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Consumer-Satisfaction-Aware Optimal Multi-Server Configuration for Profit in Cloud Computing

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ABSTRACT:

Along with the improvement of cloud computing, increasingly more firms start to adopt cloud service, which promotes the emergence of many cloud service providers. For cloud vendors, how to configure their cloud service platforms to reap the most earnings turns into more and more the point of interest that they take note of. In this paper, we take patron delight into consideration to address this hassle. Consumer satisfaction influences the earnings of cloud carrier carriers in two approaches. On one hand, the cloud configuration affects the quality of provider that's an critical element affecting purchaser satisfaction. On the alternative hand, the consumer satisfaction affects the request arrival fee of a cloud carrier company. However, few present works take client pleasure into consideration in solving income maximization problem, or the present works thinking about patron delight do not give a proper formalized definition for it. Hence, we first of all consult with the definition of patron pleasure in economics and broaden a formulation for measuring consumer pleasure in cloud computing. And then, an analysis is given in detail on how the consumer satisfaction influences the earnings. Lastly, satisfaction, considering patron service-level agreement, renting rate, energy consumption and so forth, a income maximization problem is formulated and solved to get the most efficient configuration such that the profit is maximized.

Index Terms—cloud computing; consumer satisfaction; multi-server system; profit maximization; PoS; QoS; service-level agreement;

I. INTRODUCTION

Cloud computing is the distribute of resource and computing as a service in place of a product over the internet, such that accesses to shared hardware, software, databases, data, and all assets are provided to consumers on-demand [1]. Consumers use and pay for services ondemand without considering the prematurely infrastructure prices and the subsequent protection value [2]. Because of such advantages, cloud computing is becoming an increasing number of famous and has obtained substantial interest currently. These days, there have been many cloud service providers, together with Amazon EC2 [3], Microsoft Azure [4], Saleforce.Com [5], and so on. As a type of new IT industrial model, profit is an important problem of cloud provider providers. As proven in Fig. 1, the cloud carrier vendors rent assets from infrastructure carriers to configure the provider systems and provide paid services to consumers to make profits. For cloud service vendors, how to configure their cloud carrier systems to attain the maximal earnings will become increasingly the focus that they pay attention to.



Fig. 1: The Three-Tier Cloud Structure

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The optimal configuration problem with profit maximization of cloud service vendors has been researched in before researches [2, 6] which assumed that the cloud service demand is known in advance and not affected by external factors.

Cloud services include Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (Paas). The aim of cloud computing is to allocate virtual resources that enables computing and storage data access on demand basis. For allowing more requests, cloud services has the capacity of multiplexing the physical resources among requested resources? Cloud computing and networking are the two key functionalities that are involved in the distributed clouds. Convergence between cloud and networking is more important for QoS delivery and for creation of networked cloud environments.

For cloud service providers, how to configure their cloud service platforms to obtain the maximal profit becomes increasingly the focus that they pay attention to. The optimal configuration problem with profit maximization of cloud service providers has been researched in our previous researches which assumed that the cloud service demand is known in advance and not affected by external factors. However, the request arrival rate of a service provider is affected by many factors in actual, and consumer satisfaction is the most important factor. For example, consumers could submit their tasks to a cloud computing platform or execute them on their local computing platforms. The consumer behaviour depends on if the cloud service is attractive enough to them. To configure a cloud service platform properly, the cloud service provider should know how consumer satisfaction affects the service demands. Hence, considering consumer satisfaction in profit optimization problem is necessary. However, few existing works take consumer satisfaction into consideration in solving profit maximization problem, or the existing works considering consumer satisfaction do not give a proper formalized definition for it. To address the problem, this paper adopts the thought in Business Administration, and firstly defines the consumer satisfaction level of cloud computing. Based on the definition of consumer satisfaction, we build a profit maximization model in which the effect of consumer satisfaction on quality of service (QoS) and price of service (PoS) is considered.

