How to Choose an Economic Cloud Deployment Model

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***Abstract*- Now a days, most organizations focuses on adopting cloud computing model so that they can cut capital expenditure, efforts and control operating costs. These reasons trigger aggressive growth for cloud adoption in business. However, the cloud can bring security risks and challenges for IT Management, which can be more expensive and harm for the organization to deal with it. Therefore, it is very important for businesses to understand their requirements before opting for various cloud deployment models available. Based upon applications, attributes, business requirement of an organization cloud can be deployed in several different ways. There are primarily four cloud deployment models: public, private, hybrid and community model. These models are explored and compared in this paper along with scenarios and application for which an organization could opt for each. At the end of this paper, steps are introduced for choosing an economic cloud deployment model.**

Keywords- Cloud, Cloud Computing, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud

I. INTRODUCTION

Cloud computing is a model for enabling convenient and on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction [1, 2]. Now a days, most organizations focuses on adopting cloud computing model so that they can cut capital expenditure, efforts and control operating costs. These reasons trigger aggressive growth for cloud adoption in business. However, the cloud can bring security risks and challenges for IT Management, which can be more expensive and harm for the organization to deal with it. Therefore, it is very important for businesses to understand their requirements before opting for various cloud deployment models available. Based upon applications, attributes, business requirement of an organization cloud can be deployed in several different ways. There are primarily four cloud deployment models: public, private, hybrid and community model. Although cloud computing shares the some attributes, cloud can be deployed in several different ways. These four cloud deployment models are discussed below, along with scenarios in which a business could opt for each. Each company chooses a deployment model for a cloud computing solution based on their specific business, operational, and technical requirements [3, 4].

A. *Eight points to be known by an organization before adopting cloud*

1. Know and understand the business requirement, aim, weaknesses and strengths of an organization.
2. Know and access all data security, access and privacy risks associate to an organization such as power outage, communications breakdown and change of service provider.
3. Know and verify certification of cloud service provider and their unique qualities.
4. Know the size of an organization.
5. Know and access each possibility and feasibility of a deployment model.
6. Know the in-house and outsource resource available for an organization.
7. Know the cost factor and migration process and time for each proposed model.
8. Consider critically of application and level of support.

II. PUBLIC CLOUD

Escalating complexity, increasing management and resource costs have caused many organizations to look beyond their limits, for a more

cost-effective, on-demand and flexible way to deliver application services. This scenario and need of organization develop a technique of public cloud. Public cloud allows end users to create their own services on systems that are hosted and managed outside their limits [4]. These services are all virtualized and can be created, updated and terminated using an API application. By providing some ad hoc additional capacity, flexibility and pay-as-you-use charging model service provider can make it the ideal option for businesses organizations and their own enterprise infrastructure.

In public cloud, the cloud infrastructure, resource and services is made available to the general public or various users or a large industry group or to an organization. Public cloud deployment model represents a true cloud services model. Public cloud is the most commonly described, popular and widely used model for deployment of cloud services. In this model, all of the physical resources are owned and operated by a third party cloud computing service provider. Cloud service provider provides services to multiple clients which utilizes these resources through the public Internet. Cloud Services can be dynamically provisioned and can be billed based on usage. This model provides the highest degree of cost savings while requiring the least amount of overhead [5].

The public cloud offers most possible benefits and greatest potential risks. Public cloud model helps to reduce capital expenditure and bring down operational IT costs as application and computing resources are managed by a third party services provider. Moreover, customers only pay for what they use on a usage subscription basis and they can terminate their service at any time. Thus, public clouds accelerate deployments and reduce costs [6, 7].

In addition, a public cloud also obviates the need for customers to maintain and upgrade application code and infrastructure. Many public cloud customers are astonished to see new software features automatically appear in their software without notice. Also, the public cloud frees up IT departments to focus on more value-added activities rather than hardware and software upgrades and maintenance. Google is a good example of a public cloud, as its service provided by a vendor free of charge or on the basis of a pay-per-user license policy.

A. *Risks*

Public cloud also comes with many risks. Among these, the Security and privacy are the biggest risks due to fear of organization moving data and processing beyond their own boundary, exposes sensitive corporate data to get into the wrong hands but the actual fact is that most corporate resources are more secure in the public cloud than in a corporate data center. Public cloud providers specialize in data center operations and management, and must meet the most stringent requirements for security and privacy. However, there are compliance regulations that legally require some establishment to maintain data within corporate firewalls the exact location of their data, which is generally impossible in a public cloud which virtualizes data and processing across grid national or international computers.

