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Research paper



An Overview of Pricing Models for Using Cloud Services with analysis on Pay-Per-Use Model

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Abstract

Emergence of Cloud computing in recent years has provided various options to end-users w.r.t. cloud services. Different end users have different requirements for cloud services such as IAAS, PAAS & SAAS, but these services can be availed using different pricing mechanisms such as PPU, PFR, leased based, subscription based and dynamic pricing based on factors such as initial cost, lease period, QoS, Age of resources and cost of maintenance. The authors work focusses on 'pay-per-use' model of cloud pricing by studying various aspects of this model and comparing the current pricing rates of leading cloud service provider. Through this paper, the authors try to analyse the pricing model used by provider by comparing similar pricing offered by competitors. Authors will also try to establish the fairness of pricing as basis for designing better model for such services. The idea of pay per use has emerged to counter the rampant software piracy, while capturing the marginal and heterogeneous users who have been often found to use pirated software, as the acquisition costs for perpetual usage are too high. The marginal usage does not justify the huge capital investment of perpetual license, thereby leading to software piracy. In this paper the authors have also discussed on the Pay per use SaaS model and how it is better than the perpetual licencing, Pay per use is primarily dependent upon certain market conditions, like higher potential for piracy, lower inconvenience costs, majority of marginal users, and strong cloud network presence. Whereas perpetual licensing is important for heavy users, a market having the above-mentioned conditions will always benefit the SaaS pay per use model. So while the developer finds advantages of increased authorized user network, lower costs of marketing, enhanced customer reliability, and lesser impact of piracy, the rewards for users are even greater as they get to use the licensed full & updated versions for a small fee, even for minor everyday usage without incurring the huge expenditure on acquisition.

Keywords : *IAAS, PAAS, SAAS, Cloud Pricing Models, Pay-per-use model*

1. Introduction

In the present computing scenario, use of Cloud or Cloud services has become essential for every user. We use Cloud as an online option for all kind of computing resources. Cloud presents to us a media which works as a viable software, hardware, on-demand, scalable and cost effective alternative for all computing requirements. Idea behind cloud storage and cloud services is to provide a virtual space and storage for end-users where data can be stored and accessed online efficiently at a very high speed with minimal cost. The biggest benefit for any customer is that he can use work with his required software versions and hardware platform without even investing in these requirements. With a simple high speed Internet connection and a cloud service provider, a user can access his choice of resources efficiently.
As defined by Foster et al.[18], Cloud computing is a large-scale distributed computing paradigm that is driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms, and services are delivered on demand to external customers over the Internet. Cloud computing provides a range of services to the end-user based on his requirements, which are commonly categorized as infrstrcture as a service (IaaS), platform as a service (PaaS), Software as a service (SaaS), storage as a service (STaaS), security as a service (SECaaS) and test environment as a service (TEaaS).

All the cloud services are available at a particular price as decided by service provider. Pricing becomes a crucial factor as it not only has to satisfy the revenue requirements of service provider, but also has to play a key role in gaining the consumer loyalty in the market.Many pricing models as offered by service providers fall into two major categories of *fixed pricing* and *dynamic pricing* with schemes like 'pay once for limitless use', 'pay per use', 'pay for resources' etc. There are various pricing models designed by service providers based on various research analysis, but we will be discussing about them in section 2 of this paper. But first in section 1 we discuss about Cloud computing, itsvarious services and their benefits. In section 3, we will also present a detail report on a comparison between these pricing models in reference to what consumers get against their money. In last section we will focus on SaaS and current pricing of three of most popular service providers.

2. Cloud Services

Cloud computing is no longer deemed as technology of the future. Cloud has taken the industry by storm. This includes every organization, small or big, start-up or established, IT enabled or non IT companies, have accepted the importance of cloud in

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development of business with low cost incurred on information technology infrastructure. Cloud services are categorized on the basis of customers' general requirements. For running any IT infra we primarily need three basic services. Hardware like computers of a particular configuration, compatible operating systems on which our servers and database models should work, and our range of software to suit our specific business needs. This whole endeavour needs a considerable amount of investment on all three factors. Cloud computing helps us to lower our business cost by providing all these services to us with small investment and a high speed internet connection.

