

Computational Resource Charging Mechanism for Applications Running in a Cloud Computing Environment: The case of ethio telecom

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Abstract

This paper focuses in examining mechanisms for measuring computational resources and pricing applications based on resource usage in a cloud computing environment in order to charge users. The intension is to maximize the utilization of the computational resource while trying to minimize the costs. This mechanism enables pay for use, which is, charging the user based on computational resource consumption and usage of a service instead of resource reservation or allocation. Accounting mechanism, which is responsible for keeping track of usage statistics of the system's resources and classifying them per user and application has been used to collect the usage of computational metrics and this information is important so as to estimate the cost that has to be charged to each user and to determine how the application's resource usage is responsible for the user expenses. The collected computational resource usage statistics is used by a pricing method to define the amount that has to be charged.

A case study was conducted in ethio telecom, a telecom company in Ethiopia currently preparing to introduce its own cloud services. Interview was conducted with managers and IT officers of the company so that it can be used as input for the experimentation of the accounting mechanism and qualitative analysis was employed for processing and summarizing findings. Finally, we proposed resource utilization aware charging framework to calculate the transaction cost of a service that is provided in a cloud computing environment. The framework includes a way to measure the resources (CPU, memory, bandwidth, and disk) utilized by a particular service and use it for charging.

Keywords: Cloud Computing; measuring computational resources; Pricing Applications

1. Introduction

Organizations are adopting Cloud Computing as a way to reduce the cost and complexity associated with traditional IT approaches. It has become the current emerging trend in delivering ICT services by enabling on demand resource provisioning and pay-per use business models [1]. Cloud computing has many characteristics such as high dynamic utility computing, the ability to access and pay for more or few resources such as storage and central processing unit [2]. The variety of services provided by cloud computing can be classified and organized into three major offerings: Infrastructure as a Service (IaaS), in which the user is provided with processing, storage, networks, and other fundamental computational resources; Platform as a Service (PaaS), in which the user is provided with preconfigured runtime environment, and Software as

a Service (SaaS), in which the user is provided with ready to use applications running on cloud infrastructure [3]. Because of this emerging technology, users are shifting to a paradigm in which they do not own resources, and pay for the usage of remote resources [4]. Pay per use is charging customers based on usage and consumption and it makes users aware of the cost of doing business and consuming resources by helping them to make more efficient and selective usage. This in turn results in less waste of resources and lower costs [5].

Ethio telecom is a telecom company in Ethiopia providing different telecom services. It envisions an information-based Ethiopian society where all Ethiopian people have access to information infrastructure on equitable basis. Ethio telecom shall be an internationally recognized, agile, strong and vibrant world-class ICT infrastructure and services

provider. As ethio telecom is planning moving to cloud computing to gain the enormous advantages of cloud computing and exploit new business opportunities, it will benefit from developing a charging model which is based on actual resource usage, instead of resource allocation or reservation. This provides many benefits including providing visibility of resource utilization, encouraging green computing, facilitating capacity planning and budgeting, and providing a mechanism for enterprises to justify and allocate their costs to their stakeholders. As a result, developing a charging model helps not only to bill the customer but also provides a way to map resource usage within a cloud to the service users, which is essential for proper capacity planning. Consequently the main purpose of this paper is to evaluate different charging models and to design a charging model for cloud services provided by ethio telecom. Cost or price of a service may include operating cost (pay per use), availability cost (if the service is provided subscription based), and startup cost (one-time charge). This paper focuses on the operation cost which has the highest share on the total cost of a service [4].

2. Related Work

The literature review in this section shows the different approaches to pay per use mechanism in cloud services.

The capability of cloud systems to automatically manage and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., processing, storage, bandwidth, and active user accounts) is called measured services. Resource usage can be monitored, controlled, and reported, which provides transparency for both the provider and the consumer of the service.

According to [4], current trends in the computing field envision a model that consists of services, provided in a manner similar to utilities such as electricity, gas, and water. A basic characteristic of this provisioning model is that users consume resources and are billed according to their personal demand. This current trend, which is cloud computing, attempts to realize the vision of utility

computing, through provisioning of virtualized hardware, software platforms, and applications as a service over the Internet.

Amazon EC2 (elastic Cloud Compute) is one of the most known cloud service provider. It provides on demand instances that let the customer pay for compute capacity by the hour with no long term commitments. Pricing is per instance-hour consumed for each instance, from the time an instance is launched until it is terminated [6].

