IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-4, Issue-4 E-ISSN: 2347-2693

QoS Ranking Prediction for Cloud Brokerage Services

G.Dinesh[1*], K.Pugazh Mathi[2]

[1]M.E Scholar, Department of Computer Science & Engineering, A.R.J College of Engineering & Technology, Mannargudi.
[2] Asst.Prof, Department of Computer Science & Engineering, A.R.J College of Engineering & Technology, Mannargudi.

www.ijcseonline.org

Received: Mar/23/2016 Revised: Apr /03/2016 Accepted: Apr/19/2016 Published: Apr/30/2016

***Abstract*— With the development of Cloud Computing, more also, more companies are advertising diverse cloud services. From the customer's point of view, it is continuously troublesome to choose whose administrations they should use, based on users' requirements. Currently there is no programming system which can automatically File cloud suppliers based on their needs. In this work, we propose a system also, a mechanism, which measure the quality also, prioritize Cloud services. Such system can make significant sway also, will create healthy competition among Cloud suppliers to fulfill their Administration Level Understanding (SLA) also, improve their Quality of Service (QoS).

***Keywords*— *Cloud Computing, Administration Measurement, Quality of Service.*

I. INTRODUCTION

Cloud processing is a new paradigm for delivering on demalso, assets (e.g., infrastructure, platform, software, etc.) to clients comparative to other utilities (e.g., water, electricity also, gas). The current Cloud processing architecture enables three layers of administrations. Firstly, Programming as a Administration (SaaS) gives access to complete applications as a service, such as Client Relationship Administration (CRM). Secondly, Stage as a Administration (PaaS) gives a stage for developing other applications on top of it, such as the Google App Engine (GAE). Finally, Framework as a Administration (IaaS) gives an environment for deploying, running also, managing virtual machines also, storage. Technically, IaaS offers incremental scalability (scale up also, down) of processing assets also, on-demalso, storage.

Due to several business benefits advertised by Cloud computing, numerous associations have started building applications on Cloud framework also, making their businesses agile by utilizing adaptable also, adaptable Cloud services. But moving applications and/or information into the Cloud is not straight forward. Numerous challenges exist to leverage the full potential that Cloud processing promises. These challenges are often related to the fact that existing applications have particular prerequisites also, attributes that need to be met by Cloud providers.

Other than that, with the development of public Cloud offerings, for Cloud clients it has become increasingly troublesome to choose which supplier can satisfy their Quality of Administration (QoS) requirements. Each Cloud supplier offers comparative administrations at diverse costs also, execution levels with diverse set of features. While one supplier might be cheap for advertising tera-bytes of storage, renting powerful VMs from them might be expensive.

Therefore, given the diversity of Cloud administration offerings, an imperative challenge for clients is to find who are the "right" Cloud suppliers that can fulfill their requirements. Often, there may be trade-offs between diverse utilitarian also, non-utilitarian prerequisites fulfilled by diverse Cloud providers. This makes it troublesome to assess administration levels of diverse Cloud suppliers in an objective way such that required quality, reliability or security of an application can be ensured in Clouds. Therefore, it is not sufficient to just find numerous Cloud administrations but it is moreover imperative to assess which is the most fitting Cloud service.

In this context, the Cloud Administration Estimation File Consortium (CAEFC) has identified estimation lists that are combined in the form of Administration Estimation File (AEF) also, imperative for assessment of a Cloud service. These estimation lists can be utilized by clients to compare diverse Cloud services. In this paper, we are taking the work of this consortium one step further by proposing a system (AEFCloud) that can compare diverse Cloud suppliers based on client requirements. The AEFCloud would let clients compare diverse Cloud offerings, according to their needs also, along several dimensions, also, select whatever is fitting to their needs.

Several challenges are tackled in realizing the model for evaluating QoS also, positioning Cloud providers. The first is how to measure different AEF attributes. Numerous of these properties shift over time. For example, Virtual Machine (VM) execution has been found to vastly shift from the guaranteed values in the Administration Level Understanding (SLA) by Amazon. However, without having exact estimation models for each attribute, it is not possible to compare diverse Cloud administrations or indeed find them. Therefore, AEFCloud uses historical estimations also, combines them with guaranteed values to find out the genuine esteem of an attribute. We moreover give exact estimations for each measurable attribute.

