

Analysis on Economic Viability of Location Based Cloud

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Abstract: - Computation takes its path from mainframe to Client-server and then from web Application to SaaS Application using web technology and now to Cloud Computing. The cloud computing is classified as Public Cloud, Private Cloud and Hybrid Cloud based on location. The different types of cloud offerings based on the services they provide are IaaS, PaaS and SaaS. We are knowingly or unknowingly using the Cloud Computing from the time we begin to use E-Mails such as Yahoo mail, Google mail, etc. The questions arise for most of us is whether the cloud is beneficial or not from the cloud provider's acuity and from the End-users point of view. To give the solution to these questions we are analyzing the different costs for the usage time of the powerful computer and comparing this cost amount with public cloud and private cloud from the End-users perception. The analysis is done using a mathematical model. Based on the cost and productivity analysis, we are proposing, whether to use a powerful computer or Public Cloud or Private Cloud. Under what condition Cloud is superior to having powerful computers and vice versa. We assume powerful computers may be used by individual users or small to medium size companies.

Keywords: Economics, Public Cloud, Private Cloud, IaaS, PaaS, SaaS, Mathematical Model.

I. INTRODUCTION

The Location based cloud includes public cloud, private cloud and hybrid cloud. In this paper, we are analyzing the cost pricing of public and private with the individual or company owned computer system. Based on the compared result, we conclude which is the best cloud model in terms of cost pricing and in what condition it suits the need of the customer. A private cloud is owned and managed by an organization which uses a cloud model. It is built based on the existing resources and infrastructure present in the organization or new infrastructure is created for building this cloud model. There is also provision to manage and operate infrastructure with the support of third party. Single tenant architecture and on-premise hardware infrastructure are some of the characteristics of private clouds. Public cloud is managed and owned by the independent third-party cloud provider. Many companies such as Amazon, Microsoft and Google, which built their vast infrastructure for their own business development are using this infrastructure for providing public cloud service. Multi tenant architecture and pay-as-you-go are some of the characteristics of public cloud.

Cloud Computing

Cloud computing plays an important role in today's computer world. Different Apps are developed for mobile and applications are developed for Desktop that works on cloud. The main drawback in cloud is the security. [7] Key management should be handled effectively to secure data in the cloud. In our paper realizing the importance of cloud computing we are analyzing cost price of cloud. The analyses are based on the current price of public Cloud, Private Cloud and Powerful In-house server computer.

II. RELATED RESEARCH

In [1] authors analyzed the general cost – benefit analysis of cloud without taking any particular scientific application. In [2] the authors of the paper studied and found that the computation costs overtake the storage cost for their montage application. In [3] the authors studied the S3 of Amazon and concluded that monetary costs are higher than storage costs. [4] The authors in this paper only considered the service-oriented application for quality model and issues related to the service oriented is listed. In [5] the author shows that in-house storage is only 20-50% cheaper than on Amazon S3. In [8] the authors studied through small and

large projects and worked out the cost benefit analysis for cloud and desktop grid and found that the cloud is cheaper at the beginning (about 5 days for small project and about 12 days for large project) but as days passed by the desktop grid costs less than the cloud. In [9] the authors determined the optimal number of resources in working condition and optimal throughput and cost benefit analysis is done only for the allocated resources.

Cost of public Cloud, Private Cloud and In-House Server.

Public cloud providers fix their price based on the virtual hardware they provide to the customers. Virtual hardware is categorized as General purpose, compute optimized, storage optimized, Memory optimized etc. The list of price tag of Amazon EC2 (General Purpose), Google Compute Engine and Micro soft Azure price tags are as follows

Table1: Amazon Ec2 General Purpose

S.no	VCPU	ECU	Memory(GB)	Rate
1	2	6.5	8	\$0.1/hr
2	4	13	16	\$0.2/hr
3	8	26	32	\$0.4/hr
4	16	53.5	64	\$0.8/hr
5	40	124.5	160	\$2/hr

Table2: Google Compute Engine

Sno	VCPU	Memory(GB)	Rate
1	1	3.75	\$0.0475/hr
2	2	7.5	\$0.0950/hr
3	4	15	\$0.1900/hr
4	8	30	\$0.3800/hr
5	16	60	\$0.7600/hr

Table3: Microsoft Azure

S.no	VCPU	RAM(GB)	Temp Store (GB)	Rate
1	1	1.75	225	\$0.08/hr
2	2	3.50	490	\$0.16/hr
3	4	7	1000	\$0.32/hr
4	8	14	2040	\$0.64/hr

The cost involved in building the private cloud is listed as follows.

