Research on Charge Pricing Model of New Energy Cloud Service

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Abstract: The new energy cloud aims to help achieve the national clean energy transformation and promote the upgrading of energy transformation production and consumption. Based on China's energy resources and energy transformation needs, as an emerging field, the new energy cloud business model still has a lot of research space. In order to use price leverage to adjust the relationship between user demand and cloud service supply, this paper examines its cloud service pricing model. This paper studies the contract pricing method to make the use of idle resources in the service market more reasonable, improve the utilization efficiency of cloud service resources, and alleviate market pressure. Finally, the purpose of rationally using cloud service resources and optimizing market cloud service resources is achieved.

1 INTRODUCTION

Cloud computing resources are virtualized by a huge number of physical IT resources such as CPU, storage, and network. The amount of tasks the system has to handle is very arduous, and the resources are dynamic and heterogeneous. In the cloud environment, there are a large number of users. In addition, as cloud computing shifts from technology to application, system-based resource allocation can no longer meet business needs. There is an urgent need to use the market as a carrier to study the optimization of cloud services. Therefore, "cloud computing" as a business model, how to schedule resources in the cloud service market efficiently and reasonably, and how to conduct pricing and transaction reasonably to achieve the global optimization of the market has become the focus and difficulty of cloud computing market research (Lin, Su, Meng, Liu, Liu, 2013). Scholars such as Christof Weinhardt proposed two important pricing models: pay-as-you-go pricing model and subscription pricing model. Based on that, Lamia Youssef and other scholars proposed three forms of pricing models, and pointed out that no matter which pricing model, it must adopt at least one form. The three forms are: per-unit pricing, tiered-pricing, and subscription-based pricing (Eason, Noble, Sneddon, 1955, Jose, Calero, Aguado, 2015, Yu, Chen, Li, 2014). In addition, Amazon had also proposed a dynamic pricing form as pricing on-site instances. Typical cloud service providers, such as Google, Amazon, and Microsoft, all adopt these four forms in their pricing mod.

2 PRICING MECHANISM FOR CLOUD SERVICE RESOURCES

Pricing has become an important link in the development of new energy cloud services. Only mature pricing strategies and mechanisms can ensure the commercial realization of the entire new energy cloud service market. Due to the different usage of service resources by users, in order to meet the diverse needs of users, the service resources provided by the market need to be expanded indefinitely and can be obtained at any time by users. Therefore, how to provide users with flexible, diverse and convenient pricing mode has become the key to survival in the current cloud service market. There are many pricing factors involved in the pricing of the cloud service market, and the pricing work is relatively difficult and complicated. Internet has become not only a simple tool for transmitting service information, but also a network tool for

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transmitting computing power in a cloud environment. Pricing is not just pricing for network resources, but involves more pricing factors, which brings new challenges for network resources.

Currently, the pricing mechanism of the cloud service market mainly includes the following: Amazon's EC2 pricing mechanism, and Google App Engine's pricing mechanism. In order to meet the needs of different users, Amazon has developed a flexible and elastic pricing mechanism. Amazon's Elastic Compute Cloud is the largest online retailer on the Internet. Amazon has introduced different billing models based on multiple service instances of cloud service resources. In terms of use, users need to select a virtual machine with corresponding configuration (instance storage space, memory, computing unit, etc.) as the running instance according to their own needs. However, Amazon will generally choose one or multiple running instances at the same time to meet user needs when deploying network programs. In the elastic cloud EC2, users can manage each instance on the cloud platform through the web operation interface. The instance payment pricing method generally varies depending on the user's usage. The instance payment method of Elastic Cloud EC2 is hierarchical, which is mainly based on the two aspects of instance type and specification type. Users select the appropriate instance type and specification type according to their own needs. Elastic Cloud EC2 is based on the computing power required to process user tasks and the configuration of the selected virtual machine as the upper limit of the parameters. The EC2 instance types are summarized into the following three categories. It is large-scale, small-scale and medium-sized instance. Amazon sets prices for them according to the above three instance methods, namely contract pricing, on-demand pricing, and spot real-time pricing. The pricing of data transmission mainly considers two aspects: the amount of outgoing and incoming data. The outgoing data is free of charge within the first 1GB flow rate per month, and the subsequent service flow is charged according to the user's actual usage. The more the price, the cheaper it is. The incoming data is priced at a fixed price. There is no charge for data transmission in the internal network, and the price is based on the amount of data in different regional networks. Data storage uses hard drives as the pricing factor, and adopts a comprehensive pricing strategy for duration and usage. Google App Engine implements a flexible and changeable service pricing mechanism. Each service resource is measured and charged according to two parts: a fixed quota and a charging quota, and allows daily users to purchase resources in advance according to their own wishes. The charging quota is the maximum resource usage required by the user daily. The fixed quota is the maximum amount of service resources that each user can obtain on the market set by Google itself.

