

OPTIMIZING CLOUD BROKER'S PROFITS IN THE CLOUD COMPUTING INDUSTRY

Mrs.T.Venkata Lavanya ¹, Japala Nikhil (21S15A1205) ², Nukam Karthik (21S15A1202) ³, Chinthalapati Sai Kapil Varma (20S11A1248) ⁴, Devadurga Gurunath (20S11A1247) ⁵,
ASSISTANT PROFESSOR ¹, UG STUDENTS ^{2,3,4,5},
DEPARTMENT OF INFORMATION TECHNOLOGY
MALLA REDDY INSTITUTE OF TECHNOLOGY & SCIENCE,
Maisammaguda, Medchal (M), Hyderabad-500100, T. S

ABSTRACT

Along with the development of cloud computing, more and more applications are migrated into the cloud. An important feature of cloud computing is pay-as-you-go. However, most users always should pay more than their actual usage due to the one-hour billing cycle. In addition, most cloud service providers provide a certain discount for longterm users, but short-term users with small computing demands cannot enjoy this discount. To reduce the cost of cloud users, we introduce a new role, which is cloud broker. A cloud broker is an intermediary agent between cloud providers and cloud users. It rents a number of reserved VMs from cloud providers with a good price and offers them to users on an ondemand basis at a cheaper price than that provided by cloud providers. Besides, the cloud broker adopts a shorter billing cycle compared with cloud providers. By doing this, the cloud broker can reduce a great amount of cost for user. In addition to reduce the user cost, the cloud broker also could earn the difference in prices between on-demand and reserved VMs. In this paper, we focus on how to configure a cloud broker and how to price its VMs such that its profit can be maximized on the premise of saving costs for users. Profit of a cloud broker is affected by many factors such as the user demands, the purchase price and the sales price of VMs, the scale of the cloud broker, etc.. Moreover, these factors are affected mutually, which makes the analysis on profit more complicated. In this paper, we firstly give a synthetically analysis on all the affecting factors, and define an optimal multiserver configuration and VM pricing problem which is modeled as a profit maximization problem. Secondly, combining the partial derivative and bisection search method, we propose a heuristic method to solve the optimization problem. The near-optimal solutions can be used to guide the configuration and VM pricing of the cloud

broker. Moreover, a series of comparisons are given which show that a cloud broker can save a considerable cost for users.

Introduction

Over the past few years, cloud computing has experienced tremendous development [1]. More and more cloud providers have jumped on the cloud bandwagon, and they centrally manage a variety of resources such as hardware and software and deliver them over the internet in the form of services to customers on demand [2]. Thanks to unique properties such as elasticity, flexibility, apparently unlimited computational power [3], and pay-as-youuse pricing model, cloud computing can reduce the requirement of clients for large capital outlays for hardware necessary to deploy service and the human expenses to operate it [4]. Hence, an increasing number of clients are transferring their business to the cloud. One important feature of cloud computing is pay-asyou-use [5, 6, 7], which contains two meanings. First, according to the customer resource demand such as CPU, memory, etc., the physical machines are dynamically segmented using virtualization technologies and provided to customers in the form of virtual machines (VMs), and customers pay according to the amount of resources they actually consumed. Second, the VMs can be dynamically allocated and deallocated at any time, and customers should pay based on how long the resources are actually used. Nevertheless, the pay-as-you-use pricing model is presently only conceptual due to the extreme complexity in monitoring and auditing resource usage [8], and cloud providers usually adopt an hourly billing scheme; in other words, the Billing Time Unit (BTU) of the cloud providers is one hour, for instance, Amazon EC2 [9]. Therefore, the customers should pay for the resources by the hour even if they do not actually utilize the allocated resources in the whole billing horizon [10].