Various cloud services include IaaS i.e. Infrastructure as a service where we can service providers offer virtual machines to its customers. These virtual machines can be prepared with specific configuration on cloud servers so they become responsibility of service providers' to keep them operational and running. Apart from machines cloud service providers also provide IP addresses, servers, virtual networks, firewalls etc. for client's specific requirements and data sharing. Service providers charge their client on pay per use basis for these equipment. Presently many service providers like [21]AWS, Google Compute Engine, Microsoft Azure, Rockspace and HP.

Platform as a service (PaaS) offers a computing platform to the client like server, programming language, operating system, database etc. this facility is also available on pay per use basis which means it gives complete flexibility to the developer when it comes to changing server, data base, or even compiling code on different platform for testing.

Software as s service (SaaS) is service offered by service providers where any software application is provided by the vendor on cloud and can be operated by the client online. Basic requirements like installing of the application, maintaining it like installing patches and regular upgrade are handled by the provider. What user gets is flexibility, maintenance free use of software which is available anywhere i.e. accessible and compatible with his virtual machine. Major provider in market are AWS, Google Apps, Microsoft 365, IBM, Oracle etc.

Apart from these three basic and most popular services, many more have emerged like storage as a service (STaaS), security as a Service (SEaaS) and test as a service (TEaaS) where a client can use on demand test environment, cost effective data storage etc.

3. Pricing Models of Cloud

Pricing models for cloud are majorly divided into 2 i.e. the fixed pricing and the dynamic Pricing schemes.

3.1 Fixed or Static Pricing scheme:

Each service provider defines the price of the resource, time and the services being provided .This leads to the reduced customer base and decrease in revenue and profits. [13] Also this pricing scheme is purely dependent on the time so the time interval of the offered services is predetermined. [14]This scheme includes the pricing mechanism like the pay-per-use pricing, Subscription based and list price/menu list [15]

i. Subscription based.

This model is the best model under the fixed pricing model technique**,** inthis model the customer havemonthly or yearly fees to access the service. The services opted are active for the subscription period and the service providers give the options for monthly automatic or manual renewals. This payment model is just like we use the subscription model for our Digital Set top Box wherein we are using the services as per our choice but we have to take the subscription of various channels that we wish and pay monthly or yearly to avail the services and if we don't recharge then there is automatic disconnection of the services from the service providers.

ii. Pay-per-reservation.

This is the method where you have to start paying for the services as soon as the consumers start using the service till the service is being used, this is the easiest way to implement for billing. This approach is applicable for the IaaS services where the virtual infrastructure is being used for the stipulated period of time.

iii. Pay-per-use.

This is the method where the customer has to pay for the services that are being used by him either fully or partially. Also there are various service providers that charge for the time when the customers are using the available resources. This model is mostly used in SaaS model.

iv. Hybrid Pricing

This is the combination of the subscription and the pay per use model where the services must be provided in advance for a limited period of time.

v. Consumption based.

This model is based on my actual measurement of the consumption and charged to me depending on the amount of memory, CPU cycles, disk space, network traffic etc. [12]

vi. List price/menu list

It is a fixed price which is often found in the pricing list or the catalogue

3.2 Dynamic Pricing Scheme:

The price under this scheme is calculated on the basis of the demand and supply technique. There is a request that is generated which includes the availability and the time , that query is sent to the cloud and thereafter the pricing is calculated which reflects the real time supply demand relationship and that represents a different pricing strategy which exploits the user payment potentials and thus gains larger profits to the service provider . For instance if the user is using a subscription based pricing model for the mobile services and suddenly the user need to top up his/her data pack he will approach the service provider ad he has to go through the various already prescribed packages which will benefit the service provider in the larger scenario because the user is left with very no other options.

