation Problem in the Cloud" have explained the cloud computing environment along with its various service models. They have also explained the importance of energy consumption in a cloud data center, and different techniques to conserve energy. They have redefined the existing problem, of task scheduling in the cloud environment along with the importance of virtualization technique. Authors have explained the applicability of metaheuristic approaches in scheduling cloud environments. They hae also mentioned the implementation issues of various metaheuristic techniques like Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), BAT algorithm with various environments for the service allocation problem in the cloud.

Sahoo et al. in their chapter titled "Real Time Task Execution in Cloud Using MapReduce Framework" have proposed a cloud system model for real-time task processing in the cloud. As many applications like smart devices and sensor-based tasks, generate a significant amount of data that has a time constraint, a scalable platform like cloud computing is required to process it. The authors have also discussed a real-time MapReduce framework in cloud computing used for massive data processing. Various MapReduce scheduling quality attributes are studied, and scheduling algorithms are reviewed based on these characteristics.

Dhal et al. in their chapter titled "Resource- and Energy-Efficient Virtual Machine Migration in Cloud Data Centers" have said that the recent advances in cloud computing services have led to increasing amount of energy consumption in data centers. Thus consolidation schemes for virtual machines (VMs) on physical machines on cloud data centers. Consolidation scheme being NP-complete requires heuristic techniques to get a sub-optimal solution. The authors have proposed an adaptive threshold based consolidation scheme for VMs by improving the host overload detection phase with appropriate measure of statistical dispersion and combined with minimum migration time policy of selecting the VMs for migration. This reduces the performance metric involving energy consumption and the level of SLA violations.

Sahoo et al. in their chapter titled "Network Virtualization: Network Resource Management in Cloud" have stated that virtualization provides a number of benefits to the service providers and everyday users. Virtualization technologies have recently shifted from server virtualization to network virtualization. It can deliver a new platform upon which new network architecture can fabricate and experimented. Since network virtualization in a cloud environment is a new research topic, in this chapter authors have trying to discuss various benefits, different research challenges and under taken projects on network virtual-

ization. Resource discovery and resource allocation are two important task in network virtualization. A mathematical formulation on resource allocations is present in this chapter.

Kasemsap in his chapter titled "Software as Service, Semantic Web, and Big Data: Theories and Applications" consolidated the available literature on SaaS, Semantic web and Big data. The author has described the current issues and trends with SaaS, Semantic web and Big data in order to maximize the technological impact in modern operation. He also explained the perspective of SaaS adoption and challenges of SaaS in the digital age, overview and current trend in Semantic web, Overview, concept and prospect of Big data in the digital age.

Panigrahi et al. in their chapter titled "Software Development Methodology for Cloud Computing and Its Impact" have mentioned that a single software development process model cannot work for all types of project. Software development model is an evolving process which is affected by nature of the project, types of product to be developed etc. They have mentioned how software projects can be developed for cloud computing platform and the impact of cloud computing on software development. They have highlighted the benefit of software development and the agile method of software development in cloud computing platform.

IMPACT OF THIS BOOK

This book outlines advancements in the state-of-the-art, standards, and practices of cloud computing, in an effort to identify emerging trends, research and developments that will ultimately define the future of the cloud and relation with Big Data and IoT. A valuable reference for academics and practitioners alike, this title covers topics such as virtualization technology, Service oriented architecture (SOA), utility computing, cloud application services (SaaS), grid computing, Big Data and IoT.

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Acknowledgment

At the outset, we would like to thank all the chapter authors for their excellent contributions. We would like to offer my special thanks to IGI Global for the opportunity to edit the publication.

We would like to acknowledge the role of the reviewers and editorial team for their support. Finally, we thank to our family for their continuous encouragement and support in our scholastic pursuits.

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of security concerns confront both providers and end-users. Vulnerabilities and threats are key concerns, so that value created is strategically aligned with corporate vision, appropriated and sustained. What is the extent of impact? Expert opinions were elicited of 4 C-level officers and 10 security operatives. Shared technology issues, malicious insiders and service hijacking are considered major threats. Also, an intuitive strategic model for Value-Creation Cloud-based Cyber-security is proposed as guidance in fostering IT-enabled initiatives.

The aim of cloud computing is to enable users to access resources on demand. The number of users is continuously increasing. In order to fulfil their needs, we need more number of physical machines and data centers. The increase in the number of physical machines is directly proportional to the consumption of energy. This gives us one of the major challenges; minimization of energy consumption. One of the most effective ways to minimize the consumption of energy is the optimal virtual machine placement on physical machines. This chapter focuses on finding the solution to the problem of dynamic virtual machine placement for the optimized consumption of energy. An energy consumption model is built which takes into account the states of physical machines and live migration of virtual machines. On top of this, the cloud computing model is built. Unlike centralized approaches towards virtual machine placement which result in many unreachable solutions, a decentralized approach is used in this chapter which provides a list of virtual machine migrations for their optimal placement.

The service (task) allocation problem in the distributed computing is one form of multidimensional knapsack problem which is one of the best examples of the combinatorial optimization problem. Nature-inspired techniques represent powerful mechanisms for addressing a large number of combinatorial optimization problems. Computation of getting an optimal solution for various industrial and scientific problems is usually intractable. The service request allocation problem in distributed computing belongs to a particular group of problems, i.e., NP-hard problem. The major portion of this chapter constitutes a survey of various mechanisms for service allocation problem with the availability of different cloud computing architecture. Here, there is a brief discussion towards the implementation issues of various metaheuristic techniques like Particle Swarm Optimization (PSO), Genetic Algorithm (GA), Ant Colony Optimization (ACO), BAT algorithm, etc. with various environments for the service allocation problem in the cloud.

The Network-as-a-Service (NaaS) framework integrates the cloud computing services with direct tenant access to the network infrastructure. The Network virtualization (NV) is such a platform that acts as a mediation layer to provide NaaS to tenants. NV supports the coexistence of multiple virtual networks, which is the collection of virtual nodes and virtual links on the same underlying physical infrastructure. Prior to set up a virtual network in an NV Environment, resource discovery and resource allocation are the primary job. In this chapter, we have discussed on basic NV architecture, surveyed the previous work on the resource allocation along with ongoing research projects on network virtualization.

This chapter explains the overview of software as a service (SaaS); SaaS and application service provision (ASP); the security concern of SaaS; the perspectives on SaaS adoption; the challenges of SaaS in the digital age; the overview of the Semantic Web; the current trends in the Semantic Web services; the overview of Big Data; the concept of Big Data analytics; and the prospects of Big Data in the digital age. SaaS offers a wide range of business applications through the cloud computing service providers toward enhancing organizational performance. The Semantic Web extends beyond the capabilities of the current Web 2.0, thus enabling more effective collaborations and smarter decision making in modern operations. Big Data from the cloud computing platforms provides the significant advantage, if the essential data sources are hosted by the same SaaS and enhanced by the Semantic Web technologies.

This chapter emphasizes mainly on the software development methodology basically agile methods of software development in cloud computing platforms and its impact on software development processes. This chapter also covers the benefits of agile development methodology in cloud computing platform. Along with this all traditional software development phases are analyzed to discuss the differences between the traditional software development processes and software development in cloud computing environment. This chapter also includes a brief description of programming models such as MapReduce, BSPCloud, and Dryad etc. available in the literature to handle big data in SaaS cloud. Finally, we highlight the challenges and future scope of software development process in cloud computing environment.