3 NEW ENERGY CLOUD SERVICE CHARGE PRICING MODEL

In order to formulate a pricing model for the new energy cloud service market. There are three aspects: First, determine the contract and on-demand pricing strategy for new energy cloud services in the electricity market under the condition of maximizing user utility. Second, based on contracts and on-demand pricing to determine the market's optimal pricing strategy according to the maximization of market revenue. Third, according to the actual use of the market, there will be a large amount of idle resources during certain periods of use by users. At this time, it is necessary to study and formulate pricing strategies for spot instances to make reasonable use of these idle resources. Pricing at this time is also seen as an incentive mechanism to adjust users' market service usage behavior, so as to achieve market equilibrium and efficient use of the overall market. The cloud service provider develops and provides available cloud services continuously. On the one hand, the resources that constitute the service requires cost expenditure; on the other hand, because the provision of resources or services is in order to profit, the provider will charge a certain fee to users for resources or services. Here, the resource is the basic module that constitutes the service, which is controlled and managed by the provider. Providers combine different resources into different performance levels of services in a variety of ways and provide them to customers. For customers, they use services, resources are invisible to customers, but resources are a key element for measuring service performance and the level of service it can reach. Therefore, customers sometimes have to pay a certain fee in order to continue to rent and obtain the qualification to use the service. Moreover, the level and performance of the services obtained are related to the level of fees paid. The higher the cost, the higher the performance and level of the service. The cost paid by the customer depends on the price of the service provided by the provider. The following are several cloud service charging pricing models:

3.1 Pay-As-You-Go Pricing Model

Pay-as-you-go is that customers pay for each unit of resources they use at a stable price, sometimes called pay-for-use. In other words, pay-as-you-go is charged based on the amount of resources actually used by the customer (such as the number of instances, amount of data, or usage time, etc.). The actual amount of resources used can be the total amount of use after a period of time (such as one month, one day, and one hour). During this time period, the price of the resource is stable.

3.2 Contract Pricing Model

The contract price model is that the customer signs a contract (in the form of prepayment) to order a certain service or combination of services at a stable price for a long period of time. By paying an advance payment to order a service, some papers refer to it as an on-demand advance payment. The two pricing models also reflect the characteristics of cloud computing services that can be expanded on demand and flexibly customized. Therefore, the pricing strategy of cloud computing service providers for cloud services is based on these two pricing models.

3.3 Pricing Per Unit

Pricing per unit is the basic form of the pay-as-you-go pricing model, which is usually applied to data transmission services or services that use memory. The provider determines a fixed price per unit of resource or service in advance, and then charges the total service fee based on the total amount used by the customer by multiplying the price per unit by the total amount used. Cloud service providers such as Google, Amazon, and Microsoft charge USD 0.01 per thousand per month for PUT and POST, and charge USD 0.01 per ten thousand per month for GET and HEAD. This is the price per unit, and the units are every thousand times per month and every hundred times per month. Another example is GAE (Google App Engine) which provides APIs with a free quota per application (/app/day) per day, and pricing for parts exceeding the free quota.

Table 1: Table1 Pricing of APIs.

APIs	Free Quota/ app/day	Price beyond Free Quota(US)
Datastore API	50k freeread/ write/small	$0.10/100k write ops $0.07/100k read ops $0.01/100k small ops
Blobstore API	5G	$0.13/G/month
Email API	100 recipients	$0.01/100recipients

Gae APIs takes the form of pricing per unit, and the unit of free quota is per application per day (/ APP / day). In other words, the free quota for daily reading, writing or small operations of the datastore API is 50K; The daily free quota of blobstore API is 5g; The daily free quota of email API is 100 recipients. The units that exceed the free quota are different. For example, the datastoreapi charges $0.1 per 100k write operation, $0.07 per 100k read operation and $0.01 per 100k small operation. Its unit has become x operation per 100k (x refers to read, write and small), which is different from the free quota unit (every day). As for the charge per "write" operation, it is higher than that per "read". This is generally because "write" consumes more storage devices than "read", and "write" is more difficult to achieve than "read", which takes a long time and occupies more resources. Therefore, the cost of "write" operation is usually higher than that of "read" operation. When the blobstore API exceeds 5g per day, it will charge us $0.13 per g per month, and the unit will become per g per month (/ g / month). It will be charged in natural months after the total amount is accumulated. After the email API receives more than 100 recipients per day, it will charge us $0.01 for every 100 recipients, and its unit will become every 100 recipients (/ 100recipients). It is the same unit of measurement for the same resource / service, but the free quota is different from the unit of measurement after exceeding the free quota, which shows that the pricing per unit is a relatively flexible and simple pricing form. It allows users to flexibly customize the size of resources and the pricing method of resources according to specific application requirements, which is suitable for customers who need to frequently adjust and calculate the scale of resources. Customers don't have to think too much about the troublesome it resource purchase plan, and can break up the large cost of one-time purchase of resources into the scattered cost of multiple purchases.

