International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 07 | Oct-2015 www.irjet.net p-ISSN: 2395-0072

Dynamic Solutions by Optimize Fine-grain Pricing Scheme

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Abstract - ***In Cloud computing there are various types of pricing scheme proposed that are pay-as-you-go and subscription spot policy in cloud computing but it is still suffer from wasteful payment because of coarse-gained pricing scheme. In this paper, we implement an optimized fine-grained pricing scheme for those two strong issues are addressed: (1) the benefit gained by provider and customer must contradict mutually (2) VM- maintenance overhead like startup cost is often too huge to be neglected. Not only can we gain a best charge in the suitable price choices that satisfies both customers and providers at the same time, but we also calculate a best-fit billing cycle to increase social welfare (i.e., the total of the charge reductions for every customers and the income gained by means of the provider). We carefully calculate the proposed optimized fine-grained pricing scheme by way of two extensive real-world constructions that is DAS-2 and Google. We calculate the difference between coarse-gained pricing and our proposed optimized pricing scheme and find that the customer and provider both get benefit of it.***

Keywords—Cloud Computing, IaaS, Pricing Scheme

1. INTRODUCTION

Cloud computing is Internet based computing in which larger groups of remote servers are networked to allow the centralized data storage, and on-line access to computer services or resources. Cloud computing is a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications. Basically a step on from Utility Computing a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform). Using the Internet for communication and transport provides hardware; software and networking services to client's .Clouds can be classified as public, private or hybrid. A Cloud computing provides different types of services in which Infrastructure as a Service (IaaS) is type of service. Infrastructure as a Service (IaaS) is a form of cloud computing that provides virtual computing resources over the Internet. IaaS is one of three main categories of cloud computing services, alongside Software as a Service (SaaS) and Platform as a Service (PaaS).In Amazon EC2, for example, the smallest pricing time unit of an on-demand instance is one hour [2]. Such a coarse-grained hourly pricing is likely to be economically inefficient for short-job users.

In general, there are two serious issues in deploying and provisioning virtual machine (VM) instances over IaaS environment, refined resource allocation and precise pricing for resource renting. Refined resource allocation is usually implemented by deploying VM instances and customizing their resources on demand, which impacts the performance of VMs to complete customers' workload. Precise pricing is also known as Pay-as-you-go, which involves multiple types of resources like CPU, memory, and I/O devices. Pricing is a critical component of the cloud computing because it directly affects providers' revenue and customers' budget.

An appropriate pricing scheme which can make both providers and customers satisfied is becoming a major concern in IaaS environment. In Amazon EC2, for example, the smallest pricing time unit of an on-demand instance is one hour. Such a coarse-grained hourly pricing is likely to be economically inefficient for short-job users. For instance, users have to pay for full hour cost even their jobs just consumed the resources with a small portion (such as 15 minutes) of the one-hour period. Such a phenomenon is called *partial usage waste*, which appears very often as cloud jobs are quite short in general. Based on the recent characterization of Cloud environment versus Grid systems, cloud jobs are usually much shorter (such as dozens of minutes) than Grid jobs (such as dozens of hours or days). This will induce serious partial usage waste issue. The current hourly pricing scheme probably induce idle charged resources especially for short jobs, while the fine-grained pricing scheme not only makes users pay less but also makes provider gain more due to the optimization of unit price for the same service time and more users served.