This leads to a waste of resources and raises the cost of customers to a certain degree. In addition, almost all cloud providers provide two main ways to pay for their instances: On-Demand and Reserved Instances [11, 12]. With On-Demand instances, users pay for compute capacity by per hour depending on which instances they run, and they are recommended for the applications with short-term workloads. Reserved Instances provide users with a significant discount (up to 75% in Amazon EC2) compared to On-Demand instance pricing, but customers should rent instances for long periods, e.g., from six months to several years, according to the current plans offered by real cloud providers such as Amazon [9] and Microsoft Azure [13]. Obviously, this discount cannot be enjoyed by the short-term customers. Due to above two reasons, the short-term customers always should pay more than they actually must pay. To reduce cost for this part of customers, we introduce the cloud broker, an intermediary agent between cloud providers and customers. Fig. 1 shows the relationship among the cloud broker, cloud providers, and customers. The cloud broker rents the reserved VMs from cloud providers for long periods with the reserved price and outsources the resources as on-demand VMs to customers for a lower price with respect to the price that the cloud providers charge for the same VMs. A cloud broker can help to reduce the cost of customers from two aspects. First, the cloud broker takes advantages of the price gap between reserved and on-demand VMs, renting the reserved VMs with a good price and outsourcing them as on-demand VMs with a lower price compared with the same VMs provided by cloud providers. Second, the cloud broker adopts a smaller billing cycle (BTU) than the cloud providers. Adopting the two strategies, the resource utilization can be efficiently increased and the customer requests can be accommodated with less cost. In addition to helping customers to reduce their cost, the cloud broker can earn a huge difference in price between the reserved and on-demand VMs [14]. Making profit is one of the main objectives of all enterprises. Hence, in this paper, we focus on how to maximize the profit of the cloud broker, and meanwhile, the customer cost can be reduced efficiently. Like all business, the profit model of a cloud broker in cloud computing is based on two components, namely, the revenue and the cost. For a cloud broker, the revenue is the service charge to users, and the cost is the renting cost paid to cloud service providers. A profit model of a cloud broker includes many considerations, such as the scale (the number of VMs) of a cloud broker system, the customer demand (the rate that requests submitted to a cloud broker),

the renting price (the cost price) that the resources are rented from cloud providers, the selling price (the sales price) that the cloud broker provides resources to users, the BTU, and so forth. To maximize the profit of a cloud broker, we should understand both revenue and cost, and in particular, how they are affected by those factors. The revenue of a cloud broker is determined by two factors, i.e., the customer demand and the sales price. The customer demand is measured by the task arrival rate of the cloud broker in this paper. Under a given sales price, the greater (smaller, respectively) the customer demand is, the higher (lower, respectively) the revenue is. Similarly, under a given customer demand, the higher (lower, respectively) the sales price goes, the more (less, respectively) the revenue can be obtained. Moreover, the sales price has a great impact on the customer demand of a cloud broker. If the sales price of the on-demand VMs offered by the cloud broker are much cheaper compared with the same VMs provided by the cloud providers, more customers are attracted to submit their computing requests to the cloud broker. On the contrary, if the cloud broker raises the sales price of VMs, the customer demand decreases correspondingly. Hence, determining a proper sales price is a key issue for cloud brokers to maximize their profit, which will be calculated in this paper. The cost of a cloud broker is also determined by two factors, i.e., the cost price of resources and the scale of the service system. The cost price of resources is determined by cloud providers. The service system can be modeled as a multiserver system, which consists of many resources (VMs) rented from cloud providers. The system scale determines the service capacity of the cloud broker. A cloud broker with a larger system scale can serve more customers, which can obtain more revenue but generate an increasing cost. Hence, the system scale also should be determined properly such that the profit of a cloud broker is maximized. In this paper, we study the problem of optimal multiserver configuration and resource pricing for profit maximization of cloud brokers. To maximize the profit of cloud brokers, we provide a comprehensive analysis on the profit-affecting factors and formulate an profit maximization problem. By solving the optimization problem, the optimal VM price and system scale can be obtained such that the profit is maximized.