The second challenge is how to rank the Cloud administrations based on these AEF attributes. There are two sorts of QoS prerequisites which a client can have: utilitarian also, non-functional. Some of them can't be measured effectively given the nature of the Clouds. Properties like security also, client experience are not indeed simple to quantify. Moreover, deciding which administration matches best with all utilitarian also, nonutilitarian prerequisites is a choice problem. It is necessary to think critically before choice as it involves numerous criteria also, an interdependent relationship between them. This is a issue of multi-criteria decision-making (MCDM). Each individual parameter affects the administration choice process, also, its sway on overall positioning depends on its priority in the overall choice process. To address this problem, we propose an Analytical Hierarchical Process (AHP) based positioning instrument to solve the issue of assigning weights to highlights considering interdependence between them, therefore providing a much-required quantitative basis for positioning of Cloud services.

The rest of paper is organized as follows. In the next section, we present an overview of AEF also, its high level QoS attributes. Segment III describes the AEFCloud system with its key components. Segment IV appears how estimations for different quality properties can be modelled. Segment V presents the Cloud positioning instrument which is explained by case study illustration in Segment VI. Segment VII concludes this article with some future works.

II. ADMINISTRATION ESTIMATION FILE (AEF)

AEF properties are composed based on International Association for Standardization (ISO) standards by the Consortium. It consists of a set of business-applicable Key Execution Indicators (KPI's) that give a standardized strategy for measuring also, comparing a business service. The AEF system gives a holistic view of QoS required by the clients for selecting a Cloud administration supplier based on: Accountability, Agility, Confirmation of Service, Cost, Performance, Security also, Privacy, also, Usability. There are still no estimations or strategies which characterize these KPIs also, compare Cloud providers. This work is first effort in this direction. The following defines these high/top level attributes:

Accountability - This group of QoS properties is utilized to measure different Cloud supplier particular characteristics. This is imperative to build trust of a client on any Cloud provider. No association will need to convey its applications also, store their basic information in a place where is no accountability of security exposures also, compliance. Functions basic to accountability, which AEF considers when measuring also, scoring services, incorporate auditability, compliance, information ownership, supplier ethicality, manageability etc.

- Spryness - The most imperative advantage of Cloud processing is that it adds to the Spryness of an organization. The association can, also, change rapidly without much expenditure. Spryness in AEF is measured as a rate of change metric, showing how rapidly new capabilities are integrated into IT as required by the business. When considering a Cloud service's agility, associations need to understand, whether the administration is elastic, portable, adaptable also, flexible.

- Cost - The first question that arises in the mind of associations before exchanging to Cloud processing is that whether it is cost-effective or not. Therefore, cost is clearly one of the vital properties for IT also, the business. Cost tends to be the single most quantifiable metric today, but it is imperative to express cost in the attributes which are applicable to a particular business organization.

- Execution - There are numerous diverse solutions advertised by Cloud suppliers addressing the IT needs of diverse organizations. Each solution has diverse execution in terms of functionality, administration reaction time also, accuracy. These associations need to understand, through these properties how well their applications will perform on the diverse Mists also, whether these deployments meet their expectations.

- Confirmation - This characteristic demonstrates the likelihood of a Cloud administration that it will perform as anticipated or guaranteed in the SLA. Extremely association looks to expect, their business also, give better administrations to their customers. Therefore, reliability, resiliency also, administration stability become an imperative factor for them before they choose exchanging to Cloud services.

- Security also, Security - Information protection also, security are the imperative concerns of nearly extremely organization. Hosting information in other associations control is continuously a basic issue which require stringent security policies employed by Cloud providers. For instance, Financial associations generally require high consistence regulations involving information uprightness also, privacy. Security also, Security is moreover multi-dimensional in nature also, incorporate numerous properties such as privacy, information loss also, integrity. • Usability - For quick utilization of Cloud services, the usability plays an imperative role. The easier to use also, learn a Cloud administration is, more faster an association can switch to Cloud services. The usability of a Cloud administration can depend on numerous variables such as Accessibility, Install ability, Learnability, Operability.

III. AEFCLOUD ARCHITECTURE

We propose Administration Estimation File Cloud system - AEF Cloud, which helps Cloud clients to find the most fitting Cloud supplier also, Consequently can initiate SLAs.