3.4 Tiered Pricing

Tiered pricing refers to the provision of cloud resources to customers in the form of several different levels, and different prices are set for different levels of resources. The level of resource mapping to the customer is the level of service. Service Level (Service Level) is a set of expected and implicit quality of service. The resources of each level provide the same and fixed computing power or storage capacity to customers in the service level. The higher the level, the higher the quality of services such as the quantity and performance of resources, and the different prices. Provider ’ s tiered pricing is a combination of resource tiered and per-unit pricing. Classification is to classify the performance or total amount of resources or services, and the price per unit is the price of resources or services within each class. Pay-as-you-go pricing models also often use this pricing form. The storage services, computing instances, and data transmissions in Google, Amazon, and Microsoft cloud services all adopt hierarchical pricing to provide customers with different levels of services and charge different fees based on the total amount of resources used by customers. For example, the computing instances provided by GCE (Google Compute Engine) have four levels: small, medium, large, and super large. The quality of service achieved by each level is gradually improved, that is, the configured virtual kernel, memory, and hard disk gradually expand per unit.

The resources configured by GCE for the small instance level are 1 virtual kernel, 3.75gb memory and 420gb hard disk. This level is equivalent to 2.75x gceu. The price of small instances is US $0.145 per hour. If calculated in units per gceu per hour, one small instance is equivalent to 2.75 times of gceu, and the price per gceu per hour is US $0.053. Therefore, the cost of using small instances per hour is US $0.053 * 2.75 = US $0.14575. Generally speaking, the measurement of instance computing power is nothing more than the number of cores or the general measurement of CPU, memory, hard disk and other industries. However, sometimes cloud service providers will specially formulate their own measurement units to measure instance computing power for internal use, such as Google's gceu and Amazon's ECU (ec2compute unit). The customer can measure the computing power of the instance according to the general measurement of the industry, or the computing power of the instance according to the supplier's own measurement unit. When the provider provides its own measurement unit to the customer, the provider may price its own measurement unit per unit, such as US $0.053 per gceu per hour. Of course, the two pricing units can be converted to each other, and the final calculated rate must be consistent (one small instance can be converted to 2.75 times of gceu; the rate for small instances is 0.145 per hour, and the rate after gceu is converted to small instances is US $0.14575. The error between the two is 0.00075, and the rate is basically the same.) therefore, in terms of classification, GCE is divided into four levels: small, medium, large and super large. In terms of measurement units, GCE has two measurement units. One is the standard measurement unit commonly used in the industry, namely, the number of cores, memory, hard disk, etc; The other is a self-defined unit of measure, gceu. In terms of pricing units, GCE also divides into two kinds of units of measurement. One is the unit of measurement combining grade and service time (US $0.145 per hour for small instances, US $0.29 per hour for medium instances, US $0.58 per hour for large instances and US $1.16 per hour for super large instances). This is a typical hierarchical pricing method combining resource grading and per unit pricing; The other is the measurement unit ($/ gceu / hour) combining gceu and usage time, which is the basic pricing method per unit and has nothing to do with the classification of resources.

3.5 Scheduled Pricing

Scheduled pricing is a relatively preferential price (relative preferential refers to the price per unit pricing and tiered pricing) established by the provider for customers to book a certain consumption level of service. Of course, there is a prerequisite for the relative discount, that is, the customer needs to pay a deposit (or reservation) in advance, and the provider can specifically reserve the lease of resources for the customer. Since reservation pricing does not accurately measure the actual use of resources and services by customers, On the one hand, providers may suffer losses due to underestimation of the actual usage of resources used by customers. On the other hand, the provider may overestimate the actual use of resources, making the resources underutilized, resulting in inefficient use of resources。However, because the provider shows the customer a relatively favorable price model for the reservation form, it has become the most widely used reservation pricing model that attracts customers. At the same time, reservation pricing combines the strategy of per-unit pricing and hierarchical pricing, dividing resources and services into different levels, determining the prepayment of each level, and tiered pricing. Cloud computing is considered to be a business model for the delivery of new IT resources. Due to it is a new business service that its price largely determines the extent to which the service attracts customers, and thus determines the provider's competitive advantage. In order to compete for the huge benefits brought by cloud computing, various cloud computing providers have launched a "price war". Providers constantly adjust the price level of services according to market reflections, competitors ’ actions, their own expectations, etc., constantly launch new service models and new pricing methods to meet customer service needs to a greater extent. Keep existing customers and attract new customers to compete with competitors.