Table4: Cost of Building the Private Cloud

S.No	Description	Quantity	Price
1	Physical Servers & Vmware Licensing	4	\$82,400
2	Storage Area Networks (SAN)	1	\$28,890
3	Network Switches	2	\$50,958
4	Server Cabinet & PDUs	1	\$2,000
5	Power and Cooling Costs	2496	\$54,000
6	Number of Systems FTEs to manage the environment	1.5	\$337,500
Total			\$555,748

Cost of In-House System

The Hp Density Optimized Server with model No XL170 (1 x Intel® Xeon® E5-2630 v (2.4GHz/8-core/20MB Cache/85Watts) Processor, 32GB DDR3 RAM, Open Bay Hard Disk, SAS/SATA H240 Smart HBA without, Key RAID Controller, Open Bay DVDRW, 1 x HP 1Gb Ethernet 4P 331FLR Adapter, HP iLO (Firmware: HP iLO 4) with 2GB NAND, 3Years 24x7 4Hours Onsite Warrant) costs about \$5797

BTU Value for HP Enterprise Server – 1360BTU/hr

445 W @ 100% utilization of processors

375 W @ 80% utilization of processors

1000 BTU/h is approximately 293W

Approximate energy consumption per year = ((operating hours * watt usage per hour)/1000) * Electricity cost per kWh = kWh * Electricity cost per kWh.

Cooling cost per year = (((operating hours * BTU per hour)*1000 BTU per hour)/1000) * Electricity cost per kWh = kWh * Electricity cost per kWh

Cost Comparison between In-House and Public Cloud

Let us compare the purchasing, operational and maintenance costs of In-House server with the public cloud providers such as Amazon, Google and Microsoft.[5] As In-House server is 8 Core we take the similar hardware for the cost comparison of all the above said cloud providers.

Table5: Amazon Ec2 General Purpose

	In-House Server	Amazon Server
Purchase Cost	\$ 5797	
Cost/hr (3 years)	\$0.22	\$0.4
Efficiency	40%	90%
Cost/Effective-hr	\$0.55	\$0.44
Power and Cool	\$0.02	
Manage-Cost	\$0.12	
TotalCost/Effect-hr	\$0.69	\$0.44

At first it appears in-house is better than Cloud but taking the efficiency factor the cloud costs less than the in-house further adding the management cost , power and cooling costs further lowers the cost of Cloud.

Table6: Google Compute Engine

	In-House Server	Google
Purchase Cost	\$ 5797	
Cost/hr (3 years)	\$0.22	\$0.38
Efficiency	40%	90%
Cost/Effective-hr	\$0.55	\$0.42
Power and Cool	\$0.02	
Manage-Cost	\$0.12	
TotalCost/Effect-hr	\$0.69	\$0.42

Analyzing the above table it is clear the Google cloud is better than In-house.

Table7: Microsoft Azure

	In-House Server	Microsoft
Purchase Cost	\$ 5797	
Cost/hr (3 years)	\$0.22	\$0.64
Efficiency	40%	90%
Cost/Effective-hr	\$0.55	\$0.71
Power and Cool	\$0.02	
Manage-Cost	\$0.12	
TotalCost/Effect-hr	\$0.69	\$0.71

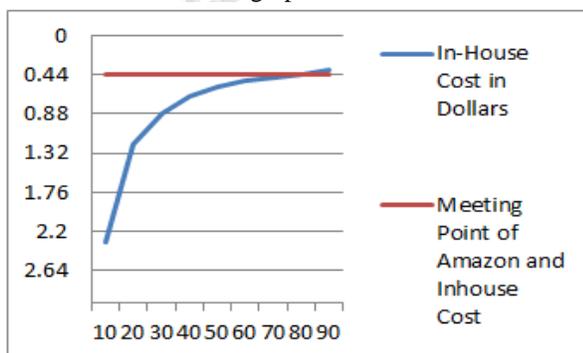
The above table shows that the in-house is better than Microsoft Azure Cloud but Microsoft provides many discounts for its customers. It also provides vast storage system. In the in-house there is no vast storage. Further in Google App Engine merely deploying the application costs nothing but when usage increases above the free usage charges begin to be incurred.