It is discussed in [7] the indispensable role metering plays in cloud computing. It enables us to collect cloud computing resources, calculate metrics, and build up the basis for the upper layer billing services.

3. The Proposed Approach

When an enterprise subscribes for an application service, for instance an email service for his company, the service provider provides it an application running on a virtual machine instance in a multi-tenant manner. The consumer will have a limited right on the virtual machine instance depending on the SaaS maturity level [8] used during the deployment and for this specific virtual machine, the resource usage is monitored, collected, and prepared for billing purpose. This helps charging the customer in actual pay for use which is based on actual usage of a service instead of resource reservation or allocation. Figure 1 shows the proposed conceptual approach which outlines the possible high level courses of action in order to collect and store computational resource utilization for a service and then calculate the service transaction cost based on resource utilization.

The first step in this process is the consumer requests a service from a service provider/broker, registering the customer virtual machine instance so that the computational resources can be collected will be part of the provisioning, and as soon as the virtual machine instance starts running, the metering tool starts to collect the usage data and sends this result to the mediation system. The mediation system formats the received message and sends it to the billing system. Service portal will be provided to the customer to check their bill and different information

about the services like the resource usage and the pricing calculation mechanism. Refer to figure

bellow for the detailed conceptual framework.

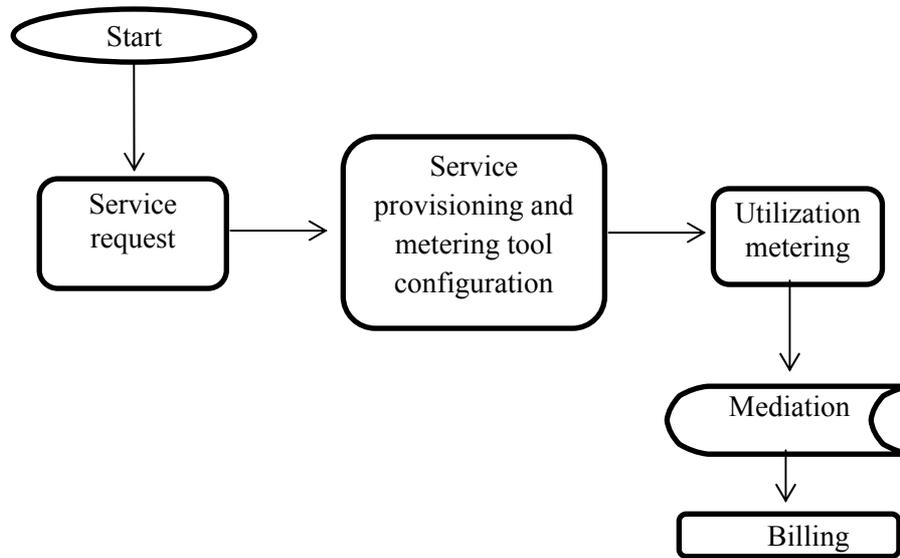


Figure 1: The Proposed Conceptual Approach

In the proposed model, the actual transaction cost calculation is done by the billing system component. To do this, the component takes into account the following inputs.

The measured utilized resource by a particular service (CPU, memory, bandwidth and disk) will be received from the accounting/metering component. This is because the calculation of transaction cost of any system that provides a service should have a way to quantify the amount of resource that the particular software or service utilizes when running the service. The measuring unit should be based on sensitivity of the resources.

- The cost per unit of each resource is also required. This part should be decided by the business unit
- Then the transaction cost model will combine the amount of resource used and the unit price, and calculate the transaction cost of availing the service.

4. Conclusion

Resource utilization aware charging framework to calculate the transaction cost of a service that is provided in a cloud computing environment based on the amount of computational resource (CPU, memory, bandwidth and storage) utilized is implemented. A case study has been conducted to

collect information regarding cloud computing, nature of the services provided, and current pricing mechanisms. We have also tried to show how the proposed solution could work by measuring, collecting, and quantifying the computational resources during the experiment. It has also been discussed how the framework measures the resources utilized by a particular service (CPU, memory, bandwidth, disk). The measured resource usage is collected and quantified in such a way that it can be used for pricing [9]. The cost model takes the amount of resources used and the unit price, and then calculates the transaction cost of availing the service. The cost model calculates the cost based on nature of service and the service user requirement, which means for the same service, different users might need to pay different amount. This way it is possible to solve problems related with differences in resource utilization and implement pay for use that is based on resource utilization.

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