4 OPTIMAL PRICING METHOD FOR NEW ENERGY CLOUD SERVICE MARKET-CONTRACT PRICING METHOD

Due to the particularity of new energy cloud services, which provide services for specific objects in specific markets, this paper studies the use of contract pricing methods. The contract pricing strategy refers to charging a fixed service fee to the user during the service time period specified by the user. The fee charged by the market has nothing to do with the user's service resource usage during the service time period. It is a contract that has been signed with the market in advance. Such as monthly pricing method is suitable for the early establishment of the cloud market, under a small number of service users, the cloud service providers in order to expand the number of users and the rapid subsequent occupation as a pricing market used. The monthly pricing method is that the service provider provides a fixed amount of cloud services for users, and a fixed total fee is deducted once a month, and each individual service is no longer separately deducted. In the pricing method of the cloud service market, contract pricing method is very common. It has the following advantages: For cloud service providers, they can take advantage of the obvious lower service price advantage of the initial cloud service market and the relatively low initial construction cost of the cloud service market to provide users with a simple and affordable way to obtain information services. For users, a fixed service can generally be obtained at a relatively suitable price, and the expenditure is relatively fixed, which can stimulate the user's service usage to a certain extent. Under the contractual pricing strategy, maximizing the user’ s personal utility will drive the user to maximize the use of cloud service resources in the market. When all users in the market adopt this kind of contract pricing strategy, it will lead to collective irrational market congestion. Then the quality of cloud service resources provided to users will decrease, and the service time will increase. Therefore, it is necessary to use a price mechanism to reduce the user's usage of cloud service resources, so that the user's usage of service resources is less than its corresponding service resource utilization rate.

Contract pricing method is the most widely used pricing model in the cloud environment for resolving service negotiations with users. It is a model based on a contract mechanism and is often used to manage the exchange of goods and services in the service market. It can help find an appropriate service resource to complete a given user demand task. Service resource consumers (users) publish their budget and time required for task execution through the cloud broker. If the service resource provider is satisfied with the conditions issued by the cloud broker, it will sign an agreement with the cloud broker. The advantage of this model is that if the selected service resource provider (cloud service provider) cannot provide a satisfactory service result, the cloud service resource consumer can choose other capable cloud service resource providers.

5 CONCLUSIONS

This paper studies the contract pricing model in terms of pricing issues in the cloud service market. This model does not require cloud brokers to negotiate with buyers and sellers but directly signs purchase contracts, which greatly simplifies the process of resource invocation and improves the service efficiency of service resources. However, in the actual market billing, there are also on-demand, spot instances, optimal pricing, and cost pricing issues during crowded periods that need to be considered. These issues should combine organically to regulate market supply and demand effectively, so as to improve the market environment.

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REFERENCES

Chuang Lin, Wen-Bo Su, Kun Meng, Qu Liu, Wei-Dong Liu. Cloud computing security: architecture, mechanism and modeling [J]. Chinese Journal of Computers, 2013, 9(6):1765-1784.

Carlos Antunes, Ricardo Vardasca. Performance of Jails versus Virtualization for Cloud Computing Solutions[J]. Procedia Technology, 2014, 5(16): 649-658.

Farrukh Shahzad. State-of-the-art Survey on Cloud Computing Security Challenges, Approaches and Solutions[J]. Procedia Computer Science, 2014, 10(37):357-362.

G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp.529–551, April1955.

Jose M. Alcaraz Calero, Juan Gutiérrez Aguado. Comparative analysis of architectures for monitoring cloud computing infrastructures[J]. Future Generation Computer Systems, 2015, 2(47): 16-30.

Miao Wang, GuiLing Wang, Jie Tian, et.al. An Accurate and Multi-faceted Reputation Scheme for Cloud Computing[J]. Procedia Computer Science, 2014,10 (34):466-473.

Mark Stieninger, Dietmar Nedbal, Werner Wetzlinger, et.al. Impacts on the Organizational Adoption of Cloud Computing: A Reconceptualization of Influencing Factors[J]. Procedia Technology, 2014, (16), 85-93.

M. Conti, S. Giordano, M. May, A. Passarella. From opportunistic networks to opportunistic computing[J]. IEEE Commun. Mag., 2010,48 (9):126–139.

Qiang Yu, Ling Chen, Bin Li. Ant colony optimization applied to web service compositions in cloud computing[J]. Computers & Electrical Engineering, 2014,8(41):18-27.

S.Abolfazli, Z. Sanaei, E. Ahmed. Cloud-Based Augmentation for Mobile Devices: Motivation, Taxonomies, and Open Challenges[J]. Communications Surveys & Tutorials, IEEE, 2014, 16 (1): 337–368.

Wang Yi-Jie, Sun Wei-Dong, Zhou Song, Pei Xiao-Qiang, Li Xiao-Yong. Key Technologies of Distributed Storage for Cloud Computing[J]. Journal of Software. 2012:23(4): 962-986.