Customer-Satisfaction-Aware Optimal Multiserver Configuration for Profit Maximization in Cloud Computing

Abstract

Along with the development of cloud computing, an increasing number of enterprises start to adopt cloud service, which promotes the emergence of many cloud service providers. For cloud service providers, how to configure their cloud service platforms to obtain the maximum profit becomes increasingly the focus that they pay attention to. In this paper, we take customer satisfaction into consideration to address this problem. Customer satisfaction affects the profit of cloud service providers in two ways. On one hand, the cloud configuration affects the quality of service which is an important factor affecting customer satisfaction. On the other hand, the customer satisfaction affects the request arrival rate of a cloud service provider. However, few existing works take customer satisfaction into consideration in solving profit maximization problem, or the existing works considering customer satisfaction do not give a proper formalized definition for it. Hence, we firstly refer to the definition of customer satisfaction in economics and develop a formula for measuring customer satisfaction in cloud computing. And then, an analysis is given in detail on how the customer satisfaction affects the profit. Lastly, taking into consideration customer satisfaction, service-level agreement, renting price, energy consumption and so forth, a profit maximization problem is formulated and solved to get the optimal configuration such that the profit is maximized.

Existing System

cloud computing is the delivery of resources and computing as a service rather than a product over the Internet, such that accesses to shared hardware, software, databases, information, and all resources are provided to consumers on-demand. Customers use and pay for services on-demand without considering the upfront infrastructure costs and the subsequent maintenance cost . Due to such advantages, cloud computing is becoming more and more popular and has received considerable attention recently. Nowadays, there have been many cloud service providers, such as Amazon EC2 , Microsoft Azure , Saleforce.com , and so forth.

As a kind of new IT commercial model, profit is an important concern of cloud service providers. The cloud service providers rent resources from infrastructure providers to configure the service platforms and provide paid services to customers to make profits. 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.

Proposed System

The request arrival rate of a service provider is affected by many factors in actual, and customer satisfaction is the most important factor. For example, customers could submit their tasks to a cloud computing platform or execute them on their local computing platforms. The customer behavior 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 customer satisfaction affects the service demands. Hence, considering customer satisfaction in profit optimization problem is necessary. However, few existing works take customer satisfaction into consideration in solving profit maximization problem, or the existing works considering customer 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 customer satisfaction level of cloud computing.

Implementation

Module description

The modules are:

1.customer satisfaction module

2.M/M/m queuing model module

3.Service-Level Agreement module

4. Cloud Computing module

customer satisfaction module

Based on the definition of customer satisfaction level in economics, develop a calculation formula for measuring customer satisfaction in cloud.Analyze the interrelationship between customer satisfaction and profit, and build a profit optimization model considering customer satisfaction. A profit maximization model in which the effect of customer satisfaction on quality of service (QoS) and price of service (PoS) is considered. From an economic standpoint, two factors affecting customer 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 customer 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 customer 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 customersatisfaction- aware profit optimization model and propose a discrete hill climbing algorithm to find the numeric optimal cloud configuration for cloud service providers.

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 unit of time). Assume that the interarrival 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 . 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 $\mu = 1/x = s/r$.

Service-Level Agreement

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

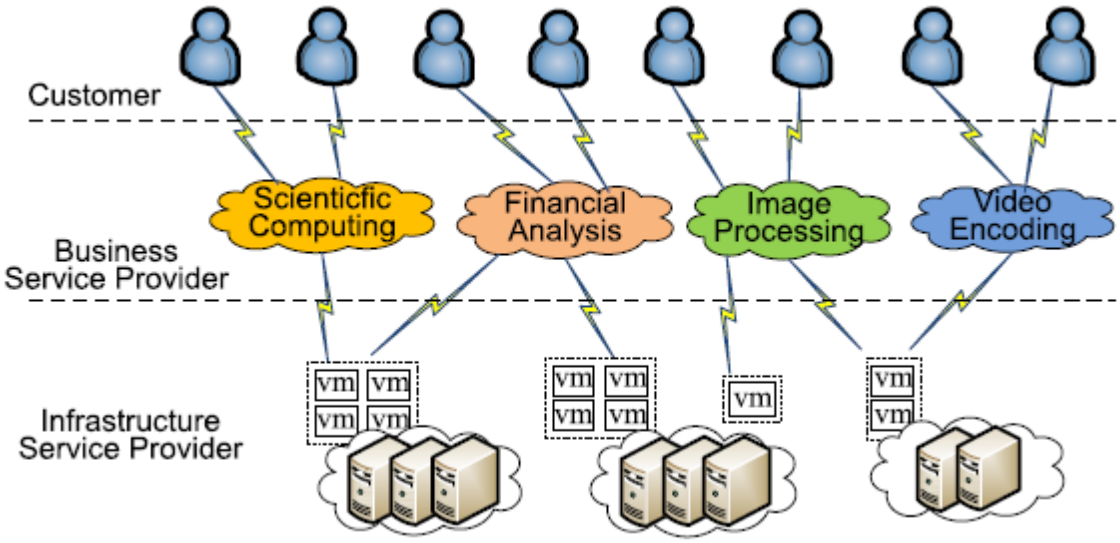
time for two reasons. First, the service time is easily measured. Second, it gives customers an intuitive feeling of QoS. For customers, they do not care how failures are managed when failures occur. They only care whether the task can be completed successfully and how long it takes. The response times 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 customer 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 customer feels dissatisfaction about the service, which leads to the degrade of the overall customer satisfaction of the service provider.