2. RELEATED WORK

From that we are surveying that pricing scheme designed for IaaS cloud platform are implemented from various point of view and considering various types of issues. In paper [1], to design a resource allocation algorithm with high prediction-error tolerance ability, also minimizing users payments subject to their expected deadlines. In paper [2], Infinite horizon revenue maximization framework to tackle the dynamic pricing problem in an infrastructure cloud. The technical challenge compared to previous pricing work is that prices are charged on a usage time basis, and as a result the demand departure process has to be explicitly modeled. An average reward dynamic program is formulated for the infinite horizon case. Its optimality conditions and structural results on optimal pricing policies were presented. They showed that the relative rewards as well as the optimal price exhibit monotonicity, which is resonant with previous result. In paper [3], Semi elastic cluster (SEC), a new execution model for HPC in the cloud that manages variable-size clusters to be shared by many users within an organization. This model brings new roles to traditional batch job scheduling algorithms, by incorporating resource provisioning and management problems into parallel scheduling. From our design and evaluation, we argue that SEC can potentially become a viable alternative to organizations owning and managing physical clusters. In addition, found that by performing load aggregation and instance reuse simultaneously, SEC can deliver significantly better cost-effectiveness without hurting user experience, compared to using the standard on-demand cloud clusters. In paper [4] investigate some of the ways in which data can be managed for work flows in the cloud. In paper[5], analyzed the relationship between the VM startup time and different factors, extract useful information, compare the performance across three cloud providers and make recommendations whenever possible. Updated performance results periodically. In paper [6], aim at optimizing fault-tolerance techniques based on a check pointing/restart mechanism, in the context of cloud computing. In paper [7], by analyzing the spot price histories of Amazon's EC2 cloud they engineer how prices are set and construct a model that generates prices consistent with existing price traces. They would especially like to sell the capacity of machines which cannot be turned off and have higher overhead expenses. Clients might be enticed to purchase this capacity if they are provided with enough incentive, notably, a cheaper price. In paper [8] Set of bidding strategies to minimize the cost and volatility of resource provisioning. Essentially, based on this model, we are able to obtain an optimal randomized bidding strategy through linear programming. Using real Instance Price traces and workload models, we compare several adaptive check pointing schemes in terms of monetary costs and job completion Time and evaluate our model and demonstrate how users should bid optimally on Spot Instances to reach different objectives with desired levels of confidence. In paper [9], Design, develop, and simulate a cloud resources pricing model that satisfies two important constraints: the dynamic ability of the model to provide a high satisfaction guarantee measured as Quality of Service (QoS) from users perspectives, profitability constraints from the cloud service providers perspectives .In paper[10],they propose two solution methods based on the best-reply dynamics and prove their convergence in a finite number of iterations to a generalized Nash equilibrium. In particular, we develop an efficient distributed algorithm for the run-time allocation of IaaS resources among competing SaaS providers. And demonstrate the effectiveness of our approach by simulation and performing tests on a real prototype environment deployed on Amazon EC2. Results show that, compared to other state-of-the-art solutions, our model can improve the efficiency of the Cloud system evaluated in term of Price of Anarchy by 50-70%.

3. SYSTEM DESIGN

Optimized fine-grained fair pricing scheme are implemented by taking into account the two important things that are VM maintenance overhead, and find a best-fit billing cycle to reach the maximized social welfare (i.e. the sum of the cost reductions for all customer and the revenue gained by the provider).to optimize the fine-grained pricing scheme by proposing three algorithms with regarding to VM- maintenance overheads: computing maximum user-accepted price and computing minimum provider-accepted price and maximizing the social welfare. With these three algorithms, one can easily find state satisfying both users and providers as long as the final price is set in the acceptable pricing range.

3.1 Resource pricing scheme:

The existing classic IaaS cloud pricing schemes, and then analyze the partial usage waste issue, and finally formulate our optimized fine-grained pricing model by taking VM maintenance overhead into consideration. Our main objective is to satisfy both customers and providers, and reach maximum social welfare meanwhile. In recent times, the pricing schemes broadly adopted in IaaS cloud market can be categorized into three types: pay-as-you-go offer, subscription option and spot market. Under the pay as-you-go scheme, users pay a fixed rate for cloud resource consumption per billing cycle (e.g., an hour) with no commitment. On-Demand Instances are often used to run short-jobs or handle periodic traffic spikes. In the subscription scheme, users need to pay an upfront fee to reserve resources for a certain period of time (e.g., a month) and in turn receive a significant price discount. The billing cycles in the subscription scheme are relatively long compared to the pay-as you- go scheme, and can be one day, one month, or even several years. Therefore, it is suitable for long-running jobs (like scientific computing).