Market Dependent Pricing: [13]

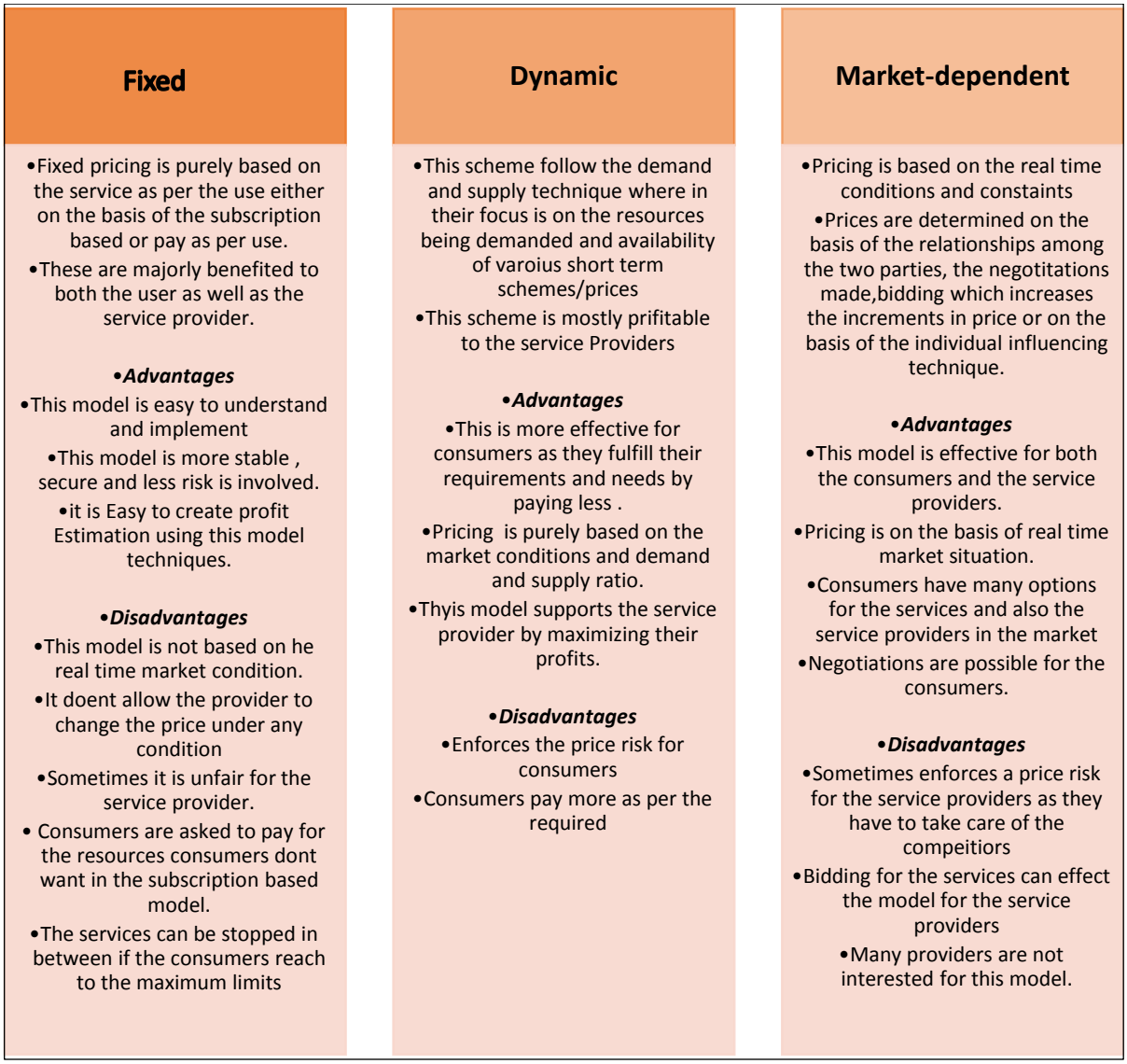
Customer pays depending on the real-time market conditions and constraints. This schemes includes:

Bargaining, the price is determined on the basis of the relationship among the parties involved. Also the requirements among both the parties.