LITERATURE SURVEY

Optimal multiserver configuration for profit maximization in cloud computing

AUTHORS: J. Cao, K. Hwang, K. Li, and A. Y. Zomaya

As cloud computing becomes more and more popular, understanding the economics of cloud computing becomes critically important. To maximize the profit, a service provider should understand both service charges and business costs, and how they are determined by the characteristics of the applications and the configuration of a multiserver system. The problem of optimal multiserver configuration for profit maximization in a cloud computing environment is studied. Our pricing model takes such factors into considerations as the amount of a service, the workload of an application environment, the configuration of a multiserver system, the service-level agreement, the satisfaction of a consumer, the quality of a service, the penalty of a low-quality service, the cost of renting, the cost of energy consumption, and a service provider's margin and profit. Our approach is to treat a multiserver system as an M/M/m queuing model, such that our optimization problem can be formulated and solved analytically. Two server speed and power consumption models are considered, namely, the idle-speed model and the constant-speed model. The probability density function of the waiting time of a newly arrived service request is derived. The expected service charge to a service request is calculated. The expected net business gain in one unit of time is obtained. Numerical calculations of the optimal server size and the optimal server speed are demonstrated.

Above the clouds: A berkeley view of cloud computing

AUTHORS: A. Fox, R. Griffith, A. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, and I. Stoica

Provided certain obstacles are overcome, we believe Cloud Computing has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new interactive Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. They need not be concerned about over-provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under-provisioning for one that becomes wildly popular, thus missing potential customers and revenue. Moreover, companies with large batch-oriented tasks can get their results as quickly as their programs can scale, since using 1000 servers for one hour costs no more than using one server for 1000 hours. This elasticity

of resources, without paying a premium for large scale, is unprecedented in the history of IT. The economies of scale of very large-scale datacenters combined with "pay-as-you-go" resource usage has heralded the rise of Cloud Computing. It is now attractive to deploy an innovative new Internet service on a third party's Internet Datacenter rather than your own infrastructure, and to gracefully scale its resources as it grows or declines in popularity and revenue. Expanding and shrinking daily in response to normal diurnal patterns could lower costs even further. Cloud Computing transfers the risks of overprovisioning or under-provisioning to the Cloud Computing provider, who mitigates that risk by statistical multiplexing over a much larger set of users and who offers relatively low prices due better utilization and from the economy of purchasing at a larger scale. We define terms, present an economic model that quantifies the key buy vs. pay-as-you-go decision, offer a spectrum to classify Cloud Computing providers, and give our view of the top 10 obstacles and opportunities to the growth of Cloud Computing.

Cloud computing and emerging it platforms: Vision, hype, and reality for delivering computing as the 5th utility

AUTHORS: R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic

With the significant advances in Information and Communications Technology (ICT) over the last half century, there is an increasingly perceived vision that computing will one day be the 5th utility (after water, electricity, gas, and telephony). This computing utility, like all other four existing utilities, will provide the basic level of computing service that is considered essential to meet the everyday needs of the general community. To deliver this vision, a number of computing paradigms have been proposed, of which the latest one is known as Cloud computing. Hence, in this paper, we define Cloud computing and provide the architecture for creating Clouds with market-oriented resource allocation by leveraging technologies such as Virtual Machines (VMs). We also provide insights on market-based resource management strategies that encompass both customer-driven service management and computational risk management to sustain Service Level Agreement (SLA)-oriented resource allocation. In addition, we reveal our early thoughts on interconnecting Clouds for dynamically creating global Cloud exchanges and markets. Then, we present some representative Cloud platforms, especially those developed in industries, along with

our current work towards realizing market-oriented resource allocation of Clouds as realized in Aneka enterprise Cloud technology. Furthermore, we highlight the difference between High Performance Computing (HPC) workload and Internet-based services workload. We also describe a meta-negotiation infrastructure to establish global Cloud exchanges and markets, and illustrate a case study of harnessing 'Storage Clouds' for high performance content delivery. Finally, we conclude with the need for convergence of competing IT paradigms to deliver our 21st century vision

Tradeoffs between profit and customer satisfaction for service provisioning in the cloud

AUTHORS: J. Chen, C. Wang, B. B. Zhou, L. Sun, Y. C. Lee, and A. Y.