3.2 Fine Grained Model:

We propose a novel optimized fine grained pricing scheme to solve the above issues. The objective of our work is two-fold, with regard to the classic coarse-grained pricing scheme and inevitable VM-maintenance overhead. On one hand, we aim to derive an acceptable pricing range for both customers and providers, and also derive an optimal price that satisfies both sides with maximized total utility. On the other hand, we hope to find a best-fit billing cycle to maximize the social welfare related to both sides. There are three key terms in our fine-grained pricing scheme: *resource bundle*, *time* granularity together is the resource bundle. The time granularity is one hour and the unit price is equal to $0: and unit price. The resource bundle serves as a kind of container to execute task workloads based on user demands. The time granularity is defined as the minimum length in pricing the rented resources. The unit price specifies how much the user needs to pay per time granularity for the resource consumption. We give an example to illustrate the above terms. In Amazon EC2's pay-as a small on-demand VM instance (Unix/Linux usage). In this example, the VM instance which bundles CPU, RAM, data storage and bandwidth 044. As another example, in Cloud Sigma, the resource bundle is not an instance but just some type of resource like CPU or RAM. Cloud Sigma does not bundle them together but allows customers to finely tune the combination of resources on demand exactly. Our work focuses on the time granularity and the unit price, aiming to implement an optimized fine-grained pricing scheme with regard to VM- maintenance overhead like VM boot-up cost. For simplicity reasons, the cloud resource bundle mentioned in our paper is referred to as VM instance similar to EC2 on-demand instance.

3.3 Coarse Grained Model:

The objective of our work is two-fold, with regard to the classic coarse-grained pricing scheme and inevitable VM-maintenance overhead. On one hand, we aim to derive an acceptable pricing range for both customers and providers, and also derive an optimal price that satisfies both sides with maximized total utility. On the other hand, we hope to find a best-fit billing cycle to maximize the social welfare related to both sides. There are three key terms in our fine-grained pricing scheme: resource bundle, time granularity and unit price. The resource bundle serves as a kind of container to execute task workloads based on user demands. The time granularity is defined as the minimum length in pricing the rented resources. The unit price specifies how much the user needs to pay per time granularity for the resource consumption. We give an example to illustrate the above terms. In Amazon EC2's pay-as you-go option, users need to pay $0:0441 per hour for a small on-demand VM instance (Unix/Linux usage). In this example, the VM instance which bundles CPU, RAM, data storage and bandwidth together is the resource bundle. The time granularity is one hour and the unit price is equal to $0:044. As another example, in Cloud Sigma, the resource bundle is not an instance but just some type of resource like CPU or RAM. Cloud Sigma does not bundle them together but allows customers to finely tune the combination of resources on demand exactly. Our work focuses on the time granularity and the unit price, aiming to implement an optimized fine-grained pricing scheme with regard to VM- maintenance overhead like VM boot-up cost.

3.4 Cloud Time Allocating:

The designed optimized fine-grained pricing scheme should also satisfy providers, yet providers may suffer higher overhead due to finer pricing rates. In the classic coarse-grained pricing scheme, the provider will suffer *To* to manage VM instance every one hour service. In the optimized fine-grained pricing scheme, the provider may suffer higher overhead due to more frequent context switch among VM instances. We use an example to highlight the difference between the two pricing schemes in Fig. 1. Obviously, the provider will suffer higher loss of payment in the second pricing scheme with finer granularity due to more frequent VM overheads appearing in the whole service time.

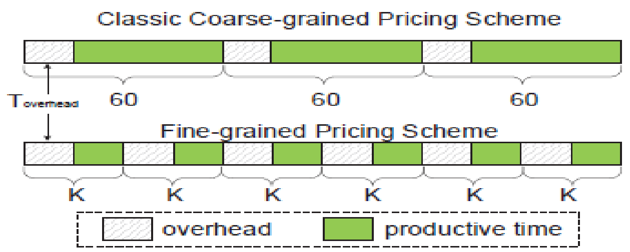

Fig. 1: Service time analysis between two pricing schemes.

4. CONCLUSION

The proposed optimized fine grained pricing scheme recognize, learn and provide dynamic solution to reduce the partial usage waste problem in cloud computing by analyzing its implication with real-world traces. We intend an optimize fine-grained pricing model to resolve the partial usage waste problem, with regard to the predictable VM maintenance in the clouds, and discover a best-fit billing cycle to exploit the social welfare. By applying the functional premise in finances, we originate an optimal price to assure equally customers and providers with maximized total functions. We appraise our optimized pricing model by using two extensive production traces, with association to the standard coarse-grained hourly pricing-model.

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