CLOUD COMPUTING AND ITS PRICING SCHEMES

Varun Kamra, Kapil Sonawane, Pankaja Alappanavar

Dept of Information Technology

Sinhgad Academy of Engineering

Pune, India

varun_kamra@ymail.com

Abstract-- **Cloud computing is a rapidly emerging technology which involves deployment of various services like software, web services and virtualized infrastructure, as a product on public, private or hybrid clouds on lease basis. These services are charged by the respective pricing scheme for the cloud. The price varies with the number and type of data structures used for query execution. In this paper we describe static and dynamic pricing schemes for cloud cache. In static pricing scheme the prices are fixed for different resources which remain constant with time. Static pricing scheme does not benefit the service provider because it does not reflect the current market value. The dynamic pricing scheme can adapt as the time changes. According to the demand of a resource the pricing is done in dynamic pricing scheme so as to maximize the profit of the service provider. In addition to this, our paper explains characteristics and the delivery models for cloud computing in short**.

Keywords-- Cloud computing, pricing schemes, query execution, virtualized infrastructure.

I. INTRODUCTION

Cloud computing is quickly emerging as a new model for delivering IT services as value-oriented services on subscription-basis. Cloud computing helps enterprises convert business and technology. Cloud computing is the deliverance of computing as a service rather than a product, wherein shared resources, software, and information are provided to computers and other devices as a metered service over a network. It promotes flexibility and incessant scalability of IT resources that are presented to end users as a service through internet medium.

Developers with inventive ideas for new Internet services no longer require the large funds in hardware to set up their service or the human expense to operate it. Presently, static pricing scheme is being used which has fixed resource usage cost unconcerned about how much a particular type of resource is in demand, which is not profitable for the service provider. Dynamic pricing scheme can adapt itself to time changes, demand of a particular resource and accordingly decide the cost of that resource using the price-demand model [1].

II. CLOUD COMPUTING

Cloud computing can be explained with the help of a simple example. In old days, about 3 to 4 decades ago, all the villagers used to have their own water wells for the purpose of drinking water and for their other daily chores. But nowadays the case is totally different. Today Municipal Corporation has provided taps at every doorstep. So whenever we need water we can simply turn the tap on and use the service. In similar fashion cloud computing services are provided on 24/7 basis. There are a number of well-known cloud service providers like Microsoft, Google and Amazon which are providing services to users anytime and anywhere [5].

Using this technology a firm does not need to buy hardware and a software license every time it hires an employee. Instead, a user's computer only needs to be capable of running cloud computing interface, for example a web browser. A good example of cloud computing would be Yahoo email and Gmail. A user is not required to have a software or server to use them. All they need is an internet connection to start using the services provided by the cloud. Mainly there are three types of cloud computing. First, public cloud whose services are intended to general public either free or by pay-as-you-go scheme. Second, private cloud whose services are directed entirely for a single organization either managed by the organization or by a third party. The third is hybrid cloud which is a composition of two or more clouds where some resources are private and some are provided externally.
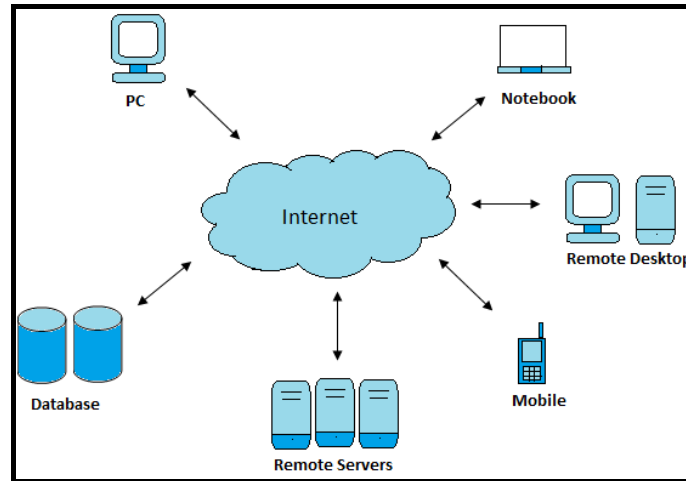
Figure 1. Cloud Computing

A. *Key Cloud Computing Characteristics*

Cloud computing involves resources like software applications, data storage and processing power being accessed on the internet. From common people we can also state that cloud computing is where dynamically scalable, device-independent and task-centric computing resources are obtained over the Internet, with any charges being on a per usage basis [3]. These characteristics are as follows:

1. *Cloud computing is dynamically scalable in nature.*

Dynamic scalability of cloud is because users only use its services according to their requirements. They will not have to spend money for resources which are often idle. And there is also no need for users to wait for completion of complex problems due to lack of processing power. The first supplier of dynamically scalable cloud was Amazon. It provided a service called Amazon Elastic Cloud or EC2. It provided cloud computing services in terms of server 'instance' as per the user requirement. The smallest standard Amazon EC2 server 'instance' is a 1.2 GHz 32-bit virtual processor core with 1.7 GB of memory and 160 GB of storage. This can be provided running either on Windows or Linux.

