RESEARCH PAPER | Computer Science | Volume : 5 | Issue : 6 | June 2015 | ISSN - 2249-555X



Security and Scheduling Challenges in Cloud Computing

KEYWORDS: Cloud computing, Security, Scheduling, Resource Management

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ABSTRACT *Modern era is use of cloud computing for various computing based services. Resources at cloud host side are required to be scheduled to cloud client in a secured manner. Security breaches and improper scheduling of resources decision may create problems for both cloud host and cloud consumer. This paper discusses various issues related to scheduling and security of cloud resources and available solutions of those problems. This paper may be useful for the cloud users as well as cloud hosts that are new to these fields.*

INTRODUCTION

Cloud computing means delivering data or applications over the internet on pay per use basis. It is different from traditional scenario that instead of everything to be stored on user's personal system it is delivered from the internet on demand [1].

Cloud computing services can be categorized as given below:

Software as a service (SaaS): Cloud based software or application run on distant computer s stored on cloud rather than user's system and controlled by others. Users access these applications on internet through their Web browser [2].

Platform as a service (PaaS): Platform as a service provides uses an environment for building and deploying their applications. Instead of paying so much money in buying everything they can only pay for as much they use [3].

Infrastructure as a service (IaaS): Infrastructure services provides user with computing infrastructure like servers, storage, networking infrastructure etc. Users doesn't need to buy their own infrastructure .They can access it from cloud when required and pay for that [4].

Cloud Deployment Models: Cloud can have four types of deployment models:

1. Public cloud: In this model services and applications are available for general public use and are free of cost. There are provision for authentication and authorization.
2. Private cloud: Systems and services are used within an organization. These clouds have better control over their data and applications.
3. Community cloud: system and services are shared by a group of organizations having a common mission.
4. Hybrid cloud: It is combination of public and private cloud. Critical applications are done through public cloud where as rest are achieved with help of private cloud [5].

Although there are many benefits of cloud computing there are several barriers to it. One of the most significant barriers in it is security. Cloud computing is a relatively new model therefore it is a critical issue how security at all levels (data, application, network) will be maintained. The major problems are due to external data storage, dependency on the "public" internet, lack of control and multitenancy.

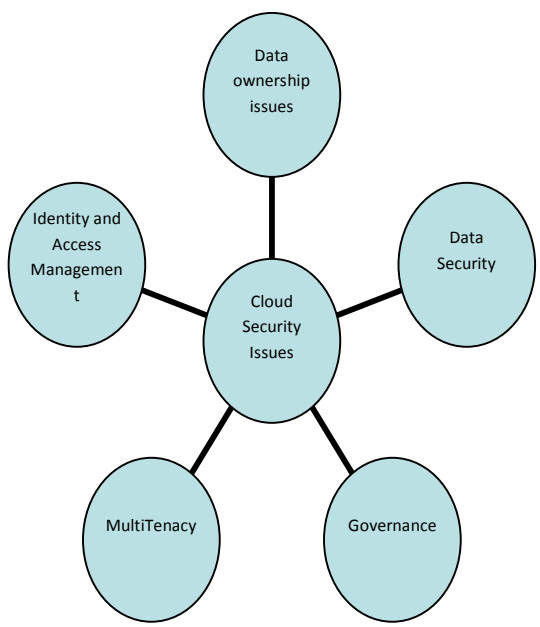


Figure 1: Various security issues related to cloud computing

Job scheduling is another critical aspect of Cloud Computing. Since the cloud's computing resources are shared by many users it is necessary that resources are utilized efficiently and users can get maximum profit from it. So there is a great need of scheduling algorithm that can make optimal use of resources as well as take less turnaround time and response time and maximum throughput from the user's view.

Rest of the paper is as follows: section 2 discusses related works of Cloud computing security and scheduling issues. In Section 3, conclusion and our contribution are presented.

BACKGROUND

A large body of literature is available on grid computing and cloud computing. Various research groups are exploring the ways to use grid and cloud computing as next

Volume : 5 | Issue : 6 | June 2015 | ISSN - 2249-555X

generations paradigm shift.

Literature on security of resources:
Takabi et al. presented security and privacy challenges that are exacerbated by the unique aspects of clouds and showed how they're related to various delivery and deployment models. They discussed various approaches to address these challenges, existing solutions, and future work needed to provide a trustworthy cloud computing environment [6].

Subashini et al. surveyed different security risks that pose a threat to the cloud. That survey was more specific to the different security issues that has emanated due to the nature of the service delivery models of a cloud computing system [7].

Jensen et al. focused on technical security issues arising from the usage of Cloud services and especially by the underlying technologies used to build these cross-domain Internet-connected collaborations [8].

