A Framework to Improve Communication and Reliability Between Cloud Consumer and Provider in the Cloud

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***Abstract*—Cloud services consumers demand reliable methods for choosing appropriate cloud service provider for their requirements. Number of cloud consumer is increasing day by day and so cloud providers, hence requirement for a common platform for interacting between cloud provider and cloud consumer is also on the raise. This paper introduces Cloud Providers Market Platform Dashboard. This will act as not only just cloud provider discoverability but also provide timely report to consumer on cloud service usage and provide new requirement based on consumer cloud usage and cost for the same. Dashboard is also responsible for getting cost of each service provider for a particular requirement. Our solution will learn from requirements and provide required details for consumer for effective usage of cloud services. This also enable service provider to understand requirements, provide quality of service, to understand new requirement and deliver. This framework also deals with how best we can use before and after usage of cloud services to choose a right service provider for a particular requirement in a community.**

Keywords—cloud computing; requirement communication; requirement engineering; cloud service; cloud discoverability; data Mining; artificial intelligence in Cloud Computing

I. INTRODUCTION

Some analysts and vendors define cloud computing narrowly as an updated version of utility computing: basically virtual servers available over the internet. Cloud computing comes into focus only when you think about what IT always needs: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software [7].

There are set of services and models working behind the scene making the cloud computing feasible and accessible to end users. Following are the models for cloud computing:

1) *Deployment models*
2) *Services Models*

Deployment models define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access: public, private, hybrid and community. Service models are the reference models on which the cloud computing is based. There are three basic categories:

1) *Infrastructure as a Service (IaaS)*
2) *Platform as a Service (PaaS)*
3) *Software as a Service (SaaS)*

A cloud provider is a company that offers some component of cloud computing – typically above three services to other businesses or individuals. Cloud providers are referred to as cloud service providers (CSP). There are a number of things to think about when you evaluate cloud providers. The cost usually be based on per-user utility model but there are a number of variations to consider. Reliability is very essential if your data must be accessible. A typical cloud infrastructure service-level agreement (SLA), for example, specifies explicit levels of service – such as, for example, 99.9% uptime – and the compensation that the user is eligible to if the provider fails to provide the service as described [8]. Hence it becomes difficult for both cloud provider and cloud consumer to match each other's requirements without a common platform.

Cloud services are seen as a deployment model, enabling users to consume software and hardware services via internet. These services are supplied by various services providers. Cloud services are designed to provide easy, scalable access to applications, resources and services, flexible pricing and customization. Cloud computing will soon become a utility [1] available anytime, anywhere.

The rest of the paper is structured as follows. Section II presents the research problem. In Section III, introduce cloud providers market platform dashboard as solution to the research problems defined in section II.

II. RESEARCH PROBLEM

With the development of cloud computing systems, consumers' requirement also become increasingly complex, this leads to following five problems between consumers and providers.

1) Due to diverse cloud services providers, consumers very often find it difficult to choose right services for their requirement. Also they don't have information on other consumer's chosen service provider for similar kind of requirement. For example, if cloud consumer has requirement for virtual servers having - operating system IBM AIX 7.1 / RAM 10 GB with network bandwidth 100 Mbps then consumer has no information on which cloud provider is offering best service for this particular requirement. No information on which service provider to choose for this particular

requirement. Also there is no method to find out which service provider did the other consumers choose for similar requirement.

2) Consumers are not aware of provider's reliability / usability / performance / scalability / interoperability for the specific requirements. There is no method or algorithm to find quality of service provided by the provider for a particular requirement. Consumer need to understand his application requirement and then choose appropriate provider. Quality of service should be based on consumer requirements.

3) Consumers don't get report on cloud usage and hence don't get recommendation on whether to continue the service or to upgrade the service with same provider or to choose new provider. Once the consumer starts consuming cloud services there is no proper channel to understand consumer usage and get recommendation.

4) Consumers don't have information whether to switch cloud provider for cost effective cloud usage.

5) Cloud service providers demand new architecture to understand requirement coming from such heterogeneous cloud consumers. Also providers don't get information on consumers chosen provider for the same requirement and reasoning for the same. This will help provider to analyze their requirement engineering [6] strategy and improve quality of service to expand their offerings.

Hence in this paper we are introducing a framework which attempts to solve all the problems noted above and help consumer to get better cloud service for their applications. Most of the on going research deals with stakeholders functions and does not address more specific topics as noted above. Some research work deals with discoverability of cloud services but doesn't deal with recommendations before discoverability. None of the research work deal with how best we can use before and after usage of cloud service to choose right service for a particular requirement in a community.