Yield Management, the best pricing policy for optimizing profits is calculated based on real-time modelling and forecasting of demand behaviour [14].

Auction, is a negotiation mechanism which allows both parties to communicate and to agree on the offer. The price is set as buyers bid in increasing increments of price.

Dynamic Market, in that case buyers and sellers determine their price reference, but are not able to influence this price as individual sellers.In this table the authors have mentioned the various features, Advantages and Disadvantages of the Different Pricing Schemes,



In table:1authors have analysed various pricing models with their usability's

Table 1: Pricing Models and their usability

Basis	Fixed Pricing Scheme	Dynamic Pricing Scheme	Market dependent Pricing Scheme
Availability	Available to the users with the pay-per use or subscription based model.	Available on the basis of the demands.	Available on the basis of the relationships among the two parties.
Adaptability	Easy to adapt	Sometimes difficult because of the demand is high the price can be increased	Adaptable only for those who can negotiate and develop good relations with the service providers
Usage	Popular among the companies	Less used as compare to the Fixed pricing model	Rarely used
Profitability	Both the users and the service providers are equally earning the profits.	More profitable to the service providers as they can increase their prescribed rates on the basis of high demands.	Mostly profitable to the service providers and sometimes to the users if they have good relations or good negotiation skills.
Cost effective	Highly cost effective because of Pay per use model	Less Cost effective	Moderate
Beneficial	Highly beneficial to the service providers if they are adapting subscription based model and also beneficial to the users with pay as per use pricing model.	Beneficial to the users as per the requirements only they are demanding for the services and with the time constraints.	Beneficial to both the users and the service providers as they have the fixed and limited customers to whom they have to work with.
User friendly	Less complicated because all the pricing is predefined.	Highly complicated because the users are less loyal and also they might vary around various other service providers	Less complicated because the pricing mechanism is fixed among the two parties only there is no one else who is involved in between
Privacy	Constant Privacy is maintained as the services are owned by the private cloud owners	Some services are maintained with certain privacy protocols	Very less providers provides the privacy feature for the
Security	This model is more secured	This model is less secured because the service provider's do not have the same customers.	This model is having security issues because of varied customers and their services for pricing

In table:2, we discuss the common factors that affect the pricing for different users:-

Table 2: Factors affecting pricing of cloud services

Initial Cost / Investment	This is an initial investment that the service provider spends to buy the resources. This investment is done on the annual basis.
Lease Period / Contract Time	It is the time where the client will have a contract for the resources from the service providers and the service providers offers lower price units for longer subscription.
Quality of Service	This is the factor where the service provider offers Quality for the services. For better Quality the users have to pay high. Also the Quality of service are on the basis of the techniques and technologies provided by the service providers to enhance the users quality of work and experience in terms of the availability , privacy, integrity ,adaptability ,scalability and security has the
Rate of depreciation [3]	It is the cost that service providers has to bear for the hardware that they use and the asset loose its value with time.
Age of Resources	It represents the age of the resources which are given on lease to the different users. As the cost of the old resources will be low as compare to the new ones.
Cost of Maintenance	This is the cost that service providers spends on the cloud hardware's and software's for their maintenance and the installation of the privacy and security algorithms

In the following table (Table 3) authors have tried to prepare a comparative analysis for the Cloud Pricing models based on sixteen models presented by cloud service providers.

