Cloud Utility Price Models

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Abstract: Cloud Computing's service models have a number of proprietary pricing models as the services has been commoditized to some extent. The SaaS especially so far has been known with a flat price within the usage time. Pricing models need to be more flexible to prevent customers from thinking that paying same price for a service over a period is no more cost effective, in spite of the level of utilization of the service. For Cloud Computing this has to be taken into account. Africans have a business model with peculiarity. In order to expand the acceptability of Cloud Computing to the African market, this peculiarity must be accommodated. This study proposes cloud utility price models to give the Cloud customer the luxury of different usage style and determine a customer specific, individual, most suitable price model. It gives the customer the opportunity to choose a price model for the predicted usage and work within the budget.

1 INTRODUCTION

Cloud Computing has a pay-per-use business model that is remarkably different from previous computing paradigms. There is need for a means to transform the computing services into monetary entities, thus the need for an appropriate Business Model. Typically in Infrastructure as a Service (IaaS) the commodities are CPU power, memory, etc. for each virtual machine (VM). For the Platform as a Service (PaaS) in general the provider is commoditizing the availability per month, used storage per month and used bandwidth. PaaS is considered to be value added virtual instances and is offered bundled together with the infrastructure. For the Software as a Service (SaaS) usage time per month is mostly quantified. This commoditization technique does not really portray the true utility model of SaaS. In the existing models, once a VM is started, the billing starts irrespective of the actual real usage of a Cloud service. It should be distinguished between a heavily used VM and an idle VM. This study proposes an enhanced billing system that incorporates some minute entities for the SaaS. Differential pricing resulted from quantifying this minute entities will portray cloud further as utility service. The paper is organized as follows: After the related work (Section 2) various price models are analysed (Section 3). Section 4 presented the taxonomy of usage items for monitoring in Cloud services. Section 5 presents rewarding models and personalized models. Section 6 shows the technical integration and Section 7 the conclusion.

2 RELATED WORK

Models are tools for expressing business logic and describing customers values (Osterwalder et al., 1998). It is difficult to apply the traditional system centric allocation policy in a highly dynamic and distributed environment. Hence the traditional business model cannot be applied in the Cloud System. Transition from the traditional Software Packaged delivery to Software Delivery as a service in Cloud Computing demands a new Business Model, as illustrated with a Gaming Software firm in (Ojala and Tyrvainen, 2011). In (Chang et al., 2010), Cloud Computing Business Models were classified into eight types and related to a Hexagon Model, which illustrates the sustainability of an organization through the adoption of the right business model. Our study focuses on the pricing models. The commercial success of Cloud computing strongly rests on a cordial business relationship between the provider and the consumer through a good pricing system. In (Teng and Magoules, 2010), an Auctioning Resource Pricing policy allows users to predict the future resource pric-

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ing as well as satisfy budget and deadline constraints without knowing offers from other users to solve the price prediction problem. The study favors the cloud provider. In (Ibrahim et al., 2011) it was established that the prices charged for computation on IaaS is personally and socially unfair. The cost does not account for actual usage and charging is not uniform the users. Hence proposed a new charging scheme for IaaS, where users pay for actual consumption.