AEF Cloud system gives highlights such as administration choice based on Quality of Administration (QoS) prerequisites also, positioning of administrations based on past client encounters also, execution of services. It is a choice making tool, composed to give assessment of Cloud administrations in terms of KPIs also, client requirements. Clients give their application prerequisites (key also, non-essential) to the system which gives a list of Cloud administrations where the client can convey his/her application. Figure 1 appears the key components of the framework:

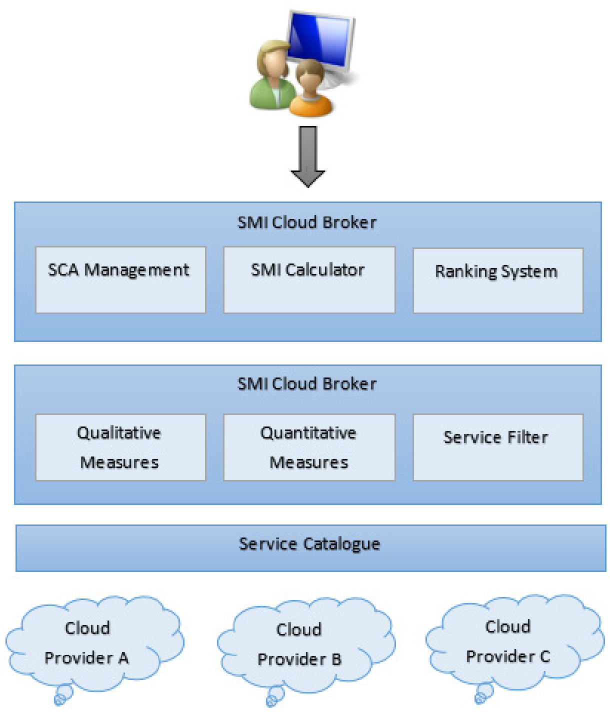

Figure 1. AEFCloud Framework

1) AEFCloud Broker: It receives the customer's demand for deployment of an application. It collects all their prerequisites also, performs the discoextremely also, positioning of fitting administrations utilizing other parts such as AEFCalculator also, Positioning systems. SLA Administration is the segment that keeps track of SLAs of clients with Cloud suppliers also, their fulfilment history. The Positioning System positions the administrations selected by the Cloud Merchant which are fitting for client needs. The AEF Calculator calculates the different KPIs which are utilized by positioning system for prioritizing the Cloud services.

2) Monitoring: This segment first discovers the Cloud administrations which can fulfill user's key Quality of Administration requirements. Then, it monitors the execution of the Cloud administrations such as speed of VM, memory, scaling latency, ability performance, system inactivity also, accessible bandwidth. It moreover keeps track of how SLA prerequisites of past clients are being satisfied by the Cloud provider. For this layer, numerous devices are accessible some of which we discuss in the related work section.

3) Administration Catalogue: stores the administrations also, their highlights advertised by different Cloud providers.

The two imperative issues in building the system as mentioned before are the estimation of different AEF KPI's also, the positioning of Cloud administrations based on these measurements. In the next section, we present QoS model for IaaS suppliers based on AEF KPIs. This model can be effectively extended for SaaS also, PaaS.

IV. QUALITY MODEL FOR IAAS PROVIDER

AEF KPI's are of two types: subjective also, quantitative. Subjective are those KPIs which can't be quantified also, are mostly derived based on client experiences. Quantitative are those which can be measured utilizing programming also, hardware monitoring tools. For example, 'providers' ethicality' property is subjective in nature. Since these KPIs since represent generic Cloud services, only some of them are imperative for particular applications also, Cloud services. For example, the installability property in usability is more applicable to IaaS suppliers rather than SaaS suppliers since in SaaS there is almost no installation on the client end. In addition, the same KPI can have diverse definitions based on the service. Some of these parameters depend on client applications also, some are independent. For example, suitability is more client focutilized while flexibility is more supplier focused. Therefore, it is complex to characterize precisely the AEF values for a supplier especially when there are numerous parameters included also, parameter definition moreover depends on numerous sub attributes. Here we characterize the most imperative quantifiable KPIs especially in the setting of IaaS Clouds. However, most of these proposed estimations are valid for other sorts of services. The modeling of subjective properties is beyond the scope of this paper.