2. *Cloud computing is independent of devices used.*

Cloud computing is device independent in a way where its resources can be accessed by any computer that has an internet connection with it. By the word computer we mean any sort of computing device be it a laptop, desktop PC ,tablet, smart phone or any other device available, but it should have an internet connection. For example, consider a presentation created in Microsoft PowerPoint is sent to a person on email over the internet. In order to open and operate on it the person must have Microsoft PowerPoint installed on his personal computer on any other device. On the other hand if the same presentation is created using Google Docs then it can be opened and edited anywhere provided that there is internet connection and a web browser available. That's the power of cloud computing.

3. *Cloud computing is task-centric.*

Cloud computing is task centric because it totally depends on the task the user wants to achieved and not on particular software. For example, if a user (say, user 1) wants to edit a document then user 2 will just have to send him a link for that document on the internet. It eliminates the need to install the software to achieve the task to be done. This also means that user does not need to buy the software or pay for its usage. And they don't have to pay anything in the periods where the resources are idle.

4. *Cloud computing costs are not fixed.*

In any kind of business there can be two types of costs involved. The fixed cost is the cost which is independent of the number of people who use the services. On the other hand, the variable cost changes with the number of people using the service and the output levels of the industry. Traditionally, computing involves the cost of building, equipping and maintaining data centers. But as cloud computing is dynamically scalable and

task centric, it has no fixed costs. In fact, all costs are on a per-usage or variable basis. For example Amazon EC2, processing power can be purchased from the cloud on per hour basis. This fact that cloud computing has only variable cost is very useful for small companies. This is because small companies are unable to afford the kinds of sophisticated business applications available to large corporations. The latest types of human resource, project management, customer relationship management (CRM) and other applications can now be accessed from the cloud by any business, large or small.

B. Delivery Models

The National Institute Standard and Technology (NIST) definition of cloud computing defines three delivery models:

1. *Software as a Service (SaaS).*

Software as a service is the delivery of software over the internet as a service. Using this service a user does not require to install any application related to the software on his/her computing device, rather he/she uses it on the cloud. The user can access this service anywhere and anytime over any computing device. Simply, SaaS allows users to run existing online applications.

Examples: Google apps and Microsoft Office Live. Google   apps are providing online document creation and formatting on Google's cloud. It also provides online spreadsheets and PowerPoint creation facilities. These can be accessed anywhere with the help of internet. Microsoft office live provides online versions of MS word, MS Excel, MS PowerPoint which can be accessed over the internet and provide similar functionality as their desktop versions. In addition to this, it also provides 25 GB of free user space

2. *Platform as a Service (PaaS).*

Platform as a service provides a computing environment for the development and deployment of applications over the internet without a need of buying the hardware and software, configuring it for the same purpose. A developer can build an application in this environment, test it and deliver it.

Example: Google app engine, Microsoft Azure. Google app engine allows developers to develop and host their applications on Google's cloud. Microsoft Azure also allows developers to build windows application in Microsoft's environment.

3. *Infrastructure as a Service (IaaS).*

In Infrastructure as a Service provides cloud service providers provide physical or virtualized hardware in the form of storage, servers, network, firewalls and load balancers. This is very useful for small scale businesses as they cannot afford to buy such costlier hardware components.

Example: Go Grid, Amazon Elastic cloud (EC2). Go grid provides network bandwidth for free to cloud users. Amazon also provides server instances to users for hosting their application.

III.   PRICING SCHEMES IN CLOUD

There are a number of different pricing schemes for cloud. Different service providers apply different schemes according to their requirement, to charge cost to users. We are mainly focusing on two pricing schemes for cloud namely static and dynamic.

A. Static Pricing Scheme

This is the simplest pricing scheme which fixes all prices for the whole time horizon .The cloud computing services are highly time dependent, so the time interval of offered service is predetermined. At these time intervals most of the requests arrive. It sets a price vector which contains prices of every resource. As the prices are fixed, the optimization in this pricing scheme is done only once. This is the main drawback of this scheme.

This scheme gives option for pay as-you-go. In pay as you go scheme, the user pays per query and has to pay only for how much resources are used. By resources we mean the different data structures that are employed in

query execution. The cloud uses different data structures to fasten the query execution process. The more the data structures used, the faster the query is executed. As an example, Amazon offers $0.15 for 1GB.

B.   *Dynamic Pricing Scheme*

The aim of cloud cache is to provide effective multiuser querying on the data but at the same time keeping the service provider gainful. In dynamic pricing scheme there are two important criteria to decide the cost of query. The first one is availability. When a user demands something from the cloud, a query is fired to the cloud .If the data is already present in the cache then the query is executed in the cache. If it is not, then the query is executed in the back-end database and the result of the query is brought back into the cache. If data is already present in the cache then less data structure is required to execute the query and hence the cost of such a query is less.