Table 3: Comparative Analysis of Cloud Pricing Models

Sno	Model name	Pricing Scheme of Model	Benefits	Effectiveness	Implementation	Maintenance	Pricing	Challenges
1	Pay as you go	Fixed Pricing Scheme	Prices remain constant	Effective to the service Provider as they set the Prices.	This model is implemented for calculating the price for each service	Maintenance is at the client side	Prices are fixed and constant	It is unfair for the client as they might pay more than necessary
2	Subscription based	Fixed Pricing Scheme	Pricing is assigned on the basis of the subscription plan	This model is effective for both the clients and service providers	This model is implemented and effective for both the service provider as well as the client	Maintenance cost is beard by the Clients.	Pricing is done on the basis of the plan being subscribed	Client sometime pay more depending on the subscription plan he is opting for the required services
3	Dynamic Resource Pricing	Dynamic Pricing Scheme	It is used for the federated Cloud and supports various resource types	It can balance the number of successful and the number of allocated resources depending upon the market conditions	Theoretical study is done with some simulation	Maintenance is done at the Service Provider side because they lower down the cost of the resource which are old.	Pricing is Assigned based on the demand and supply of the resources	It is less scalable of high demand in the market
4	Pay-for-resource	Fixed Pricing Scheme	It is benefitted to both the users as well as the service Provider	It is more effective for the client because this model give the opportunity to the clients to utilize maximum resources	This model is implemented for the price calculations	Maintenance is done at the service providers end	Pricing is fixed by the cloud service provider	
5	Hybrid Pricing	Fixed / Dynamic Pricing scheme	This model is more beneficial to the Client	This model is least effective because the of the pricing scheme as it is based on the job queue wait time	This model is implemented because of the limited resources required for certain clients	Maintenance is difficult because of high demands	Pricing is purely on the basis of the job queue wait situation and the pricing is never fixed	Pricing can be highly varied for the same set of resources
6	Dynamic Auction	Market Based Pricing Scheme	This model tolerate fluctuations of user's distributions	This model is less effective	This is under theoretical and simulation process	Maintenance is difficult under this model	Pricing mechanism is based on the truthfulness and dynamic adjustment	This is difficult for the clients , if they do not have good relations with the service providers
7	A double auction	Market Based	Beneficial to the clients as	Effective for the clients as	This model is under theoretical	Maintenance is the service	Flexibility in the pricing	Difficult for Clients to

	Bayesian game-based pricing model	Pricing Scheme	they enables to buy resources from various providers	free resources can be exchanged	study and ready for simulation	providers job	mechanism	choose the best service provider with certain constraints
8	Double sided combinational Auction to Resource and Allocation	Market Based Pricing Scheme and Dynamic Pricing scheme	Both the users and service providers are befitted by the resource allocation mechanism	It is effective when client requires various services and many participants exists	This is under study	Maintenance is difficult	Pricing is calculated on the basis of resource allocation mechanism	This model does not make optimization of energy consumption
9	Pricing algorithm for cloud computing Resources	Dynamic Pricing Scheme	This model is fair for the service provider because it maximises the revenues	It is Effective for the service providers and easy to adapt	This model is used for the study and further review	Maintenance is easy for the service providers	Pricing is on the real time environment	Model is fixed and cannot adapt the changes in the demand and supply market
10	Genetic Model for pricing in Cloud computing Markets	Dynamic Pricing Scheme	This model is biased for the service providers	This model is effective in the market because it achieves high revenues	This model is under study with simulation	Maintenance is difficult	Pricing is based on the real time environment which gives high revenues and stable costing	Difficult in the very high demand conditions and market behaves in the irrational way
11	Value based Pricing	Dynamic Pricing Scheme	It is beneficial for the consumers as this model satisfies the demands of the customers	This is effective because the pricing is on the basis of customers point of view	This model is implemented	Maintenance is done at the service providers end	Pricing is based on the services that are defined depending on the customer's point of view	It is little difficult to implement at the service providers end
12	Cost based Pricing	Market Based Pricing Scheme	Beneficial to the service Providers	This pricing model is effective for the service provider as their objective is to increase maximum profit.	This model is already implemented and functional	Maintenance is don't at the service Providers end	Pricing is done at the service providers End which is easy with an objective to increase the profit	Pricing is done by provider without the customer's influence.
13	Competition based Pricing	Dynamic Pricing Scheme	This model is more beneficial to the clients	This model is effective for clients.	This model is already implemented	Maintenance is at the clients side	Prices are calculated on the basis of Competitor's prices.	This is the model which ignores the cloud customers because their main focus is on the service providers
14	Customer based pricing	Dynamic Pricing Scheme	This model is beneficial to the Clients as they can pay for their needs and requirements	This model is effective for both the providers and customers	This model is successfully implemented	Maintenance is done at the customers end	Prices are calculated on the basis of the need of the customers and this model is more considerate in the cloud computing	This model is less benefitted to the providers because they charge lower Prices than their customers
15	A novel financial economic model	Dynamic Pricing Scheme	This model is beneficial for both customers and service providers	This model is effective in terms of the Quality services provided by the service providers	This model is under theoretical study	Maintenance can be done at the providers ends	Prices are charged for the assets only required by the customers	The main challenge is for the service providers because of the maintenance of the assets provided to the customers
16	Data centre net profit optimization with the individual job deadlines	Market based pricing model	This model is biased towards the service Providers	Model is effective for the providers as they maximise the profits	This model is under theoretical study	Maintenance cost is high	Pricing is based on the service providers and mainly reduces the cost and	This model considers only the static job arrivals and departures which effects