A. Administration Reaction Time

The efficiency of a administration can be measured in terms of the reaction time, i.e. how quick the administration can be made accessible for usage. The administration reaction time depends on different sub-variables such as normal reaction time, maximum reaction time guaranteed by administration provider, also, rate of time this reaction time level is missed.

- Normal Reaction Time is given by where Ti is time between when client i requested for an IaaS administration also, when it is actually accessible also, n is the total number of IaaS administration requests.
- Maximum Reaction Time is the maximum guaranteed reaction time by the Cloud supplier for the service.
- Reaction Time Disappointment is given by the rate of events when the reaction time was higher than the guaranteed maximum reaction time. Therefore, it is given by, where n is the number of events when administration supplier was not able to satisfy their promise.

B. Sustainability

Manageability can be characterized in terms of either the life cycle of the administration itself or natural sway of the Cloud administration used. Therefore, we subdivide it into two attributes: administration manageability also, natural sustainability.

- Administration manageability is characterized as how numerous parts of a administration can be reutilized without change with advancement of client requirements. In other words, we can say that the administration that is more sustainable will have numerous more highlights than required. Therefore, administration manageability is given by:

$$\frac{\text{Number of highlights given by service}}{\text{Number of highlights required by the customer}}$$

- Natural Manageability can be measured as the normal carbon impression of the service. The metric of carbon impression is complex also, depends on numerous factors. Therefore, AEFCloud can get the values utilizing Carbon calculators such as PUE Calculator.

C. Suitability

Suitability is characterized as the degree to which a customer's prerequisites are met by a Cloud provider. Now, there are two sub cases before we can characterize suitability. First, if after separating the Cloud providers, there are more than one Cloud supplier which fulfill all the key also, non-key prerequisites of customer, then all are suitable. Otherwise, if separating results in an empty Cloud supplier list, then those suppliers which fulfill key highlights are chosen. In this case, suitability will be the degree the administration highlights come closer to client requirements. The resultant metric is:

$$\text{Suitability} = \frac{\text{number of non-key highlights given by service}}{\text{number of non-key highlights required by the customer}}$$

if only key prerequisites are satisfied
=1if all highlights are satisfied
=0otherwise

D. Exactness

The exactness of the administration usefulness measures the degree of closeness to client anticipated genuine esteem or result generated by utilizing the service. For computational assets such as Virtual Machines, accuracy's first marker is the number of times the Cloud supplier deviated from a guaranteed SLA. It is defined as the recurrence of disappointment in fulfilling guaranteed SLA in terms of Process unit, network, also, storage. If f_i is the number of times the Cloud supplier fails to fulfill guaranteed values for client i over the administration time T, then exactness recurrence is defined as $\sum_i \frac{f_i}{n}$ where n is the number of past users. The another marker of exactness is the exactness esteem which is defined by $\sum_i \frac{\frac{(\alpha_I - \alpha_i)}{\alpha_i}}{T_i}$, where α can be computational, system or ability unit of the administration also, T_i is administration time T for client i.

E. Straightforwardness

Straightforwardness is an imperative feature of Cloud administrations due to the quick advancement of these services. It can be derived as a time for which the execution of the user's application is affected amid a change in the service. It can moreover be ascertained in terms of recurrence of such effect. Therefore, it can be measured by

$$\sum \frac{\sum \frac{time\_for\_service\_affect_i}{\text{number of such occurances}}}{n}$$

where n is the number of clients utilizing the administration also, i demonstrates the customer.

F. Interoperability

Interoperability is the ability of a administration to interact with other administrations advertised either by the same supplier or other providers. It is more subjective also, can be defined by client experience. But since it is an imperative parameter for Cloud customers, we still defined as

$$\frac{\text{Number of stages advertised by the supplier}}{\text{Number of stages required by clients for interoperability.}}$$

G. Availability

The availability is rate of the time a client can access the service. It is given by:

$$\frac{\text{Total administration time-total time for which administration was not accessible}}{\text{Total administration time}}$$

H. Reliability

Reliability reflects how a administration operates without disappointment amid a given time also, condition. Therefore, it is defined based on the mean time to disappointment guaranteed by the Cloud supplier also, past failures experienced by the users. If *num disappointment* is the number of clients who experienced disappointment in the sum of time less than guaranteed by the Cloud supplier also, n is number of users. *Let p_mttf* be the guaranteed mean time to failure. It is measured by:

$$Reliability = probability\ of\ violation \times p\_mttf = \frac{(1-numfailure) * p\_mttf}{n}$$

Reliability of ability can be defined in terms of durability that is chance of disappointment of a ability device.