3 PRICE MODELS

According to (Rappa, 2004) water, electricity and public transportation employed the metered usage of service business models. While radio, TV, telephone and Internet access uses mainly the subscription model with some metered services for special services. Cloud Computing is often seen as a part of larger development towards long-dreamed vision of society where computing is delivered as a utility (Zhang et al., 2010). The cost of compute power can be calculated by amortizing the capital cost over the lifetime of the system as done in costing electricity systems. The total cost of a cloud service will be a function of capital funds, depreciation, interest rates and system lifetime. In (Jtmaa, 2010) seven categories of cost in a Cloud System are identified, they are: server hardware, software, maintenance, network, facilities, cooling and real estate cost. These cost will be translated to the consumer in two basic categories fixed cost and the variable metered cost. Fixed cost include, startup cost and availability cost, this is synonymous with the access cost. The variable cost is the operational cost, to be determined by the consumption style. According to (Strømmen-Bakhtiar and Razavi, 2011) the metered usage model is applicable to products whose standardized quality is to some extent regulated. Therefore proposed the metering model for IaaS (processing power, storage devices, servers, I/O, other hardware etc). The IaaS costing to include legal cost (e.g court or litigation cost), data restoration and disaster recovery cost (though a limit can be set) and regulatory requirements (location dependent regulations, regular backups). The metered model of the IaaS can have variants like metering plus subscription or fixed basic plus metered price model to allow for flexibility. PaaS is usually bundled with IaaS, so the PaaS cost is incorporated as added value in IaaS. In costing PaaS, customization can be allowed like a free start, billing above free limit and metering price model. The subscription and pay-as-you go model is proposed for the SaaS layer. The subscription can also have considerations for booking in advance and discounts for prepayment. Next is an overview of possible price models:

Static Price Models. Static Pricing is fixed for a period of time, and has a number of flavors.

- Flat fee: Customers pay a flat fee for a service for a fixed price.
- Menu Price: The customer pays a price that is already found on the catalog.

Variable by Market Value Price Models. On the other extreme of the static pricing is a pricing mechanism dictated purely by the market value. This pricing mechanism has a number of variants.

- Haggling or Bargaining: The buyer and the seller dispute the price to finalize on a productive agreement.
- Yield Management: A pricing policy that allows for optimizing profit by anticipating, influencing and forecasting customer behavior (e.g. hotel rooms).
- Auctioning: This offer services for competitive and open bid can either be Forward or Reverse Auction.
- Dynamic Market: This flavor results from continual change in both supply and demand of a product or service. Only allows both buyers and sellers to collectively change price.

Variable by Customer Characteristics Price Models. In another category of pricing mechanism, pricing can be determined by the characteristics of the customers, like the volume consumed and other customer preferences but will not be affected by the market value. This is also implemented in a number of ways.

- Service Bundles: Prices can be set according to the bundling of services features.
- Customer CV: The history of customers patronage can also influence the price for a set of customers.
- Purchased volumes can as well be used to differentiate prices for different customers.

The Customers valuation can also determine the final price of a product or service.

4 TAXONOMY USAGE ITEMS

Clouds have a pay-per use model, which implies the usage monitoring of Cloud resources in clouds essen-

tial. Based on a survey of the monitoring items of e.g. Amazon, GO Grid, RightScale, and Salesforce, a taxonomy of Cloud Use Items has been developed at the level of IaaS, PaaS, and SaaS. From the provider point of view, everything that causes cost is of interest. From the customer point of view business related values are more important.

Use Items in IaaS. Use items in IaaS are categorized in Compute, Storage, Network resources with their attributes (see Table 1). A long way to go is the integration of QoS into the Cloud infrastructure, but has to come, if Clouds want to be successful in business areas.

Table 1: Use Items in IaaS.

Compute Resource	
Attributes	**Explanation**
No of Instances	number of on demand
Type	CPU performance (e.g. MIPS), Memory size, etc.
Time of usage	Typically per hour
OS	Licensing issue
QoS	Snapshot, backup, etc.
Storage Resource	
Attributes	Explanation
Storage Vol.	Volume per month
QoS	Redundancy, backup, etc.
Network Resource	
Attributes	Explanation
Msg transfer	Upload, download, etc.
Components	Need for firewall, routers

Use Items in PaaS. Table II lists the attributes in the service model PaaS, which are not so wide spread as the IaaS ones. Of course all the use items of the IaaS can be taken into account at the PaaS level, but there are additional ones.

Table 2: Use Items in PaaS.

Attributes	**Explanation**
Deployment	Data size, time of the deployment
Database	Volume size, performance issues
Scalability	Min/max limits, speed, etc.
Application development	Support for development, debugging, library support, etc.
Programming language	Type of programming language and possible licensing issues
QoS	Availability., API supp., security

Use Items in SaaS. At present for the SaaS, only the time of usage is being monitored. This study intends to extend the monitored entities to items described in Table 3.

