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PROFIT MAXIMIZATION FOR CLOUD BROKER IN CLOUD COMPUTING

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ABSTRACT
With the rise of cloud computing, an increasing number of applications are being deployed in cloud environments. A key characteristic of cloud computing is its pay-as-you-go model. Despite this flexibility, many users end up paying more than what they actually use due to the standard one-hour billing interval. Additionally, cloud service providers often offer discounts for long-term commitments, which are inaccessible to short-term users with minimal computing needs. To address these issues and help users reduce expenses, a new entity known as a cloud broker is introduced. This broker acts as a mediator between cloud service providers and end users. It purchases reserved virtual machines (VMs) from providers at a discounted rate and resells them to users on-demand at lower prices than what providers usually charge. Cloud brokers also implement shorter billing cycles, further helping users to minimize costs. Besides benefiting users, cloud brokers can also generate profits by capitalizing on the price difference between reserved and on-demand VMs. This paper explores strategies to effectively configure a cloud broker and determine optimal VM pricing to maximize profits while simultaneously reducing costs for users. Several factors influence the broker's profitability, including user demand patterns, acquisition and selling prices of VMs, and the broker's operational scale. These variables are interdependent, adding complexity to the profit analysis. We begin by examining these factors comprehensively and then formulate a profit maximization problem, which involves determining the best multi-server setup and VM pricing scheme. To solve this problem, we introduce a heuristic approach that combines partial derivatives with bisection search techniques. The resulting near-optimal solutions can assist brokers in making informed decisions about resource configuration and pricing. Experimental results and comparisons demonstrate that cloud brokers can substantially reduce costs for users while maintaining profitability.

Keywords:
Cloud broker, cloud computing, cost reduction, profit maximization, service demand, VM pricing.

1. INTRODUCTION

Over recent years, cloud computing has rapidly evolved and expanded. A growing number of service providers have entered the field, offering centrally managed hardware and software resources as on-demand services over the internet. This model is attractive due to its key features such as scalability, flexibility, near-unlimited computing capabilities, and a pay-as-you-use pricing structure. These benefits significantly lower the upfront investment needed for hardware and reduce operational costs for clients, making cloud adoption increasingly popular across industries.

One standout aspect of cloud computing is its pay-as-you-use pricing approach, which has two primary implications. First, using virtualization, physical machines are partitioned based on user requirements (like CPU, memory, etc.), and these resources are delivered as virtual machines (VMs). Clients are charged only for the number of resources they consume. Second, VMs can be provisioned or released at any moment, and ideally, customers would pay strictly for the actual time those resources are utilized.

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However, this ideal model remains largely theoretical. In reality, the intricacies involved in accurately tracking and auditing resource usage have led most providers like Amazon EC2 to adopt a more practical hourly billing system. This means customers are charged for full hours of usage, regardless of whether they utilize the full duration or not, resulting in unnecessary costs and inefficiencies.
Moreover, cloud providers generally offer two main payment options: On-Demand Instances and Reserved Instances. On-Demand pricing is flexible and suited for short-term workloads, allowing users to pay per hour depending on their instance type. In contrast, Reserved Instances offer substantial discounts—sometimes up to 75%—but require users to commit to long-term contracts, often ranging from several months to a few years, as seen in platforms like Amazon EC2 and Microsoft Azure. Naturally, these long-term benefits are out of reach for users with short-lived or sporadic needs.
These limitations mean that short-term users often end up paying more than necessary. To address this issue, the concept of a cloud broker is introduced. Acting as a middle layer between cloud providers and end-users, the cloud broker helps optimize costs by offering more flexible and affordable access to cloud resources.

2. LITERATURE SURVEY

[1] Buyya et al. proposed the fundamental principles and paradigms of cloud computing, offering a comprehensive foundation for service models and deployment types. This work laid the groundwork for understanding cloud-based infrastructure and brokerage roles.

[2,3,4] Fox et al. presented an academic overview of cloud computing challenges and opportunities, while Li et al. introduced a fund-constrained investment strategy aimed at maximizing cloud broker profits. These models emphasized economic viability and practical deployment issues.

[5,6] Vaquero et al. and Mell & Grance contributed significantly to the definition of cloud computing, clarifying essential characteristics like on-demand self-service, resource pooling, and measured services.

[7] Zhang et al. proposed models for online resource scheduling and dynamic resource reservation, respectively, using predictive pricing and game-theoretic approaches to optimize resource utilization.

[9] Mei et al. introduced a profit maximization scheme that ensures Quality of Service (QoS) by optimizing cloud resource allocation based on queuing models and cost-benefit analysis.

[10,11,12] Various heuristic approaches were developed by Nesmachnow et al. and others to improve broker strategies under different workload conditions. These include resource allocation optimization, pricing schemes, and multi-cloud coordination for cost efficiency.

3. PROBLEM STATEMENT

Cloud computing's traditional one-hour billing cycle often leads to inefficiencies, with users paying for resources they do not fully utilize. This creates a gap in cost optimization, both for users and service providers. Cloud brokers, acting as intermediaries between cloud providers and users, have the potential to address this issue by renting reserved VMs at lower costs and offering them on demand with shorter billing cycles. However, determining the optimal configuration and pricing strategy for cloud brokers to maximize profits while minimizing user costs remains a significant challenge.
The problem lies in analyzing key factors such as user demand, the purchase cost of reserved VMs, and the sales price of on-demand VMs, and formulating a model that balances profitability and user savings. An efficient solution must address these variables and provide a strategy for cloud brokers to achieve profit maximization without compromising user satisfaction.