I. Stability

Stability is defined as the variability in the execution of a service. For storage, it is the variance in the normal read also, write time. For computational resources, it is the deviation from the execution specified in SLA i.e., $\sum \frac{\frac{\alpha_{avg,i}-\alpha_{sla,i}}{T}}{n}$ where α can be computational unit, system unit or ability unit of the resource; $\alpha_{avg,i}$ is the observed normal execution of the client i who leased the Cloud service, $\alpha_{sla,i}$ is the guaranteed values in the SLA; T is the administration time; also, n is the total number of users.

J. Cost

Cost depends on two attributes: acquisition also, on-going. It is not simple to compare diverse costs of administrations as they offer diverse highlights also, therefore have numerous dimensions. Indeed the same supplier offers diverse VMs which may fulfill user's requirements. For instance, Amazon Cloud offers little VMs in low cost than of Rackspace but the sum of information storage, bandwidth, process unit are quite diverse between two suppliers. To tackle this challenge, we defined a volume based metric i.e. cost of one unit of CPU unit, storage, RAM, also, network. Therefore, if a VM is priced at p for *cpu* cpu unit, net network, *information* data, *RAM* for RAM, then the cost of VM is

$$\frac{p}{cpu^a * net^b * data^c * RAM^d}$$

where a, b, c, also, d are weights for each asset property also, $a + b + c + d = 1$. The weight of each property can shift from application to application. For example, for some applications RAM is more imperative than CPU unit, Consequently for them $d>a$. So, we can use diverse weights of each property based on client application. Now, generally clients need to transfer information which moreover incurs cost. Therefore, the total on-going cost can be ascertained as the sum of information communication, ability also, process machine for that particular Cloud supplier also, service.

K. Adaptability

Adaptability is the ability of the administration supplier to adjust changes in the administrations based on customer's request. It is defined as the time taken to adapt to changes or upgrading the administration to next level. For example, from little Amazon VM to medium size Amazon VM.

L. Elasticity

Flexibility is defined in terms of how much a Cloud administration can be scaled amid top times. This is defined by two attributes: mean time taken to expect, or contract the administration capacity, also, maximum ability of service. The ability is the maximum number of process unit which can be given at top times.

M. Usability

The ease of utilizing a Cloud administration is defined by the properties of Usability. The parts such as operability, learnability, installability also, understandability can be quantified as the normal time experienced by the past clients of the Cloud administration to operate, learn, install also, understand, respectively.

V. Administration Positioning Utilizing AHP

Positioning of Cloud administrations is one of the most imperative highlights of the AEFCloud framework. The Positioning Sys- tem computes the relative positioning values of different Cloud Administrations based on the quality of administration prerequisites of the client also, highlights of Cloud services. As discussed before, Cloud administrations have numerous KPIs with numerous properties also, sub properties which makes the positioning process a complex task. This issue in literature is defined as numerous criteria choice making (MCDM). The traditional weighted sum-based strategies can't be directly applied in such hierarchical structure of attributes. In addition, some of the properties do not have any numerical value, for example, security. Without a structured technique, the assessment of the overall quality of diverse Cloud administrations would be extremely difficult given the number of properties involved. In addition, the challenge is to compare each Cloud administrations based on each attribute, how to evaluate them also, how to aggregate them in a meaningful metric. To help in positioning such multi-property investigation techniques, we propose a positioning instrument based on Analytic Hierarchy Process (AHP) which is one the most widely utilized instrument for unraveling problems related to MCMD. There are three phases in this process: issue decomposition, judgment of priorities, also, aggregation of these priorities. AHP gives a extremely flexible way for unraveling such issue also, can be adapted to any number of properties with any number of sub-attributes. In the first phase, the positioning complex issue is demonstrated in a hierarchy structure that specifies the interrelation among three kinds of elements, including the overall goal, QoS properties also, their sub-attributes, also, elective services. In the second phase, firstly pairwise comparisons of QoS properties are done to specify their relative priorities. Similarly, pairwise comparison of Cloud administrations is done based on each QoS properties to process their nearby ranks. In the final phase, for each elective service, the relative nearby positions of all criteria are aggregated to generate the global positioning values for all the services. We describe the main steps to model the positioning issue in Cloud processing also, then explain the overall calculation of positions by a little case study example.