Zomaya The recent cloud computing paradigm represents a trend of moving business applications to platforms run by parties located in different administrative domains. A cloud platform is often highly scalable and cost-effective through its pay-as-you-go pricing model. However, being shared by a large number of users, the running of applications in the platform faces higher performance uncertainty compared to a dedicated platform. Existing Service Level Agreements (SLAs) cannot sufficiently address the performance variation issue. In this paper, we use utility theory leveraged from economics and develop a new utility model for measuring customer satisfaction in the cloud. Based on the utility model, we design a mechanism to support utility-based SLAs in order to balance the performance of applications and the cost of running them. We consider an infrastructure-as-a-service type cloud platform (e.g., Amazon EC2), where a business service provider leases virtual machine (VM) instances with spot prices from the cloud and gains revenue by serving its customers. Particularly, we investigate the interaction of service profit and customer satisfaction. In addition, we present two scheduling algorithms that can effectively bid for different types of VM instances to make tradeoffs between profit and customer satisfaction. We conduct extensive simulations based on the performance data of different types of Amazon EC2 instances and their price history. Our experimental results demonstrate that the algorithms perform well across the metrics of profit, customer satisfaction and instance utilization.

Energyaware preemptive scheduling algorithm for sporadic tasks on dvs platform

AUTHORS: J. Mei, K. Li, J. Hu, S. Yin, and E. H.-M. Sha

Dynamic Voltage Scaling (DVS) is a key technique for embedded systems to exploit multiple voltage and frequency levels to reduce energy consumption and to extend battery life. There are many DVS-based algorithms proposed for periodic and aperiodic task models. However, there are few algorithms that support the sporadic task model. Moreover, existing algorithms that support the sporadic model lack of functionalities in terms of energy-saving. In this paper, we propose a novel energy-aware scheduling algorithm named Cycle Conserve Dynamic Voltage Scaling for Sporadic Tasks (CC-DVSST) algorithm which is an improvement to DVSST. There is a large amount of time slack in the DVSST scheduling due to the significant difference between the actual execution time and the worst-case scenario. Introducing DVS with EDF, CC-DVSST scales down the voltage of a processor when tasks are completed earlier than they are expected, so that the slack time can be reused for other tasks, hence saving energy. Experimental results show that CC-DVSST can reduce the total amount of energy consumption up to 46% compared to DVSST while retaining the quality of service by meeting the deadlines.

Existing System:

In general, a service provider rents a certain number of servers from the infrastructure providers and builds different multi-server systems for different application domains. Each multiserver system is to execute a special type of service requests and applications. Hence, the renting cost is proportional to the number of servers in a multiserver system. The power consumption of a multiserver system is linearly proportional to the number of servers and the server utilization, and to the square of execution speed. The revenue of a service provider is related to the amount of service and the quality of service. To summarize, the profit of a service provider is mainly determined by the configuration of its service platform.

Disadvantages of Existing System:

- The waiting time of the service requests is too long.
- Sharp increase of the renting cost or the electricity cost. Such increased cost may counterweight the gain from penalty reduction. In conclusion, the single renting scheme is not a good scheme for service providers.

