METERING THE CLOUD PROVIDERS

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Abstract: Cloud computing has recently emerged as a modified computing platform, which offers a variety of services for different level of users. At the moment, such services are offered at very low prices, but as the concept of cloud computing will find more adopters, a real market will emerge. At that point in time it will be critical for the customers to verify the bills that they receive from their cloud provider. Therefore, there is a need to not only verify the correctness of the bill but also that the whole process should be real time and automated. An automated cloud metering solution is presented in this paper. The idea is to design a meter which monitors the respective activities as defined in the terms of SLA and generates a bill accordingly. This generated bill will then be automatically compared with the cloud provider's bill for any errors. This position paper describes the architectural design of the cloud meter and functioning of the automated meter, and then concludes with the information about the future work.

1 INTRODUCTION

Traditional grids and data centers have recently evolved into cloud computing with an economical pricing model, based on the utilization of resources. With the introduction of friendly user interface, cloud computing allows the users to deploy their application on a highly scalable, available and fault tolerant platform, hosted by the cloud providers (Cloud Providers, 2010). Cloud computing major reason of success is the economic model associated with it, i.e. "Pay as You Go (Cloud economic model, 2010)". The users are only billed for the amount of the service used, rather than paying for the whole package. An SLA is an electronically (sometimes paper based) signed agreement between the user and the cloud provider for the service the user is interested in and thus billing is done accordingly (EC2, 2011) (Azure, 2011). But there is no method till writing of this paper, which allows the user to independently verify the bill being sent by cloud provider for services usage.

Metering is a widely applied concept for measuring the volume used of any utility. Meters are being constantly used in our daily life such as electric, water and gas meters. These utility meters not only help to measure the usage of utility but also helps the consumer to have the confidence that the amount he has been billed is correct. It is a human nature that when money involves in any sort of activity, the trust line becomes thin. He wants to make sure that he is not being cheated or fooled.

The development of the Internet has bridged the path to the new information era and with the advent of cloud computing, we are now moving one step forward towards making computing as a utility. Cloud computing offers different services (Lizhe, Gregor, et.al., 2008) to users, among which some of the famous ones are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). These services are offered at very attractive prices and allow the organizations/users to reduce their cost on purchasing computing hardware, software and then later maintaining them. The cloud computing also leverages the users from worrying about investing in the up-gradation of their systems at some regular time intervals.

To enjoy any of the service offered by the cloud provider, the customer formally e-signs the contract defined in terms of the SLAs with the service provider. The SLA basically specifies contractual commitments of the provider on which services will be offered to the customer. The committed quality level of a service is specified in a set of Service Level Objectives (SLOs) in the form of service metrics, threshold values, and tolerances (Telemanagement Forum, 2011). Billing by the

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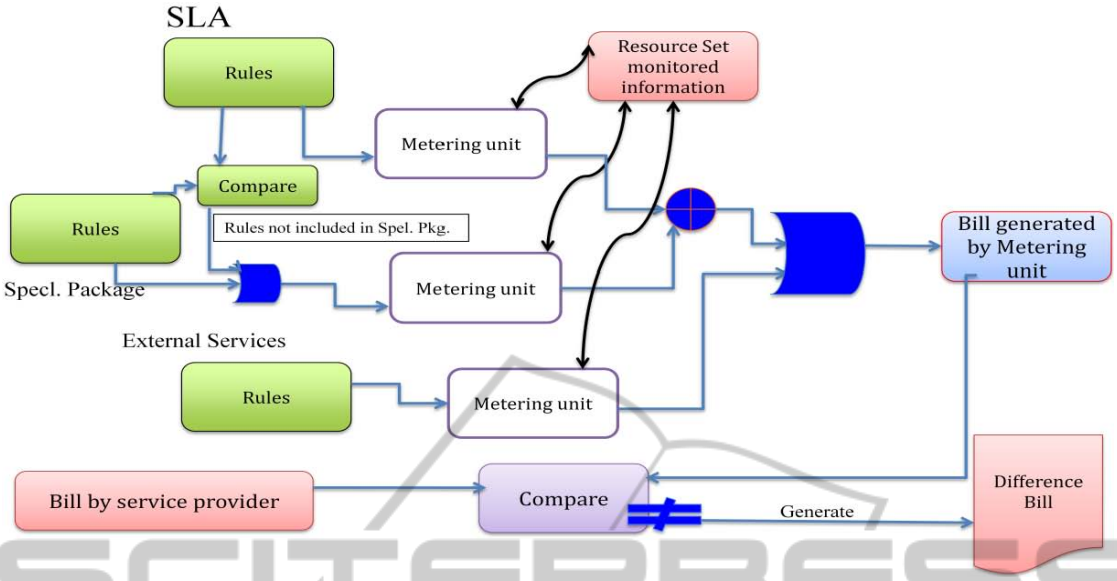