From an economic standpoint, two factors affecting consumer satisfaction are QoS and PoS. The PoS is determined by cloud service providers. The QoS is determined by the service capacity of a cloud service provider which largely depends on its platform configuration. Under the given pricing strategy, the only way to improve the consumer satisfaction level is to promote the QoS, which can be achieved by configuring cloud platform with higher service capability. Doing therefore will have an effect on a cloud service supplier from 2 asides. On one hand, the upper client satisfaction level ends up in the next market share; therefore the cloud service supplier will gain additional revenues. On the opposite hand, additional resources area unit rented to boost the service capability that ends up in the rise of prices. Hence, the last word answer of up profit is to search out AN best cloud platform configuration theme. During this paper, we tend to build a client satisfaction aware profit optimisation model and propose a distinct hill rising algorithmic program to search out the numeric best cloud configuration for cloud service suppliers.

II. EXISTING SYSTEM

Cloud is one of the emerging technologies in computer engineering. Several companies move around on the way to this technology due to lessening maintenance cost. Number of organizations offer cloud service such as SaaS, IaaS, PaaS. Different organization provides same service with different service charges and waiting time. So consumers can select services from these cloud providers according to their criteria like cost and waiting time. By using 'demand pricing' strategy, providers can provide services with minimum cost without losing any income or valuable resource time. But the existing system does not provide any automated job scheduling considering consumer cost, provider benefit, consumer waiting and provider idle time.



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To estimate the service demand of a service provider, it is critical to measure its consumer satisfaction. In business management, there have been many specialists who focus on the researches of the definition of consumer satisfaction.

In recent years, cloud computing has become a booming service industry. How to increase profit is an important issue for cloud service providers. Many works have been done to research this issue. There are some researches focusing on the profit maximization problem of the service providers.

III PROPOSED SYSTEM

The request arrival rate of a service provider is affected by many factors in actual, and consumer satisfaction is the most important factor. For example, consumers could submit their tasks to a cloud computing platform or execute them on their local computing platforms. The consumer behaviour depends on if the cloud service is attractive enough to them. To configure a cloud service platform properly, the cloud service provider should know how consumer satisfaction affects the service demands. Hence, considering consumer satisfaction in profit optimization problem is necessary. However, few existing works take consumer satisfaction into consideration in solving profit maximization problem, or the existing works considering consumer satisfaction do not give a proper formalized definition for it. To address this problem, we use the definition of consumer satisfaction leveraged from economics and develop a formula to measure consumer satisfaction in cloud. And then, how cloud configuration affects consumer satisfaction and how consumer satisfaction affects the profit of cloud service providers are analyzed. Based on these works, a profit maximization problem considering consumer satisfaction is formulated and solved such that the optimal configuration is obtained.

A. CONSUMER SATISFACTION LEVEL

Consumer satisfaction is an important factor that should be considered in a service market, i.e., cloud computing, which is a measure of how products and services supplied by a company meet or surpass consumer expectation [9, 10], and it directly affects the number of consumers of a company, and the profit consequently. In general, the overall consumer satisfaction level of a company is an accumulation of the satisfaction values of all consumers.

Based on the definition of consumer satisfaction level in economics, develop a calculation formula for measuring satisfaction in cloud. consumer Analyze the interrelationship between consumer satisfaction and profit, and build a profit optimization model considering consumer satisfaction. A profit maximization model in which the effect of consumer satisfaction on quality of service (QoS) and price of service (PoS) is considered. From an economic standpoint, two factors affecting consumer satisfaction are QoS and PoS. The PoS is determined by cloud service providers. The QoS is determined by the service capacity of a cloud service provider which largely depends on its platform configuration. Under the given pricing strategy, the only way to improve the consumer satisfaction level is to promote the QoS, which can be achieved by configuring cloud platform with higher service capacity. Doing so can affect a cloud service provider from two asides. On one hand, the higher consumer satisfaction level leads to a higher market share, so the cloud service provider can gain more revenues. On the other hand, more resources are rented to improve the service capacity, which leads to the increase of costs. Hence, the ultimate solution of improving profit is to find an optimal cloud platform configuration scheme. In this paper, we build a consumer satisfaction- aware profit optimization model and propose a discrete hill climbing algorithm to find the numeric optimal cloud configuration for cloud service providers.