The second important criterion is time horizon i.e. at what time the query is requested. If the query is requested on timing of high traffic then the cost of query execution is more. Since the demand and supply for a particular resource changes over time so, fixed price does not reflect the actual cost in the market. The figure given below illustrates the service provider's loss when using static pricing. There can be two cases. First, under-demand where the supply is more than demand and fixed price is likely to be higher than the price in the market in which case users will look for alternative resources. Second, over-demand where supply is less than demand and fixed price is likely to be less than the price in the market leading to service provider's loss.
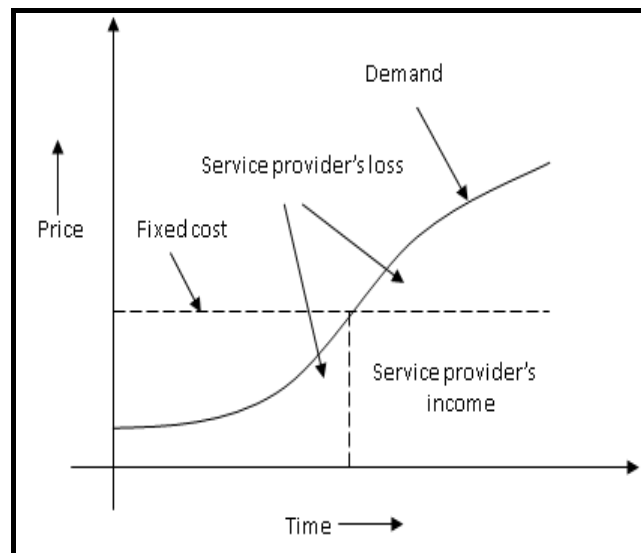

Figure 2. Static Pricing limits service provider's profit [6]

There are certain other factors which need to be considered in dynamic pricing scheme. Though dynamic pricing model does not reject request for lower value fare classes and derive benefit, it tries to adjust prices for every fare class [4]. For example the higher valued class A will ensure maximum availability, while the lower valued class B will provide less availability. This scheme accepts any incoming request that will not exceed cloud resource's remaining capacity, but it will influence the demand by adapting price. In this approach the fluctuation in the demand can be remunerated while simultaneously increasing returns.

In our implementation of dynamic pricing scheme, we have assumed two types of users of cloud. The first one is the premium user who pays some initial amount for better quality of service and the second one is the free user who has free access to the cloud service, but provided lesser quality of service. Assuming Infrastructure as a service in the form of storage of files and retrieval on/from the server, we have considered some unit price for the service. We go on checking the demand for a particular resource in the past hour and the price goes on increasing depending upon the number of hits in an hour for that resource. The price gets multiplied by the demand in previous hour starting from the current time instance. In this way the service provider gets profited. The price also goes on decreasing if there is no demand for the service in past hour.

For the first time when the premium user demands for a resource (file) it gets searched in all the server nodes, the required file is given to the user and its path is saved. So the next time when a different premium user requests for the same file he will be able to download or access it instantly whereas, this is not the case with free users. Every time when a free user asks for a file, the file is searched on all the nodes, retrieved and then given to the user. So obviously there is time span required when a free user downloads a file as compared with a premium downloading it.

IV. CONCLUSIONS

This is the era of cloud computing. The future scope of cloud computing is considerably high. By our explanation we can clearly make out that dynamic pricing scheme is dominant over static pricing which has many disadvantages. Static pricing cannot ensure service provider's benefit since there is always fluctuations in demands of a particular resource and hence fixed price cannot reflect the current market situation whereas, this is not the case with dynamic pricing scheme. By using dynamic pricing scheme a service provider can offer a user to request for different resource types.

REFERENCES

[1]   Verena Kantere, Debabrata Dash, Gregory Francois, Sofia Kyriakopoulou, and Anastasia Ailamaki, "Optimal Service Pricing for a Coud Cache" , IEEE Transactions on Knowledge And Data Engineering, 2011,
[2]   Verena Kantere, Debabrata Dash, Anastasia Ailamaki,"An Economic Model for Self Tuned Cloud Cache", 2009.
[3]   Christopher Barnatt , "A brief guide to cloud computing", Associate Professor of Computing & Future Studies in Nottingham University Business School, April 2010.
[4]   Arun Anandasivam, Marc Premm, "Bid Price Control and Dynamic pricing in Clouds", 17th European Conference on Information System, 2009.
[5]   CSI communications, Volume No. 35, Issue No. 2, May 2011
[6]   Marian Mihailescu and Yong Meng Teo "Dynamic Resource Pricing on Federated Clouds", May, 2010