III. CLOUD PROVIDERS MARKET PLATFORM DASHBOARD

Our primary research goal is to provide a dashboard to consumer to key in there requirements and get recommendations to choose cloud service provider. The same tool will be used by provider to understand requirements, analyze and expand offering. This dashboard uses StakeCloud Platform concept [2]. StakeCloud Platform takes in requirement input and search for cloud services provider who providers such service and match the results. It doesn't take our research problems into consideration. It only deals with cloud service discoverability and doesn't provider recommendations through learning.

Cloud providers market platform dashboard deals with how best we can use before and after usage of cloud service to choose the right provider for a particular requirement in a community. This platform requires providers to open there service discoverability and cloud monitoring features. In the course of development provider may have to open various other features for the consumer benefit.

To meet the research goal, we depicted Cloud Providers Market Platform Dashboard in Fig 1. The framework contains 8 components. Dashboard is a community based where all consumers and all providers are using the same platform for communication. All providers who wish to be part of this dashboard should adhere to standards defined by Engine component.

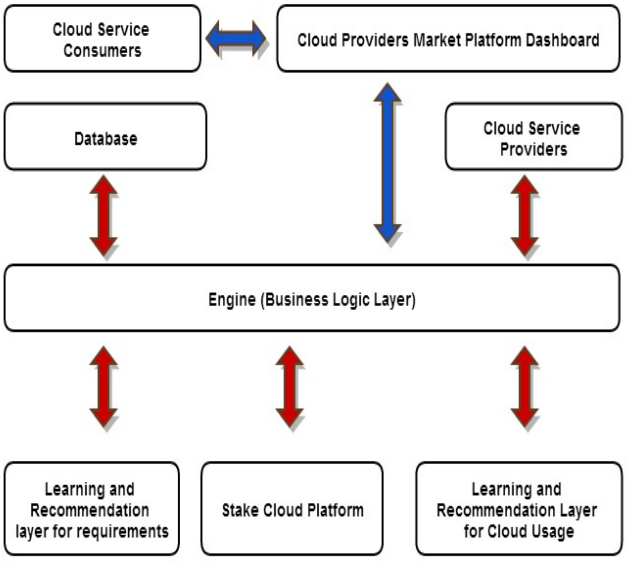

Fig. 1. Cloud Providers Market Platform Dashboard

"ABC Inc" is a company which needs virtual server on cloud. Consider "ABC Inc" as cloud consumer. Scenario based demonstration is done using all 8 components of the framework defined above.

Step by Step scenario to illustrate the framework

- Cloud consumer (ABC Inc) access "Cloud Provider Market Platform Dashboard" via HTTP / HTTPS protocols and access requirement request form to input his requirement.
- Consumer inputs the requirement in the dynamic web platform. Consumer gets to choose his requirement for his application from the web. For Example: Which server operating system, Disk size, RAM details, Bandwidth details, IPV6 support, required software's (like database / IDE) etc. Consumer waits for the result once he submit job to Dashboard as in Fig.2.
- Once consumer submits his requirement, dashboard inputs data into Database component through Engine component (Could be any of the database on the cloud for example: Informix / MySQL or Oracle) and pass the control to Engine via internet protocols. Engine component acts as a master and is sole responsible for driving this framework. All the communication between Engine and to other component is via HTTP / HTTPS protocol.

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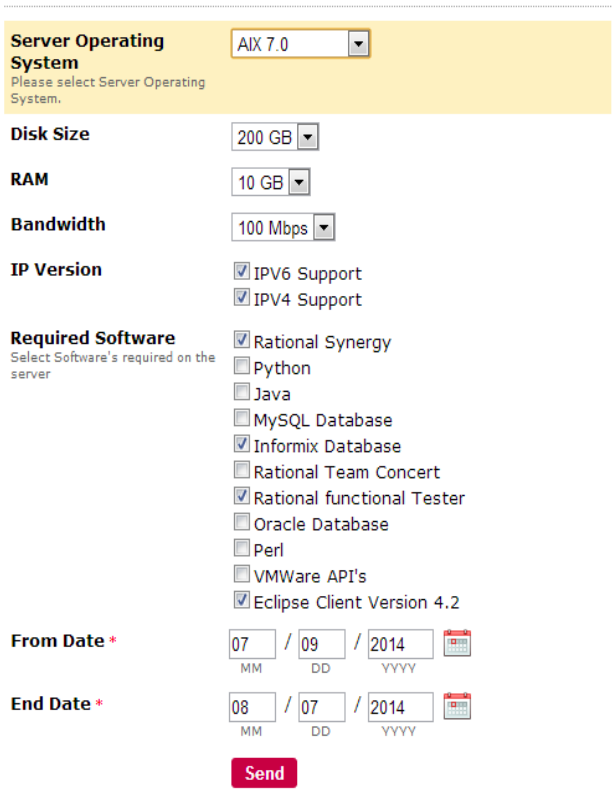