Cloud Computing

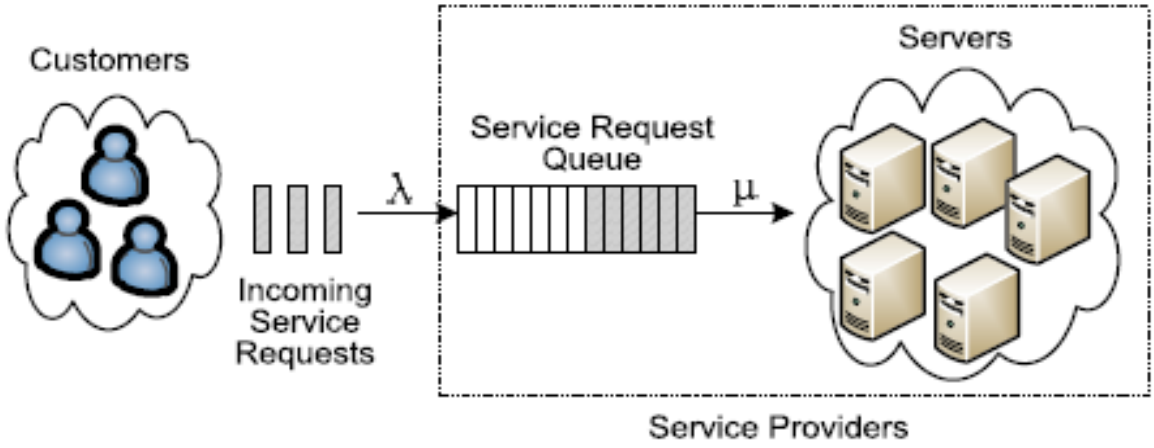
Cloud computing describes a type of outsourcing of computer services, similar to the way in which the supply of electricity is outsourced. Users can simply use it. They do not need to worry where the electricity is from, how it is made, or transported. Every month, they pay for what they consumed. The 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 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.

Architecture



Queuing model



Algorithm Implementation

RSA algorithm

RSA is one of the first practical public-key cryptosystems and is widely used for secure data transmission. In such a cryptosystem, the encryption key is public and differs from the decryption key which is kept secret. In RSA, this asymmetry is based on the practical difficulty of factoring the product of two large prime numbers, the factoring problem. RSA is made of the initial letters of the surnames of Ron Rivest, Adi Shamir, and Leonard Adleman, who first publicly described the algorithm in 1977. Clifford Cocks, an English mathematician working for the UK

intelligence agency GCHQ, had developed an equivalent system in 1973, but it was not declassified until 1997.

A user of RSA creates and then publishes a public key based on two large prime numbers, along with an auxiliary value. The prime numbers must be kept secret. Anyone can use the public key to encrypt a message, but with currently published methods, if the public key is large enough, only someone with knowledge of the prime numbers can feasibly decode the message.[2] Breaking RSA encryption is known as the RSA problem; whether it is as hard as the factoring problem remains an open question.

RSA is a relatively slow algorithm, and because of this it is less commonly used to directly encrypt user data. More often, RSA passes encrypted shared keys for symmetric key cryptography which in turn can perform bulk encryption-decryption operations at much higher speed.

System Requirements

H/W System Configuration:-

Processor	-	**Pentium –III**
Speed	-	1.1 Ghz
RAM	-	256 MB(min)

Hard Disk	-	20 GB
Key Board	-	Standard Windows Keyboard
Mouse	-	Two or Three Button Mouse
Monitor	-	SVGA

S/W System Configuration

- Operating System :Windows95/98/2000/XP
- Application Server : Tomcat5.0/6.X
- Front End : HTML, Java, Jsp
- Scripts : JavaScript.
- Server side Script : Java Server Pages.
- Database Connectivity : Mysql.

Conclusion

In this paper, we consider customer satisfaction in solving optimal configuration problem with profit maximization. Because the existing works do not give a proper definition and calculation formula for customer satisfaction, hence, we first give a definition of customer satisfaction leveraged from economics and develop a formula for measuring customer satisfaction in cloud. Based on the affection of customer satisfaction on workload, we analyze the interaction between the market

demand and the customer 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.

Future Enhancement

A group of calculations are conducted to compare the profit and optimal configuration of two situations with and without considering the affection of customer satisfaction on customer demand. The results show that when considering customer satisfaction, our model performs better in overall.