Comparison of In-house Cost relative to efficient utilization of hardware with the public Cloud

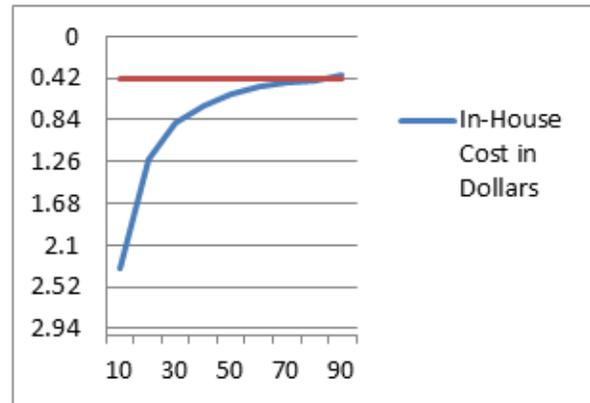
Table8

Efficient utilization of resources in percentage	In-House Cost in Dollars
10	2.33
20	1.23
30	0.87
40	0.69
50	0.58
60	0.51
70	0.47
80	0.44
90	0.38

If we analyze in terms of efficient utilization of hardware, in-house price overtakes the price of cloud under certain efficient utilization of hardware. In the case of Amazon and Google public cloud In-house price overtakes the price of Cloud at about 80% utilization of hardware. This can be illustrated as stated in the graph below



Graph1: In-house and Amazon comparison



Graph2: In-house and Google comparison

Cost comparison between public cloud and private cloud

The In-house costs more than Cloud due to under utilization. The utilization can be improved through automatic provisioning and virtualization Technology built in private cloud.

The cost of building the private cloud is about \$555,748 (@21.16/hr) for building the system with 4 physical servers. Only maintenance cost will be bared by the company after 3 years as it will be owned to the company which built the private cloud.

Let us also compare costs incurred in a private Cloud versus public cloud. [5] For an in-house data center of private cloud the hardware should be purchased to meet the peak demand. In public cloud resources are allocated based on the demand. Now the cost analysis between public and private cloud is based on the provisioning of resources.

The virtual capacity needed at time is

$$V(t) = D(t) + \delta dD/dt \dots\dots\dots 1$$

The Total virtual capacity provisioned over a time interval T is therefore

$$V = \int_T (D(t)dt + \delta dD/dt) = DT + \delta(D_{max} - D_{min}) \dots\dots\dots 2$$

The cost equation of private cloud can be given by $C_{private} = cD_{max}T + pV$

The cost equation of public cloud can be given by $2cV$

The ratio of in-house costs to that of an equivalent cloud infrastructure is given as

$$\frac{C_{private}}{C_{public}} = \frac{cD_{max}T + pV}{2cV}$$

Substituting in equation 2 the ratio can be written as

$$\frac{C_{private}}{C_{public}} = \frac{1}{((2DT)/(TD_{max}) + (1 - D_{min}/D_{max})(2\delta)/T)}$$

c is the cost of CPU per hour; T is the Total time interval; D_{max} is the peak demand; p is the power cost

[5] if $D_{max} = D_{min}$ and $DT = TD_{max}$ public and private cloud make no differences

[5] As in reality $D_{max} \gg D_{min}$ and $DT \ll TD_{max}$ the public cloud is better than private cloud.

III. CONCLUSION

Based on the analysis we conclude that the cost of the cloud and in-house depends on the utilization of the resource. In In-house we have to purchase the whole hardware based on peak demand. So its upfront cost is heavy. In the case of cloud both private and public costs are fixed based on the usage of the resources and the payments are mostly made monthly and no upfront costs are paid. More over latest technology hardware and software will be available in the cloud but in the case of in-house we have to purchase afresh. On analyzing the PaaS and IaaS model we conclude that PaaS is best suited in terms of cost for small and medium scale organization. IaaS suits large organization which need IT Solution with heavy storage need.

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