Figure 1: Cloud Meter Architecture.

cloud providers for the usage of services are done on the terms finalized in the SLA.

This paper talks about the design of a cloud meter that can be used by the user to independently and automatically very the bill being sent by the provider. By using this cloud meter the user will then have the confidence that they are being billed only for the resources they have used. In case the cloud provider fails to meet any terms mentioned in the contract, the penalties could also be identified and then verified automatically.

2 RELATED WORK

Industry as well as academia have done research or developed some products for monitoring SLA compliance. However, most of these approaches are narrowed to some specific services, e.g., web services, or a certain set of SLA parameters, e.g., availability, round-trip time, and response time (Daidalos, 2004), (Hasan, Stiller, B., 2007), (Keller, A., Ludwig, H., 2003) (SSSC). The IBM's Web Service Level Agreement (WSLA) Framework gives a general concept for the SLA management and mainly focuses on web services (Keller, A., Ludwig, H., 2003). The SLA management lifecycle by IBM comprises of five stages: negotiation and establishment, deployment, measurement and monitoring, corrective management action, and termination (Keller, A., Ludwig, H., 2003). The functionality needed for these various stages is implemented as WSLA services, which interact across different domains.

However, these monitoring approaches and tools cannot be applied to the cloud computing because cloud computing doesn't give access to underlying hardware. Only a virtual OS is the interface, which is hosted on a hypervisor. And thus this virtualization layer hides all underlying information of the hardware from the interacting user. Although some companies (Monitoring), have launched commercial monitoring service for cloud computing but these monitoring software are mostly restricted to monitor certain features of cloud providers. However need of a general 3rd party automated metering tool to monitor cloud providers in an independent manner are still missing.

3 ARCHITECTURAL DESIGN OF CLOUD METER

Fig.1 depicts the cloud metering architecture having the Metering Unit as a major component, which consists of sets of automated meters. The automated meters may or may not interact with each other for conducting a particular metering. The Metering Unit implements the Meter Algorithm for a particular metering application. A meter algorithm is a technical description of rules signed in the SLA.

A metering process requires at least two types of input: SLAs (the regular SLA signed at the beginning of a contract. Additionally if some special