Table 3: Use Items in PaaS

Attributes	**Explanation**
No of user access	More users cause more load
No of transactions	Completed transactions
Usage history	rewarding if experienced customers
Usage period	Daytime or night usage
QoS	Request Response Time, etc.

5 REWARDING MODELS

Exchanging ownership requires methods of setting worth, which is pricing. There is the need to commoditize to a standard level in order to price effectively. Next rewarding models are discussed: Rewarding Loyal Customers: Customer usage history could also be used to initiate a price differential. To retain existing customers, long usage history may be rewarded. This may entice a customer to stay with an old client. Economically, it is cheaper, since e.g. an experienced customer requires less help and most likely has fewer problems to deal with. Rewarding Off Peak Usage: Usage outside off peak period could initiate price differential. Instead of zero utilization of SaaS services in some period, a personalized price for such period might entice some SME users. E.g. discount if the service is used between 10pm and 4am in the morning. Rewarding Completed Transactions: Service provider could give discount for a service that generates more income (e.g completed transactions in an online shop). Rewarding Increased Users: Monitoring the number of users accessing a service implies service specific inspection. It might be used to adjust the charge for the service. E.g. a very active service may have it charge slightly raised to increase revenue for the provider.

5.1 Personalised Model

Each of the above pricing introduces better opportunity for negotiation, thereby introducing flexibility which results in personalize pricing to the Cloud consumer. The user is expected to adhere to the earlier specifications, during the usage the actual usage style is computed by the system to choose the best pricing model. Business models that vary with customer characteristics are known to be thriving in Africa. A typical African is very comfortable with discriminatory pricing. The customer has the feeling of capturing surplus while the seller is also satisfied that a desperate buyer pays more. Customers characteristics are a good means of haggling. Africans are not used to static pricing model. In order to expand the accept-

ability of Cloud Computing to the African market the variable pricing system need be incorporated deeply into Cloud Computing. African buyers enjoy a feel of personalize pricing.

6 INTEGRATION INTO CloudIA

CloudIA (Sulistio et al., 2009) is a private cloud established by HFU to harness the potentials of Cloud Computing for its internal usage and also for Small and Medium Enterprises (SMEs). The CloudIA architecture is based on OpenNebula with extra modules for monitoring, QoS, etc., and special security issues. It has layers: the Business, the System and the Resource layers. The proposed Utility Price Model is incorporated into the Business Layer of CloudIA. As shown in Fig. 1 a customer can access the Utility Price Module through the GUI Interface to specify the price model individually. The boundaries (min/max values) are stored in the Business Templates which have to be maintained by the provider for groups of customers (e.g. well known customers, first-use customers, etc.) The Accounting module, which collects from the Cloud API (e.g. no of running instances) Open Nebula Database (e.g. history data), and from the Cloud Resources itself (e.g. no. of SaaS users).

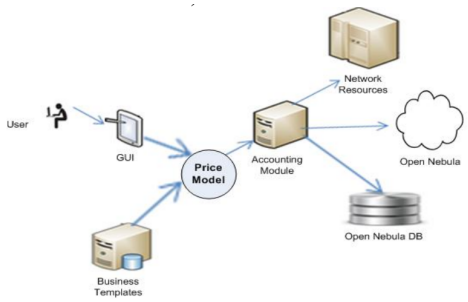

Figure 1: Architecture of the Cloud Utility Model.

7 CONCLUSIONS

Negotiation in form of give-and-take compromise is an essential feature of the African Business; this made static pricing unattractive to a typical African. Customizing Cloud offerings for African involves embellishment of the pricing scheme with negotiation that allows the buyer to personalize pricing. This study proposed price models that accommodates variable pricing, hence attractive to the African markets. It gives the customers the flexibility of choosing a usage style accompanied by a flexible pricing as well. The customer can get better prices if the usage of the Cloud services are predicted and therefore allows the Cloud provider to improve its planning and therefore improve the utilization of the Cloud infrastructure. Effort is ongoing to develop mathematical models for the price models and afterwards employs appropriate simulations to validate the models.

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