B. *Challenges*

The public cloud poses many challenges such as reliability, cost, blank slate and technology viability.

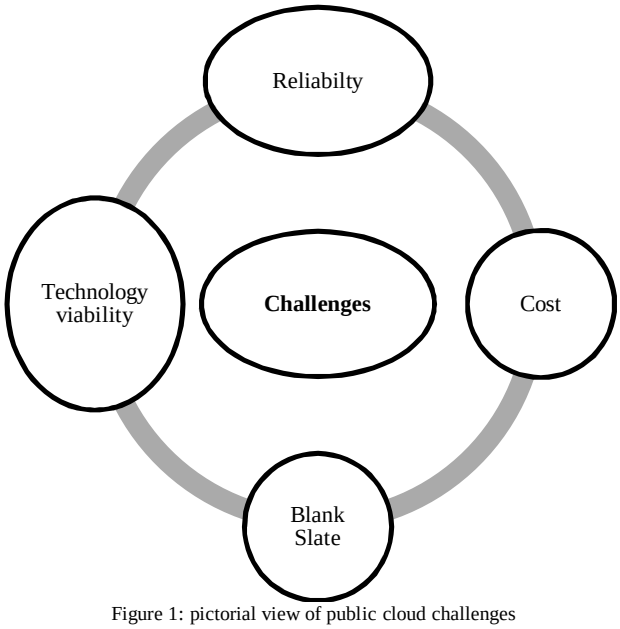

Figure 1: pictorial view of public cloud challenges

Reliability in cloud is the reliability of public cloud resources. For example, Amazon EC2 public cloud has high profile, outages, causing companies to be left stranded without much visibility into the nature of the outage. Cost of cloud can be extremely difficult to estimate because pricing is complex and often companies can not accurately estimate their usage. Blank Slate in cloud is the way to redefine corporate policies and application workflows from scratch which generally provides plain vanilla services. Vendor and Technology viability is the difficult to know which vendors and technologies will be around in the future.

C. *Applications*

Public cloud is best suited for business requirements where organizations is required to manage load spikes, host, applications, utilize meantime infrastructure and manage applications which are consumed by many users.

III. Private Clouds

The cloud infrastructure is operated solely for a specific company. It may be managed by the company or a third party and may exist on or off the premises. This is the most secure of all cloud options. This model doesn't bring much in terms of cost efficiency: it is comparable to buying, building and managing your own infrastructure. Still, it brings in tremendous value from a security point of view. During their initial adaptation to the cloud, many establishment face challenges and have concerns related to data security. These concerns are taken care of by this model, in which hosting is built and maintained for a specific client. The infrastructure required for hosting can be on-premises or at a third-party location. Security concerns are addressed through secure access VPN or by the physical location within the client's firewall system [5].

Furthermore, for mission-critical applications we need to consider downtime in terms of internet availability, quality and performance. Hence, hosting the application with an on-premises private cloud is the suggested approach. Several SaaS applications, such as Sugar CRM, provide options to their clients to maintain their data on their own premises to ensure data privacy is maintained according to the requirements of the particular business. Amazon also provides the option of a virtual private cloud [6, 8].

Private cloud model requires more investment and cost effective model comparable to buying, building and managing infrastructure. The infrastructure required for hosting can be on-premises or at a third-party location. It brings in tremendous value from a security point of view. During their initial adaptation to the cloud, many organizations face challenges and have concerns related to data security which is taken care by this model [8, 9].

In addition, a private cloud gives an organization greater control over its processing and data resources, providing ease of mind for worried executives, if not greater security and privacy for sensitive data. And since a private cloud runs in an existing data center, IT administrators don't have recreate security and other policies from scratch in a new environment. Application and compute resources are managed by an internal data center team Because of the above reasons, many establishments are beginning their journey into the cloud with private clouds. This is especially true in the infrastructure-as-a-service arena where IT administrators are implementing virtualization software to consolidate servers and increase overall server utilization, flexibility, and efficiency.

A. *Challenges*

Private cloud has its own challenges. IT administrators have to learn and install new software such as hypervisors and cloud management utilities. They need to manage two compute environments side by side and keep IT policies aligned in both. This adds to complexity and staff workload. And it goes without saying that a private cloud runs in an existing corporate data center, which carries high fixed costs to maintain.