Proposed System:

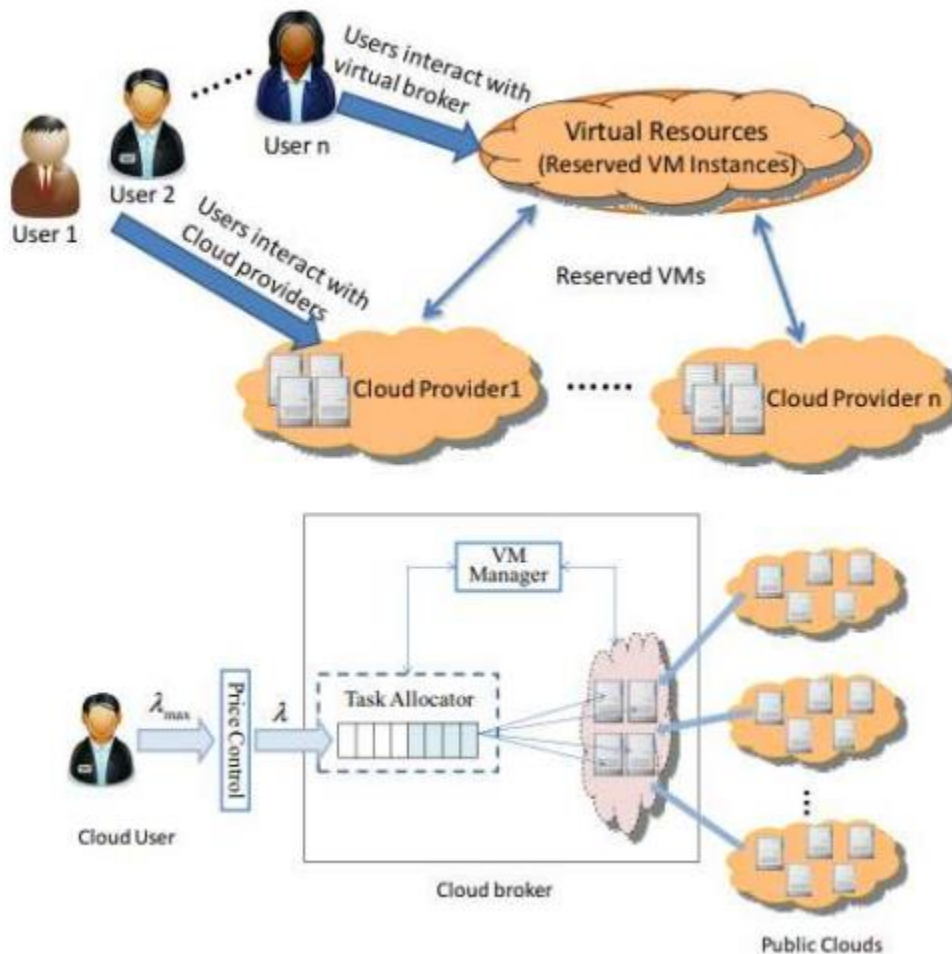
Here we study the problem of optimal multi-server configuration and resource pricing for profit maximization of cloud brokers. To maximize the profit of cloud brokers, we provide a comprehensive analysis on the profit affecting factors and formulate a profit maximization problem. By solving the optimization problem, the optimal VM price and system scale can be obtained such that the profit is maximized. To reduce the cost of cloud users, a novel business role between cloud providers and cloud users, i.e., cloud broker, is introduced. A cloud broker is treated as a multiserver system, which is modelled as an M/M/n/n queuing model. Based on this model, all the profit affecting factors are analysed. A detailed analysis on the relationship between the sales price of VMs and the customer demand is given. Based on the analysis, the expected charge to a VM request is