Fig. 2. Requirement Request Form

- The requirement submitted by cloud service consumer is processed by 2 layers through Engine: 1. Learning and Recommendation layer for requirements 2. Stake Cloud Platform [2].
- Learning and Recommendation layer has the ability to collect data from Engine layer and pass information to dashboard based on pervious matching requirements from various consumers and their selected cloud providers details. Also usage report of the same. This component learns every requirement coming in and keeps track of all the activity related to requirement. This helps the consumer to choose right cloud service provider. This layer also has the ability to provide information on provider's reliability / usability / performance / scalability etc from Cloud service usage layer Fig.5.

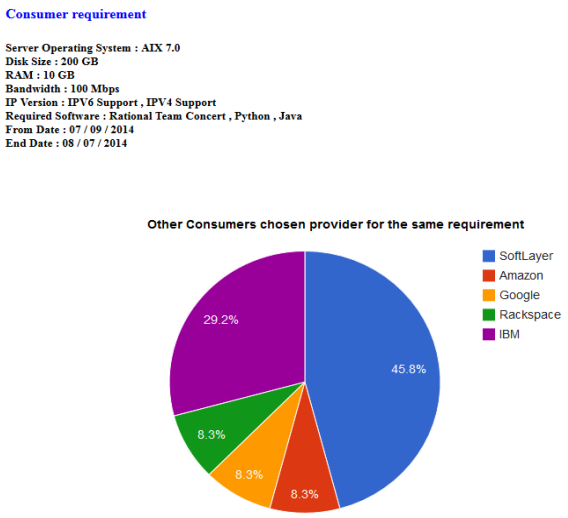

Fig. 3. Other consumers of the same requirement and there provider details (overall chart)

- Stake Cloud Platform [2] has been enhanced to provide quotation (cost) for the services from various providers after the match is found for the requirement. Requirements are processed and list the matching result in the dashboard Fig 4. Above 2 layers are responsible for listing cloud service providers for the consumer requirement.

Cloud Service Provider	Requirements	Cost	Cost Effective
Softlayer	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$200 per day	Yes
IBM	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$203 per day	Yes
Amazon	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$308 per day	No
Google	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$310 per day	No
Rackspace	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java From Date : 07 / 09 / 2014 End Date : 08 / 07 / 2014	$307 per day	No

Fig. 4. Cloud provider list from stake cloud platform component with cost (for a particular requirement)