							increases the customer satisfaction	the performances of the customers

4. Comparison of Pay-Per-Use Pricing of Saas Services by Leading Cloud Service Providers

Table 4: Pricing of Microsoft Azure SAAS Services [22]

	Shared	Basic	standard	Premium
Web, Mobile or API Apps	100	Unlimited	Unlimited	Unlimited
Disk Space	1 GB	10 GB	50 GB	250 GB
Maximum Instances	-	Upto 3	Upto 10	Upto 20
Price (Rs, per second basis)	0.86	4.96	6.61	18.18

Table 5: IBM Cloud pricing for SAAS [23]

	Specifications	Memory (MB)	Pricing (USD)
ASP.NET Core	Run one or more apps 375GB hours free	64	0.07 per GB-hour
PHP	Run one or more apps 375GB hours free	64	0.07 per GB-hour
Compose of MySQL	1GB Storage Scales automatically with data Deploys into the IBM Compose public cloud	102	8.00 / 1 – 9 GB 16.20 / 10 – 24 GB 14.40 / 25 – 49 GB 12.60 / 50 – 99 GB 10.80 / 100 – 499 GB 9.00 / 500 – 999 GB 7.20 / 1,000 - 4,999 GB 5.40 / 5,000+ GB

Table 6: AWS Cloud pricing for SAAS: Assuming running IDE for 4 hours per day for 20 days in a month with 30 min hibernation setting [24]

	Amount (USD)	Comments
Compute Fees	1.05	t2.micro Linux instance at $0.0116/hour x 90 total hours
Storage Fees	0.80	$0.10 per GB-month of provisioned storage x 8-GB storage
Total Monthly Fee	1.85	

5. Future Study

In the future study the authors will work on the service provider's model and the various service plan provided by them. Authors will analyse the cost effective organisation which is providing the better services with the cost effective plans on the pay per use pricing model.

6. Conclusion

Authors have tried to compare and present the pricing models offered by cloud service providers to the end-user. These service models are designed to fulfil three potential requirements. Firstly they should provide maximum outcome to user as per their requirement. Secondly, pricing should be competitive enough to let service provider survive in the market. Thirdly, since it is also a business model, pricing should generate some revenue to the service provider. Authors have tried to prepare a comparative analysis on these models and enlisted various advantages and disadvantages of each. We understand that cloud right now seems to be the technology of the future, but the way service providers are charging for various cloud services, hold the key to successful implementation and mass popularity of cloud.

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