SYSTEM DESIGN

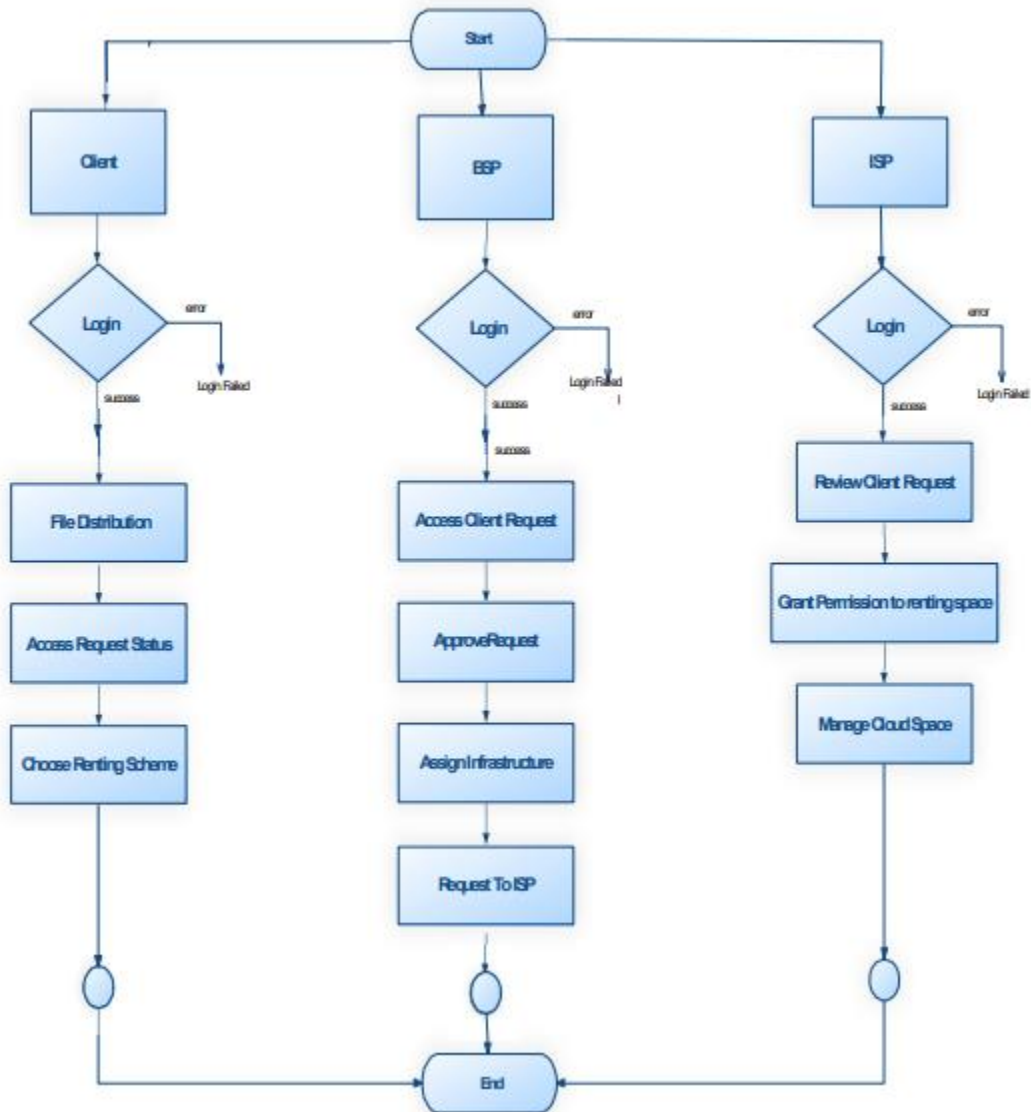
calculated. A series of numerical calculations are conducted, which show that the cloud broker can reduce the cost for cloud users efficiently and yet make a considerable profit at the same time

Advantages of Proposed System:

- Since the requests with waiting time D are all assigned to temporary servers, it is apparent that all service requests can guarantee their deadline and are charged based on the workload according to the SLA. Hence, the revenue of the service provider increases.
- Increase in the quality-of-service requests and maximize the profit of service providers



FLOW DIAGRAM:



HARDWARE REQUIREMENTS:

- System : Intel Core i5 or equivalent
- Hard Disk : 500 GB
- Ram : 16 GB

SOFTWARE REQUIREMENTS:

- Operating system : - Windows 10
- Coding Language : J2EE/J2EE
- Data Base : MYSQL

INPUT DESIGN AND OUTPUT DESIGN

INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded
- The dialog to guide the operating person
- Methods for preparing input validations and

OBJECTIVES

- 1) Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

- 2) It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.
- 3) When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow.