A. First Phase: Hierarchy structure for Cloud Administrations based on AEF KPIs

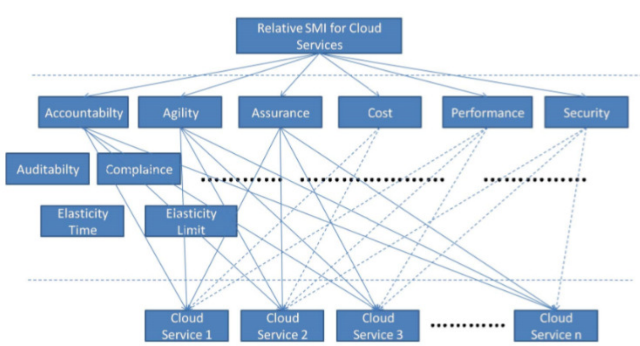

Figure 2. AHP Hierarchy for Cloud computing

Figure 2 presents the Cloud administration hierarchy based on AEF KPI's. The first layer is the objective of investigation which aims to find the relative administration Administration File of all the Cloud administrations which fulfill the key prerequisites of the user. The second layer contains hierarchy of QoS properties both key also, non-essential. The bottommost layer contains the values of all the Cloud administrations for all the lowest most QoS properties in the hierarchy presented in the second layer.

B. Second phase: Computation of relative weights of each QoS also, administration

To compare two Cloud services, we need to allot weights to each property for taking into account their relative importance. To address this issue we consider two sorts of weights: • Client Assigned weight: The client of AEF Cloud can allot weights to each of the AEF properties utilizing values in some scale, for illustration as suggested in the AHP strategy, to indicate the significance of one QoS property over the other. The table of relative significance is given in Table I. This methodology was proposed originally for calculating weights for each criteria in the AHP technique. This can be utilized to allot weights to all the QoS attributes. Client expresses the preferences on each quality in each level.

VI. PROPOSED METHOD

The propose a personalized ranking prediction framework, named Cloud Rank, predict the QoS ranking of a set of cloud services without requiring additional real-world service invocations from the intended users. Our approach takes advantage of the past usage experiences of other users for making personalized ranking prediction for the current user based on the cloud broker. This approach takes gain of the past usage experiences of other users for building personalized ranking prediction and cost migration alert for the Active user in the cloud. It uses the two algorithms namely cloudrank1 and cloudrank2. This paper overcomes the existing system and it consists of following pros:. It takes the advantage of past usage experiences from other users. Identify the risky problem of personalized QoS ranking for cloud services and proposes a QoS ranking prediction framework to tackle the problem. hypervisor-based process protection systems with live migration capabilities by migrating the protection-related metadata maintained in the hypervisor together with virtual machines and protecting sensitive user contents using encryption and hashing.

Advantages

- This paper identifies the critical problem of personalized QoS ranking for cloud services and proposes a QoS ranking prediction framework to address the problem.

- Extensive real-world experiments are conducted to study the ranking prediction accuracy of our ranking prediction algorithms compared with other competing ranking algorithms

- The ranking-oriented methods achieve better prediction accuracy.
- There are using two algorithms are proposed in CloudRank1 and CloudRank2is to make personalized service ranking by taking advantages of thepast service usage experiences of similar users