B. *Applications*

Private cloud deployment model is well suited to mission critical applications, which consider downtime in terms of internet availability, quality and performance. Hence, hosting the application with an on-premises private cloud is the suggested approach. Private cloud model is also

adopted and used by organizations where data or applications are required to conform to various regulatory standards such as SOX, HIPAA, or SAS 70. These standards may require data to be managed for privacy and audits that govern the corporation. Similarly, different countries have different laws and regulations for managing and handling data, which can impede the business if cloud is under different jurisdiction.

IV. Hybrid Cloud

Hybrid cloud model is made from combination of two or more than two clouds which may be public or private or community cloud in such a way that its environments appear as a single cloud with implementing standards in order to provide services. In simple words, it is a reserved private space within a public cloud. In Hybrid cloud, organization provides and manages some resources on-site and off-site server based cloud infrastructure. Hybrid cloud is the most common method of cloud deployment within a medium to large organization and employs aspects and issues of rest cloud deployment models [5, 6].

A company may use internal resources in a private cloud to maintain total control over its proprietary data. It can then use a public cloud storage provider for backing up less sensitive information. At the same time, it might share computing resources with other establishment that have similar needs. By combining the advantages of the other models, the hybrid model offers organizations the most flexibility. The key to a hybrid cloud is obtaining cloud management software that spans both private and public cloud environments. The software supports the same hypervisors used in each environment and has built-in interfaces to the public cloud provider [10].

The main benefit of deploying hybrid cloud is that it provides the scalability and low costs of a public cloud without exposing mission critical applications and data to third party. Hybrid clouds lack the flexibility, security and certainty of in-house applications. Hybrid cloud provides the flexibility of in house applications with some degree of fault tolerance combined with locally usability without dependency on internet connectivity. Hybrid deployment model has secured applications and data hosting on a private cloud, while providing cost benefits by keeping shared data and applications on the public cloud. In general, this model reduce total cost of ownership (TCO), improve return on investment (ROI), continuous data replication, predictable costs, capacity-on-demand scalability and no large capital outlay. Hybrid clouds are obviously more complex and challenging to manage. Currently, few people have experience blending private and public clouds in a seamless way [11].

This deployment model helps businesses to take advantage of secured applications and data hosting on a private cloud, while still enjoying cost benefits by keeping shared data and applications on the public cloud. This model is also used for handling cloud bursting, which refers to a scenario where the existing private cloud infrastructure is not able to handle load spikes and requires a fallback option to support the load. Hence, the cloud migrate workloads between public and private hosting without any inconvenience to the users.

A. *Applications*

1. Hybrid model is well suitable for organization which has full outsourced to combine community cloud services with public cloud services.
2. Hybrid model is also used for handling cloud bursting, where the existing private cloud infrastructure is not able to handle load spikes and requires a fallback option to support the load. Hence, the cloud Shifts workloads between public and private hosting without any inconvenience to the users.
3. Hybrid clouds may be the best option for medium and large sized establishment.
4. Well applicable to those enterprises who are increasingly pursuing a strategy that uses the private cloud for the bulk of processing and the public cloud to handle peak loads.

V. Community Cloud

Community cloud is a cloud service deployment model in which the cloud shares multi-tenant infrastructure by several organizations from a

specific community or group. This specific community must agree upon the policy, regulatory compliance & considerations, computing concerns such as audit requirement, performance requirement, security and jurisdiction [5].

Community cloud is managed by three ways: internally, externally and by third party service provider. The main reason to choose a community cloud as a deployment model is to increase participation of organizations of a public cloud having more privacy, security and policy compliance [6].

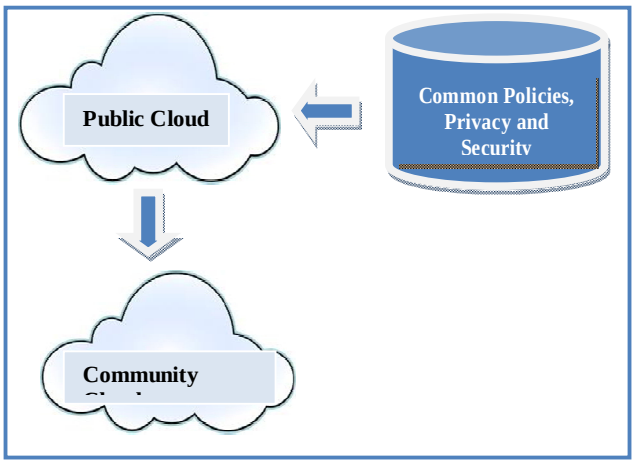

Figure 2: How a community cloud implement

In other words community cloud provides a hybrid form of public cloud to a limited number of organizations which governed, managed and secured commonly by all the participating organizations. These organizations have similar cloud requirements, central cloud computing facility and goal is to work together on joint projects, applications and research.