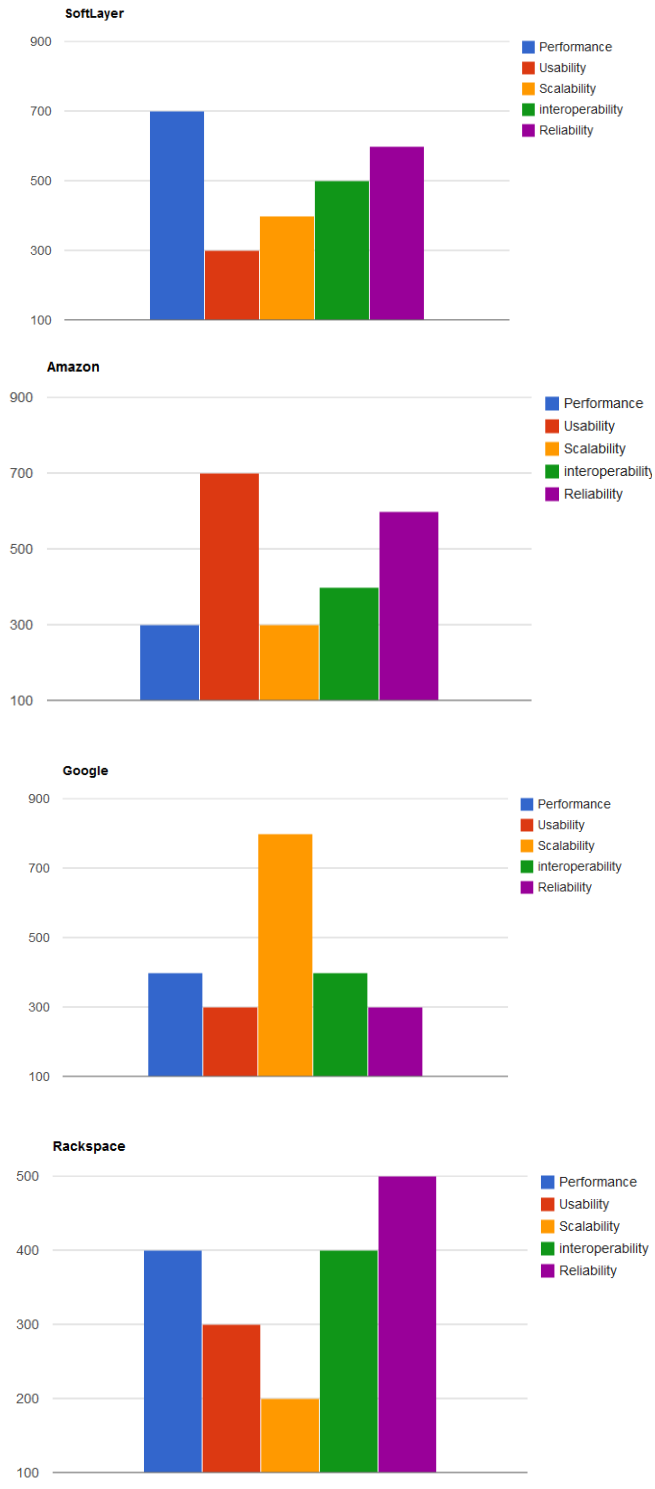

Fig. 5. Cloud providers Quality of Service for the requirement in question

- Once the consumer selects a services provider and start's consuming the service, the learning and recommendation layer for cloud usage is activated. This layer has the ability to store consumers chosen service provider and also monitor its activity (as part of SLA [5]). Note that for these activities cloud service provider is actively involved and interact with Engine component. This layer provides timely report to consumer through dashboard on cloud service usage. Also responsible for upgrade or down-grade SLA's [5] with recommendation of switching between different providers for cost effective cloud usage. This report is always based on cloud usage for a particular application and its expense as seen in Fig.6.

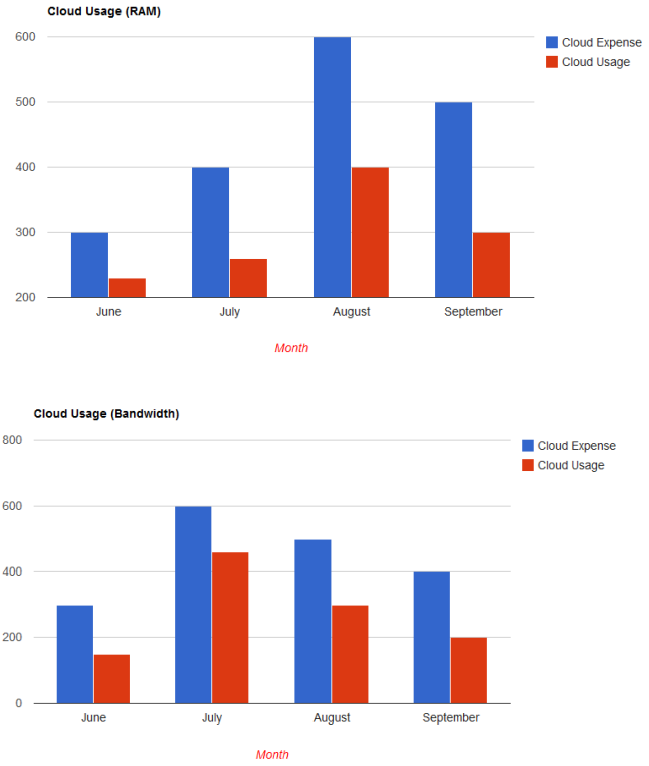

Fig. 6. Cloud Usage report

- Cloud usage report in Fig.6 indicates consumer need to down-grade service level agreement with the provider for cost effective cloud service usage. Also indicates whether consumer needs to switch to different provider for effective usage of cloud services as seen in Fig.7.