B. M/M/M QUEUING MODEL

The cloud service system is a multi-server system shown in Fig. 2 which can be modelled as an M/M/m queuing model. In the M/M/m model, m is the number of servers, and all servers run at an identical speed s (measured by the number of instructions that can be executed in one



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unit of time). Assume that the inter arrival times of service requests are independent and identically distributed (i.i.d.) exponential random variables, in other words, the arrival requests follow a Poisson process with arrival rate λ .



Fig. 2: The M/M/m Queuing Model.

The execution requirements of the tasks (measured by the number of instructions to be executed) are i.i.d. exponential random variables r with mean r. Since the server execution speed is s, the service times of the requests are also i.i.d. exponential random variables x =r/s with mean x = r/s. Hence, the average service rate, i.e., the average number of service requests that can be completed by a server with speed s in one unit of time, is $\mu = 1/x = s/r$.

C. SERVICE-LEVEL AGREEMENT

In general, the QoS is affected by many factors such as the service time, the failure rate and so forth. However, in this paper, we measure the QoS of a request by its response time for two reasons. First, the service time is easily measured. Second, it gives consumers an intuitive feeling of QoS. For consumers, they do not care how failures are managed when failures occur. They only care whether the task can be completed successfully and how long it takes.

The response times of requests are different from each other due to the changing system workload and limited service capacity, which leads to different QoS and QoS satisfaction. In general, each consumer has a tolerable response time which is related to the execution requirement of its requests. We denote the tolerable response time of a request with execution requirement r by cr/s0, where s0 is be baseline speed of a server and c is a constant coefficient. If the response time of a request exceeds the tolerable value, the consumer feels dissatisfaction about the service, which leads to the degrade of the overall consumer satisfaction of the service provider.

D. OPTIMAL CONFIGURATION

Consumer satisfaction level leads to a higher market share, so the cloud service provider can gain more revenues. On the other hand, more resources are rented to improve the service capacity, which leads to the increase of costs. Hence, the ultimate solution of improving profit is to find an optimal cloud platform configuration scheme. In this paper, we build a consumer satisfaction- aware profit optimization model and propose a discrete hill climbing algorithm to find the numeric optimal cloud configuration for cloud service providers. In this proposed system, an optimal multiserver configuration strategy. Through the optimal strategy, the optimal configuration of multi-server system, i.e., the server size and the server speed can be determined such that the profit of a multi-server system is maximized. Some papers consider the profit problem under different cloud computing environments.

E. CLOUD COMPUTING MODEL

Cloud computing describes a type of outsourcing of computer services, similar to the way in which the supply of electricity is outsourced. Users can simply use it. They do not need to worry where the electricity is from, how it is made, or transported. Every month, they pay for what they consumed. The idea behind cloud computing is similar: The user can simply use storage, computing power, or specially crafted development environments, without having to worry how these work internally. Cloud computing is usually Internet-based computing. The cloud is a metaphor for the Internet based on how the internet is described in computer network diagrams; which means it is an abstraction hiding the complex infrastructure of the internet. It is a style of computing in which IT-related capabilities are

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provided "as a service", allowing users to access technology-enabled services from the Internet ("in the cloud") without knowledge of, or control over the technologies behind these servers.

IV CONCLUSION

In this paper, we consider consumer satisfaction in solving optimal configuration problem with profit maximization. Because the existing works do not give a proper definition and calculation formula for consumer satisfaction, hence, we first give a definition of consumer satisfaction leveraged from economics and develop a formula for measuring consumer satisfaction in cloud. Based on the affection of consumer satisfaction on workload, we analyze the interaction between the market demand and the consumer satisfaction, and give the calculation of the actual task arrival rate under different configurations. In addition, we study an optimal configuration problem of profit maximization. The optimal solutions are solved by a discrete hill climbing algorithm. Lastly, a series of calculations are conducted to analyze the changing trend of profit.

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