4. PROPOSED SYSTEM

This project aims to develop an efficient cloud broker system that strategically manages virtual machine (VM) configurations and pricing to enhance profitability while ensuring affordability for users. Various factors such as

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user demand trends, the acquisition cost of reserved VMs, and sales pricing structures are analyzed to understand their influence on the broker's profit margins.
The solution involves a thorough evaluation of these contributing variables and models the scenario as a profit maximization problem. To address this, we introduce a heuristic algorithm that combines methods like partial derivatives and bisection search to approximate near-optimal solutions. These solutions act as strategic guidelines for configuring the broker's virtual environment and setting competitive prices. Comparative analysis shows that the system significantly reduces user costs while sustaining broker profitability.

5. ADVANTAGES AND DISADVANTAGES

Advantages:
- Cost Savings for Users
- Live Cost Transparency & Savings Calculator
- Flexibility & Customization
- Ideal for Businesses & Startups
- Smart VM Recommendation System

Disadvantages:
- The growing number of public and private cloud service providers creates confusion due to their varied offerings and technical differences.
- Each provider typically offers unique VM types, pricing models, and service interfaces, which makes it difficult for users to identify the best fit for their application needs.
- To simplify this complexity, cloud brokers aim to standardize and simplify the cloud marketplace, though integrating different provider systems can still be a challenge.

6. OBJECTIVES

- Maximize earnings by reselling reserved cloud instances as on-demand services at competitive rates.
- Provide affordable cloud solutions to customers by leveraging lower-cost reserved resources.
- Offer tailored and fine-grained billing options to meet diverse customer requirements.
- Enhance user experience by reducing costs and simplifying access to cloud services.
- Efficiently manage cloud resources to avoid wastage and meet dynamic demands.

7. SYSTEM ARCHITECTURE

The system follows a three-tier architectural design comprising the presentation layer, business logic layer, and data access layer. Each tier handles a distinct part of the application's workflow, from user interaction to server processing and data storage.

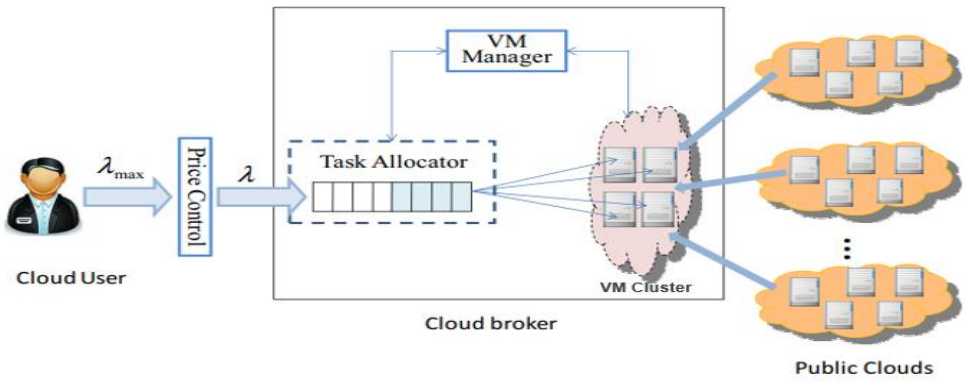

Figure 1 System Architecture

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Modules:

Customer:

The user has to register with the application then only the customer has to login with the application after successful login the customer can perform some actions such as cloud request, upload, view file details, Rent Request, view request, rental space, logout.

The user demand, the resource size, are analyzed comprehensively, and a profit maximization problem is formulated and solved to get the optimal configuration of the virtual platform and the optimal price of the resources.

Broker:

A cloud broker serves as a middle layer between cloud service providers and end-users, primarily aiming to assist customers with short-term computing needs in benefiting from the cost savings typically reserved for long-term users. To do this, the broker purchases a substantial number of reserved instances from cloud providers over extended periods and uses them to build its own virtual resource platform. These resources are then made available to clients as on-demand virtual machines (VMs) at a more affordable rate and with a finer billing granularity such as 30-minute billing intervals compared to the standard hourly rates charged by most cloud providers. When users need computing resources, they can choose to send their requests either directly to a cloud provider or through a cloud broker. This decision often depends on the difference in pricing between the broker's and the provider's on-demand VM offerings.

Cloud Server:

Here the server no need not to register with the application directly can login, after successful login the server can perform some actions such as customer request, view users, logout**.**

8. RESULTS

The project successfully enhanced broker profitability by optimizing VM purchases and pricing strategies while offering cost savings to users. It improved resource utilization, efficiently handled varying demands, and provided a scalable, flexible solution for cloud service delivery.

9. FUTURE SCOPE

Cloud brokers can maximize profits by optimizing pricing models and automating resource allocation using AI. Multi-cloud solutions and value-added services like security and compliance can attract more customers. Dynamic pricing strategies based on demand prediction will enhance revenue. Green cloud initiatives can reduce operational costs while improving sustainability. Blockchain integration can ensure transparent billing and efficient service management.

10. CONCLUSION

This project explores an effective strategy for enhancing the profitability of cloud brokers while simultaneously reducing costs for users. By acting as a middle layer between cloud providers and consumers, the cloud broker acquires long-term reserved virtual machines and repackages them into more affordable, on-demand offerings with shorter billing intervals.

We presented a methodical approach to configuring the broker's virtual infrastructure and establishing pricing models that support both profit generation and user satisfaction. The solution uses mathematical modeling and optimization techniques, including queuing theory and numerical analysis, to identify near-optimal configurations. The experimental results validate that this model not only improves resource efficiency but also achieves significant savings for users, confirming the viability and impact of the proposed framework.

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