Recommended provider list after cloud usage report

Cloud Service Provider	Requirements	Cost	Cost Effective
Softlayer	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$200 per day	Yes
IBM	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$320 per day	No
Amazon	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$210 per day	Yes
Google	Server Operating System : AIX 7.0 Disk Size : 200 GB RAM : 10 GB Bandwidth : 100 Mbps IP Version : IPV6 Support , IPV4 Support Required Software : Rational Team Concert , Python , Java	$310 per day	No

Fig. 7. Recommended provider list after cloud usage report

- All the data generated are stored in Database component for data retrieval at later stage. Experiments

carried out are part of stimulation and doesn't involve real time data.

- Cloud service provider learns all the activity through Engine to improve their requirement engineering strategy and improve quality of service to expand their offerings. Note that cloud service provider component is dynamic (always in sync with Engine layer) and constantly updated, which is a drawback of Stake Cloud Platform [2] where service offerings are extracted from provider. This might not be true at the time of consuming service since its not dynamic Fig 8.

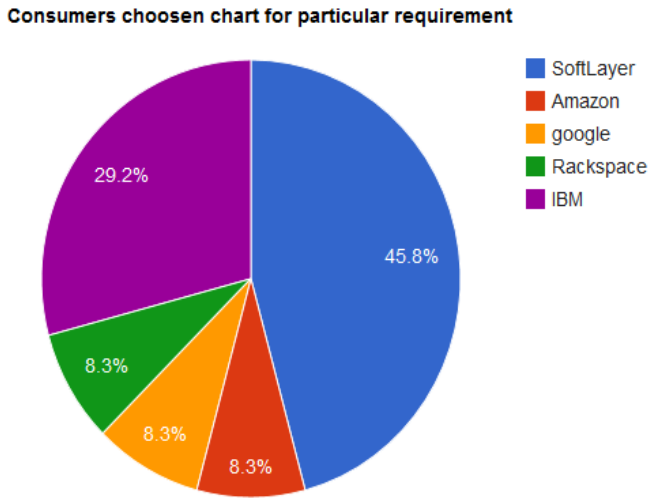

Fig. 8. Consumers Choosen chart for particular requirement.

Cloud provider market platform dashboard is driven by data. As data is collected, Engine layer writes new rules to retrieve data for consumer to choose right service provider for that particular requirement. Also provider understand requirement and enhance their requirement strategy to provide matching quality of service.

IV. Furture Work and Conclusion

The main contributions of this research lie in enabling consumers to find the best mapping cloud services for their requirement, and in supporting providers to identify real consumer needs. Above research experiment is part of stimulation and doesn't involve real time data.

Future work includes implementing this research work involving all the stake holders in real time. And also to improve performance and automatic switching between providers for cost effective cloud usage. There is a need to integrate SLA trust model with the above proposed dashboard [9].

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References

[1] R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic. Cloud computing and emerging it platforms: Vision, hype, and reality for delivering computing as the 5th utility. Future Generation Computer Systems, 25(6):599–616, 2009.

[2] Todoran, I., & Glinz, M. (2012). Towards bridging the communication gap between consumers and providers in the cloud. Proceedings of the WICSA/ECSA 2012 Companion Volume on - WICSA/ECSA '12, 78. doi:10.1145/2361999.2362012.

[3] S. Lichtenstein, L. Nguyen, and A. Hunter. Issues in it service-oriented requirements engineering. AJIS, 13(1):176–191, 2005.

[4] P. Patel, A. Ranabahu, and A. Sheth. Service level agreement in cloud computing. In Cloud Workshops at OOPSLA09, pages 1–10, 2009.

[5] J. J. M. Trienekens, J. J. Bouman, and M. V. D. Zwan.Specification of service level agreements: Problems, principles and practices. Software Quality Journal, 12:43–57, 2004.

[6] B. Verlaine, I. Jureta, and S. Faulkner. Towards conceptual foundations of requirements engineering for services. In Proc. RCIS 2011: 5th Intl. Conf. on Research Challenges in Information Science, pages 1–11. Gosier, 2011

[7] http://www.infoworld.com/d/cloud-computing/what-cloud-computing-really-means-031

[8] http://searchcloudprovider.techtarget.com/definition/cloud-provider

[9] Alhamad, M., Dillon, T., & Chang, E. (2010). SLA-Based Trust Model for Cloud Computing. 2010 13th International Conference on Network-Based Information Systems, 321–324. doi:10.1109/NBiS.2010.6