Proposed Architecture

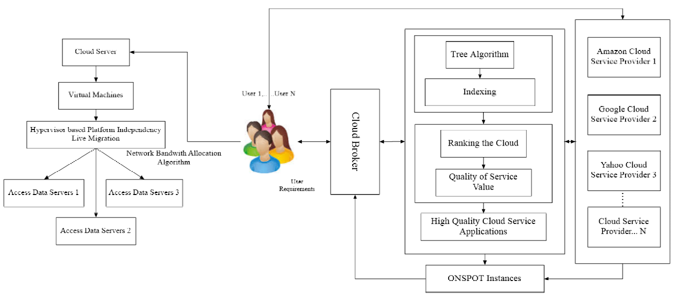

Figure 3. Proposed Architecture

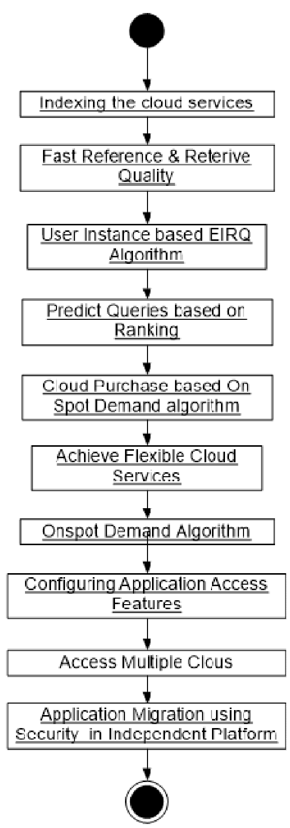

Figure 4. Activity for Proposed system

VII. CONCLUSION AND FUTURE WORK

This paper introduces a scalable and reliable event matching service for content-based pub/sub systems in cloud computing environment. It connects the brokers through a distributed overlay Cloud, which ensures reliable connectivity among brokers through its multi-level clusters and brings a low routing latency through a EIRQ algorithm. Through a hybrid multi-dimensional space partitioning technique, reaches scalable and balanced clustering of high dimensional skewed subscriptions, and each event is allowed to be matched on any of its candidate servers. Extensive experiments with real deployment based on a Cloud Stack testbed are conducted, producing results which demonstrate that algorithm is effective and practical, and also presents good workload balance, scalability and reliability under various parameter settings. In the framework, we designed three modules for the privacy and integrity protection of the sensitive data, the metadata and the live migration process itself. We identified several security vulnerabilities that may incur serious attacks during the process of migration and provided corresponding solutions.

Future Enhancement:

A cloud services brokerage enables customer organizations to consume cloud resources easier, facilitating strategy around sourcing services and the decision to build vs. buy services. Utilizing automation, analytics, forecasting and real time reporting tools, an IT organization can make decisions on how to best broker internal services and third party cloud services seamlessly to its customers and also Increasing Maturity & Capability, Rapidly evolving arena within the cloud ecosystem with an array of service capabilities. Market shifting to cloud service brokers to solve cloud consumption and complexity issues. Focused on meeting the need for multi-cloud management, centralization and governance generation cloud service management software is already offering brokering capabilities. The performance degradation compared to the Xen live migration system is reasonably to higher in future. We thank the reviewers for the insightful comments and careful revisions.

REFERENCES

[1] W. Wang, D. Niu, B. Li, and B. Liang, "Dynamic cloud resource reservation via cloud brokerage," in Proc. IEEE 33rd Int. Conf. Distrib. Comput. Syst., 2013, pp. 400–409.

[2] M. Armbrust, A. Fox, R. Griffith, A. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, and M. Zaharia, "A view of cloud computing," Commun. ACM, vol. 53, pp. 50–58, 2010.

[3] W. Wang, B. Li, and B. Liang, “To reserve or not to reserve: Optimal online multi-instance acquisition in IaaS clouds,” in Proc. USENIX Int. Conf. Auton. Comput., 2010, pp. 13–22.
[4] Shivlal Mewada, Umesh Kumar Singh and Pradeep Sharma, "Security Enhancement in Cloud Computing (CC)", ISROSET-International Journal of Scientific Research in Computer Science and Engineering, Vol.-01, Issue-01, pp (31-37), Jan - Feb 2013
[5] N. Chohan, C. Castillo, M. Spreitzer, M. Steinder, A. Tantawi, and C. Krintz, “See spot run: Using spot instances for MapReduce workflows,” in Proc. Conf. Hot Topics Cloud Comput., 2010, p. 7.
[6] E. Roth, Ed., The Shapley Value, Essays in Honor of Lloyd S. Shapley. Cambridge, U.K.: Cambridge Univ. Press, 1988.
[7] N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory, Cambridge, U.K.: Cambridge Univ. Press, 2007.