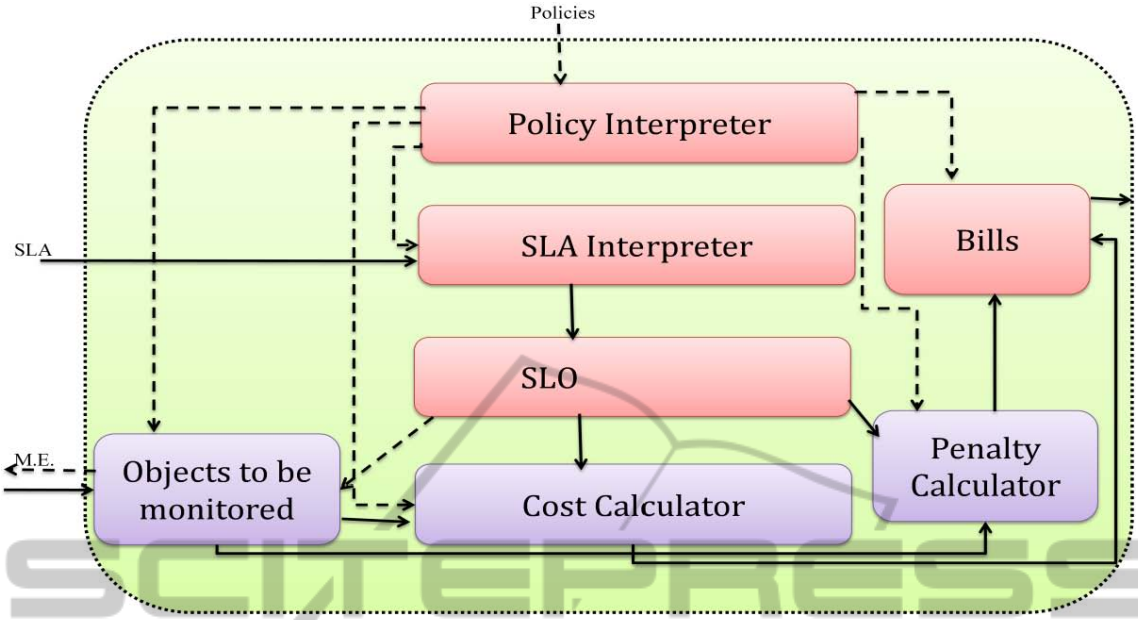

Figure 2: Automated Meter's Internal Architecture.

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package is offered by the provider during the age of contract for some special service then this SLA also becomes the part of an input. It is not necessary that this special package covers all the areas of the signed regular SLA, therefore this is considered as an additional input only at the time it is offered. Beside the above two mentioned SLAs, if some other external service(s) being used then it's SLA is also considered as an input for the metering unit) and secondly the monitored information (provided by the Resource Set monitored information). Monitored information describes what actually happens, whereas SLA describes expected situations. The metering unit then evaluates these data using the automated meters.

The result of this metering process is the bill generated by combing all the metering units. This generated bill is then automatically compared with the cloud provider's bill and is checked for any difference in the two bills. In case of any difference, a bill containing the areas of differences is generated. For transparent metering of the cloud providers, none of the components has to be installed on the cloud provider's servers. But for different service layers of cloud computing, the cloud meter component placements and monitoring methods vary. But these placement techniques and monitoring methods are not discussed in this paper.

4 INTERNAL ARCHITECTURE OF AN AUTOMATED METER

As described, a metering unit contains a set of automated meters and it implements the meter algorithm for a particular application. This means that automated meters have the task to execute the metering algorithm. In order to reduce implementation complexity and to achieve modularity, the following assumptions are made in designing the architecture of an automated meter:

- A metering Unit deals with a set of SLAs. Without the loss of generality each automated meter is assumed to be responsible for a particular SLA.
- Each SLA contains a set of conditions linked by a logical expression. Hence, the result of the evaluation of each condition as well as the evaluation of the logical expression linking all the conditions determine the compliance of relevant monitored data with a SLA.

The approach developed here proposes the following common metering algorithm:

1. Interpret and apply valid monitoring policies during the metering.
2. Interpret the assigned SLA Specification, for which the automated meter is responsible.
3. Retrieve relevant monitored resource usage data.
4. Evaluate monitored data whether they meet SLA conditions. Evaluate the logical expression linking

all SLA conditions and accordingly calculate the cost.

5. Generate a bill as a result of the evaluation.

Fig.2 shows the architecture of the automated meter to execute the proposed meter algorithm. The Policies Interpreter (PI) takes policy decisions and configures other components based on metering policies. The SLA Interpreter retrieves the SLA assigned to the meter based on the configuration information from PI. The SLA interpreter; then generates the SLOs and cost calculator. Cost calculator takes the relevant monitored resource usage data and then generates the relevant usage bill from it. The SLO determines whether there is a violation of the SLA based on the result of monitored data. In case of any violation, the respective penalty cost is calculated by the penalty cost calculator and the cost is then added to the bill. The final bill is then sent to the bill generator.

5 CONCLUSIONS

An architectural design step for metering the service usage on cloud providers has been completed. Since different layers of services offered by cloud computing have different user interfaces, therefore different monitoring techniques are being currently studied and are in final stages of designing the monitoring block. Implementation of the metering unit will then be started immediately and as a first step the SLA interpreter will be made. The ultimate goal is to have a framework for automated metering of different service layers offered by cloud computing giving users the confidence that they are not being overbilled.

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