OUTPUT DESIGN

- 1) A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.
- 2) Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

3) Select methods for presenting information.

of an information system should accomplish one or more of the following objectives.

Create document, report, or other formats that contain information produced by the system. The output form

- ❖ Convey information about past activities, current status or projections of the
- ❖ Future.
- ❖ Signal important events, opportunities, problems, or warnings.
- ❖ Trigger an action.
- ❖ Confirm an action.

RESULT

FIG 1 REGISTRATION

The screenshot shows a registration form titled "Registration Form" on a dark blue background with a glowing cloud network graphic. The form includes input fields for "Full_name:", "User name:", "Password:", "E-Mail:", "Mobile:", and "Location:". Below the fields are "Submit" and "Reset" buttons. A green "Register Your Details" button is located in the top right corner of the form area.

FIG 2 CUSTOMER LOGIN

The screenshot shows a customer login form titled "Customer Login" on a dark blue background with a glowing cloud network graphic. The form includes input fields for "Username:" and "Password:". Below the fields are "Submit" and "Reset" buttons. An orange "Customer Login" button is located in the top left corner of the form area.

FIG 3 CLOUD SERVICE PROVIDER LOGIN



FIG 4 INFRASTRUCTURE SERVICE PROVIDER LOGIN



FIG 5 SERVICE AGREEMENT



FIG 6 CLOUD SERVICE PACKAGES

Profit Maximization for Cloud Brokers in Cloud Computing

Cloud Service Packages

Infrastructure Name	Package	Cost	Policy	Request
Amazon AWS	15TB	\$1500	long	CHOOSE PACKAGE
Amazon AWS	3TB	\$300	long	CHOOSE PACKAGE
Amazon AWS	6TB	\$1600	short	CHOOSE PACKAGE
Amazon AWS	24TB	\$2800	short	CHOOSE PACKAGE
DriveHQ	14TB	\$1050	long	CHOOSE PACKAGE
DriveHQ	7TB	\$1300	short	CHOOSE PACKAGE
DriveHQ	2TB	\$150	long	CHOOSE PACKAGE
DriveHQ	24TB	\$2500	short	CHOOSE PACKAGE
Windows Az	5TB	\$100	short	CHOOSE PACKAGE
Windows Az	10TB	\$1000	long	CHOOSE PACKAGE
Windows Az	15TB	\$3000	short	CHOOSE PACKAGE
Windows Az	1TB	\$100	long	CHOOSE PACKAGE

CONCLUSION

In this paper, we focus on the profit maximization problem of cloud brokers. A cloud broker is an intermediary entity between cloud service providers and customers, which buys reserved instances from cloud providers for long periods of time and outsources them as ondemand VMs for a lower price and fine-grained BTU with respect to what the cloud service providers charge for the same VMs. Due to the lower service price and the finer-grained BTU compared with the public clouds, the cloud broker can save much cost for customers. This paper tries to guide cloud brokers on how to configure the virtual resource platform and how to price their service such that they can obtain the maximal profit. To solve this problem, the virtual resource platform is modeled as an M/M/n/n queue model, and a profit maximization problem is built in which many profit-affecting factors are analyzed based on the queuing theory, as well as the relationship between them. The optimal solutions are solved combining the partial derivative and bisection method. Lastly, a series of calculations are conducted to analyze the changing trend of profit and the ratio of user cost savings. In this paper, we adopt the linear price-demand price when we analyze the broker's profit since it is the most common function in real market. Whereas, different cloud markets might show different price-demand relationship.

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