Asma et al. surveyed the cloud computing security issues. Their main contribution is to classify the issues according to the different service models and to provide some directions for solutions. Enough or adequate security can be achieved by solving these issues [9].

Dillon et al. aimed to pinpoint the challenges and issues of Cloud computing. They first discussed two related computing paradigms - Service-Oriented Computing and Grid computing, and their relationships with Cloud computing. They also identified several challenges from the Cloud computing adoption perspective. Last, they highlighted the Cloud interoperability issue that deserves substantial further research and development [10].

Literature on cloud computing and scheduling of resources:
Sotomayor et al. presented a model for predicting various runtime overheads involved in using virtual machines, that allows efficient support advance reservations in [12].

Shrivastava et al. proposed two algorithms 1) Starvation-Removal and 2) AR-to-BE Conversion to solve problems related to resource management. They demonstrated experimentally results of the proposed algorithms to stop starvation of BE leases for resources and effectively improve request acceptance rate [13]. Starvation removal algorithm with improvements was also proposed in [14].

In [15] CBUD Micro, a performance evaluation tool was presented that can be used at both cloud host and consumer side for resource management by supporting scheduling decisions. They also described the vision and architecture of CBUD Micro in detail and the way in which core components were implemented.

In [16] a new leasing policy named CRI (Consumer Rating Index) and an algorithm for prioritizing consumers on the basis of CRI scores was proposed to manage the cloud host resources properly. This policy and algorithm can be used for efficient functioning at cloud hosts side was also presented.

In [17] mEDF (Modified Earliest Deadline First) algorithm and leasing policy for deadline driven resource management was introduced. This algorithm takes care of minimum capacity expenses at cloud host side. mEDF can be used for deadline driven scheduling with minimizing response time and completion time.

COMMA (Cost Oriented, Market and Migration Aware) for maintaining a balance between cost, profit and migrations of VM during peak loads was introduced in [18]. This paper showed that COMMA leasing policy and algorithm are effective and can be used for making profit and maintain QoS in a cloud environment.

Cloud service negotiation techniques were presented in [19]. Authors also presented a survey of challenges and current state of resource negotiation. They showed the different agent based methods for cloud negotiation. The focus was on most advanced agent cloud coordinator that will be able to deliver Quality of Service (QoS) for cloud provider so that it allows an increase in performance, reliability and scalability of applications.

Foster et al. presented a study in [20] that strives to compare and contrast Cloud Computing with Grid Computing from various angles and give insights into the essential characteristics of both.

Beloglazov et al. conducted a survey of research in energy-efficient computing and propose: (a) architectural principles for energy-efficient management of Clouds; (b) energy-efficient resource allocation policies and scheduling algorithms considering QoS expectations and power usage characteristics of the devices; and (c) a number of open research challenges, addressing which can bring substantial benefits to both resource providers and consumers. [21]

Buyya presented vision, challenges, and architectural elements for energy-efficient management of Cloud computing environments. They focused on the development of dynamic resource provisioning and allocation algorithms that consider the synergy between various data center infrastructures (i.e., the hardware, power units, cooling and software), and holistically work to boost data center energy efficiency and performance [22].

Pandey et al. presented a particle swarm optimization (PSO) based heuristic to schedule applications to cloud resources that takes into account both computation cost and data transmission cost. They experimented with a workflow application by varying its computation and communication costs. They compared the cost savings when using PSO and existing 'Best Resource Selection' (BRS) algorithm. Their results show that PSO can achieve: a) as much as 3 times cost savings as compared to BRS, and b) good distribution of workload onto resources [23].

Hoffa explored the use of cloud computing for scientific workflows, focusing on a widely used astronomy application-Montage. The approach was to evaluate from the point of view of a scientific workflow the tradeoffs between running in a local environment, if such is available, and running in a virtual environment via remote, wide-area network resource access [24].

Zhang presented a survey of cloud computing, highlighting its key concepts, architectural principles, state-of-the-art implementation as well as research challenges. The aim of his paper was to provide a better understanding of the design challenges of cloud computing and identify important research directions in this increasingly important area [25].

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Beloglazov et al. proposed an energy efficient resource management system for virtualized Cloud data centers that reduces operational costs and provides required Quality of Service (QoS). Energy savings were achieved by continuous consolidation of VMs according to current utilization of resources, virtual network topologies established between VMs and thermal state of computing nodes [26].

CONCLUSION

Security and scheduling are the main aspects of any computing paradigm. Cloud computing is used in many application areas and its security is important at both sides that is at cloud host and cloud consumer. Scheduling of resources is also a major factor cloud computing to exploit the full power of computing resources. Discussed problems and their solutions in this paper are the key research topics to study.

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