Community Cloud model is the combination of many computing paradigm such as grid Computing, Digital Ecosystems, Green Computing and Autonomic Computing. The costs are spread over fewer users than a public cloud, so only some of the cost savings possible of cloud computing are realized. Community cloud can be deployed in two modes: Federated community cloud model and Brokered community cloud model.

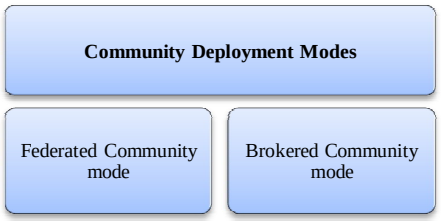

Figure 3: Types of Community Deployment models

The Federated community cloud model is used when there is sharing of over capacity. Federated model is not supported by current products and has some legal impact of a service provider. Brokered community cloud model takes care of trust establishment and contract settlement. This model can handle disputes in the cloud. It is more transparent in terms of operation and accountability.

Community deployment model have many advantages. First is improved manageability over privacy, control and government compliance. Second is improving performance of the cloud services and low latency services. Third is ease of troubleshooting problems and marketing due to access to hundreds of traders, historical and real-time information, and technology services. Forth is more scalable according to handle growth and changing requirements globally. Fifth is simplified and easy access to a broad range of cloud services. Lower deployment Costs relative to a private cloud as no longer have to provide the resources to develop and to maintain basic structure. High Security due to it is hosted in our ultra-secure Global Liquidity Centers.

A. *Applications*

1. Various state-level government departments requiring access to the same data relating to the local information related to infrastructure, such as hospitals, roads, electrical stations, etc., can utilize a community cloud to manage applications and data.
2. Community cloud is applicable to groups of establishment which may want to share their IT basic structure with other organizations within their sector. For example, for electricity companies, federal agencies and payroll companies, for Public Sector groups with shared interests or among banks.
3. In government, where shared services and other pooling arrangements among councils, departments

and agencies must make best use of taxpayers' money, the idea of community cloud is winning popularity.

VI. Comparison of different Cloud Deployment models

Although each of the cloud deployment models offers possible for cost savings, improved services levels and faster deployment, there are some key differences between them. Organizations often choose public and private cloud solutions for different reasons [12].

Table I:
A Parametric comparison of various cloud models

Parameters	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Cost and Investment	Very Less approach to 0	Very high cost	reduce total cost of ownership	More than a private cloud
Size	Large	Small	Very large	Medium
Security and Privacy	Very less	Very much	More	More
Infrastructure Require	Off-Premise only	On-Premises or at a third-party	Can be On or off-Premise	Can be On or off- Premise
Integration	Very Difficult	Very Easy	Difficult	Easy
Application	Business requirements organizations where manage load spikes, utilize meantime infrastructure and applications	Business and mission critical application and IT services	Smaller and medium sized organizations	Various Public & Private Sector companies, banks, federal agencies and companies
Level of Control	Low	High	Moderate	High
Examples	IBM Smart Cloud Amazon EC2	Amazon VPC VMware Cloud Infrastructure Suite	Microsoft Azure and Force.com	Google Apps

Although public clouds are getting much of the attention at this point, private clouds possible offer more significant advantages over time including lower total cost of ownership (TCO), increased security control and easier integration. In the public sector, private clouds may be more appropriate as they can better address issues such as operational expense fluctuation, budget cycle and funding source alignment and procurement issues.

VII. Relationship of various cloud deployment models

Following figure is the good pictorial view of relation of various cloud deployment models. This figure divides into two sections. One section is based on customer level services and second one is based on service provider level. Community and Hybrid cloud model is common to both sections. But the private and public cloud models provide their services in their different sections [13].

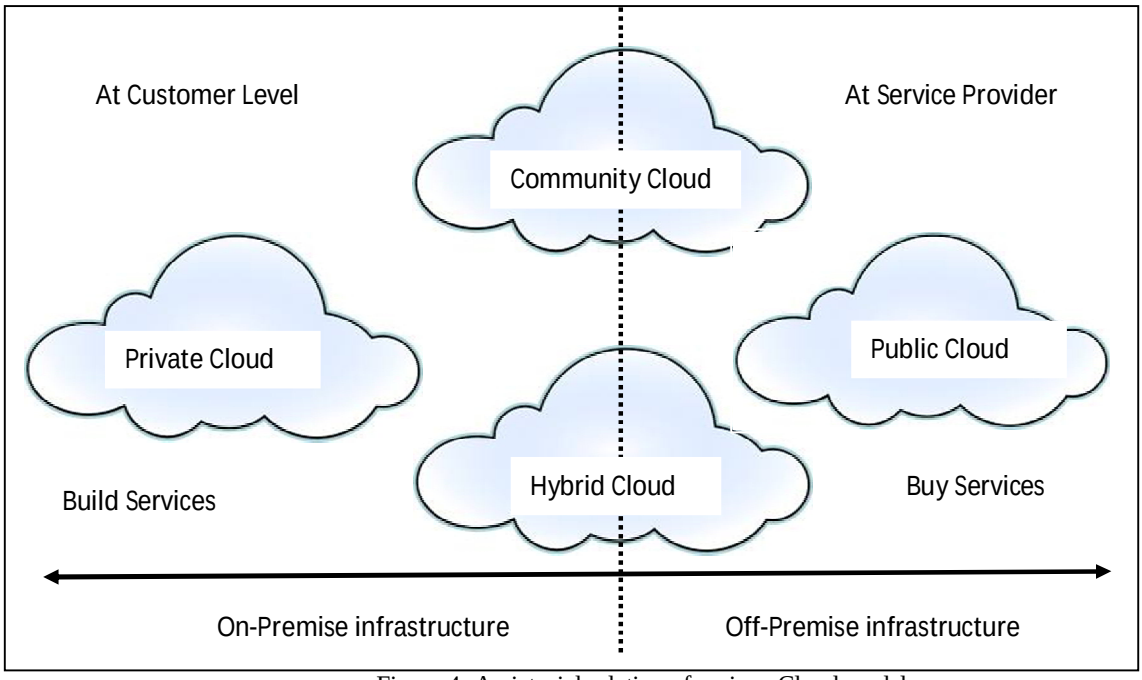

Figure 4: A pictorial relation of various Cloud models

VIII. STEPS FOR CHOOSING AN ECONOMIC CLOUD DEPLOYMENT MODEL

TABLE 2:
STEPS FOR CHOOSING AN ECONOMIC CLOUD

Step No.	Step Name	Description
Step 1	**Review contract of model**	Helps the cloud provider to handles many of those details but larger cloud providers have clout in licensing
Step 2	**Access cost and investment to the model**	Access economies of scale such as cost savings and budget
Step 3	**Maintain standard with the model**	Make choices about standards affecting participants determined by a third party
Step 4	**Troubleshooting by the model**	Streamline troubleshooting by migrating responsibility from individual institutions to the network
Step 5	**Performance by the model**	Gives significant performance advantage over cloud by with both high-performance bandwidth and latency
Step 6	**Privacy and control policies of the model**	Access issues and policies such as information privacy, ownership and applicable laws
Step 7	**Risk Management given by the model**	Access issues such as risk management, control, troubleshooting and ownership
Step 8	**Network Dependency in the model**	Access any dependency in network resources and services

IX. CONCLUSION

There are four major deployment models available for cloud computing: public, private, community and hybrid. As in most things in life, there is rarely a clear-cut solution to choose cloud computing model. Organizations will experiment with public and private clouds, and most will probably have a mix of both. Most data center shops have already implemented virtualization, which is the first step on the way to private clouds. Once they get comfortable with private clouds, they will soon experiment with hybrid and community cloud computing to support peak computing rather than spend millions on new hardware. If the data is particularly sensitive, they may begin with a community cloud inside a public cloud data center to ease their fears about security, privacy, and reliability. The community cloud can be a good option if participation is based on the organization's needs and culture and reflects the organization's requirements for infrastructure, business processes, and data management.

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