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DESIGN OF AGENT BASED SYSTEM FOR MONITORING AND CONTROLLING SLA IN CLOUD ENVIRONMENT

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ABSTRACT

Cloud Computing is mainly used as utility where cloud user hires services on pay-per usage mode. Cloud Provider provides services and Cloud User avails services. The services are provided on mutually agreed terms and conditions. Service Level Agreement (SLA) is an agreement between Cloud Service Provider and Cloud User, describing terms and conditions of services being offered. The SLA has both functional and non-functional requirements and has multiple levels. In order to maintain the synergy of Cloud user, the resource allocation has to be strictly monitored and controlled. Any deviation of SLA parameters has to be immediately highlighted as it affects both Cloud user and Cloud Provider. This paper presents the design of Agent Based Monitoring and Controlling multi level SLA in Cloud Environment. The agent monitors functional SLA parameters contiguously and compares against the agreed SLA parameters. It also generates alerts in case of any deviation. The proposed design will help both Cloud Provider and Cloud User in controlling agreed levels of SLA parameters.

Keywords: Agent, Cloud Computing, Service Level Agreements (SLA), SLA Parameters, Monitoring & Controlling SLA Agent

I INTRODUCTION

Cloud Computing model enables user to have on-demand access to resources from available pool of resources. The Cloud provider insures the reliable services to Cloud user. The demand of resources to accommodate exponential growth of ICT has made Computing as fifth essential utility after water, electricity, gas and telephony [1]. Cloud computing is an on-demand computing where cloud users are provided with pool of hardware and/or software resources and these resources can be used in pay-per-use basis [2]. Cloud computing raises many issues related to service contracts in implementation and deployment stages both at Hardware and Software levels. These issues further relates to service contracts management and compliance checking. By managing these issues motivation/interest of Cloud user can be maintained in cloud services.

To ensure reliable service, the Cloud provider monitors and controls the set of Terms and Conditions agreed with Cloud user. Agreed Terms and Conditions are mentioned in Service Level Agreements (SLA). It is considered as the most important element that provides some degree of assurance to both Cloud users and Cloud providers in the Cloud paradigm. The SLA defines the scope of usage and provision of resources. Cloud provider needs SLA to define the trust and quality of services they provide to users as well as an agree framework for costs and charges. This makes monitoring and controlling SLA the most important from Cloud

provider side. The Terms and Conditions are mostly part of resources that to provide to Cloud user like RAM, computation time etc. The resources are provided from a common pool.

SLA plays a vital role in enforcing Quality of Service (QoS). The issues related to SLA in Cloud computing are about service availability, response time, performance, security etc. Thus a dynamic and volatile agent based system is required to monitor the terms of SLA and act timely to provide QoS in Cloud and ensures trust of Cloud users. This motivated to frame and design an agent based system for monitoring and controlling SLA and has been described in the paper. The paper has been organized into six sections; section II reviews the background and related work, section III briefs the architecture of proposed system, section IV details multilevel SLA, section V describes the design of proposed Agent based system for monitoring and controlling SLA followed by conclusion and scope for future work in section VI.

II BACKGROUND AND RELATED WORK

Service Level Agreement (SLA) is a document that includes a description of agreed services, service level parameters, guarantees, actions and remedies for all cases of violations. Thus SLA is an important agreement of negotiations between Cloud service provider and Cloud user. The SLA is very important to determine the resource/services availability, reliability, scalability, security, etc. Furthermore, SLA is a legal document which describes the way in which services will be made available and framework for service charges.

SLA compliance has been implemented and validated in research projects of French ANR SemEUsE and European Celtic SERVERY cooperative [3] [4] [5]. The three layered model comprises of Service Monitoring (top level), Data Collector (middle layer) and Core Monitoring (lowest level) is used. Core Monitoring takes data from low level indicators i.e. from hardware and passes data to Data Collector layer which filters and processes data received and send it to Service Monitoring layer in the appropriate format [6]. This ensures the services are provided to Cloud users. SLA parameters are classified into functional and non-functional requirements. In order to fulfil the need of Cloud user, both functional and non-functional requirements of Cloud services are satisfied. Non-functional requirements like availability, scalability, cost calculation method, configuration of service are used in monitoring SLA.

The agent based three layered model is used for Monitoring and Controlling SLA in Cloud Environment [7]. The agents are considered to be autonomous entities, such as software programs or robots [8]. The agents interact with each other for a selfish or cooperative goal. In other words agents can share a common interest or they can pursue their own interests. Agent must be able to change its behaviour based on changes occurring in its environment. Agent should be reactive, autonomic, collaborative in behaviour, adaptive, etc. In the three-layered architecture, lowest layer comes in the action as soon as Cloud user logs in and virtual machine is created/initiated. The Monitoring and Controlling Agent (MCA) as a Terms Collector (TC) gathers the SLA terms from Cloud service provider whenever new cloud user is registered. MCA as a Term Monitor (TM) gathers information from Cloud environment from time to time to maintain QoS being provided by the Cloud service provider. The information collected as TC i.e. SLA's agreed upon and data gathered as TM i.e. the SLA's being provided, are compared and any violations are projected as alerts to Cloud users/provider.

2.1 Proposed Model of Agent Based Monitoring and Controlling Multilevel SLA

Based on the review and background of related work, various SLA parameters currently used in ensuring Quality of Service (QoS) in Cloud environment, an agent based Monitoring and Controlling Multilevel SLA (MACSLA) has been modelled. Figure 1 shows architecture of proposed model. The Monitoring and Controlling Agent (MCA), as Term Collector (TC) gathers the agreed SLA parameters and their desired level from the database. The database stores information like profile of Cloud user and SLA parameters and their desired level. It also collects current SLA parameters and their level from running virtual machine as Term Monitor (TM). MCA then compares both the levels. On finding variation in the levels of SLA parameter, agreed and provided, alerts are sent to Cloud user as well as Cloud provider.

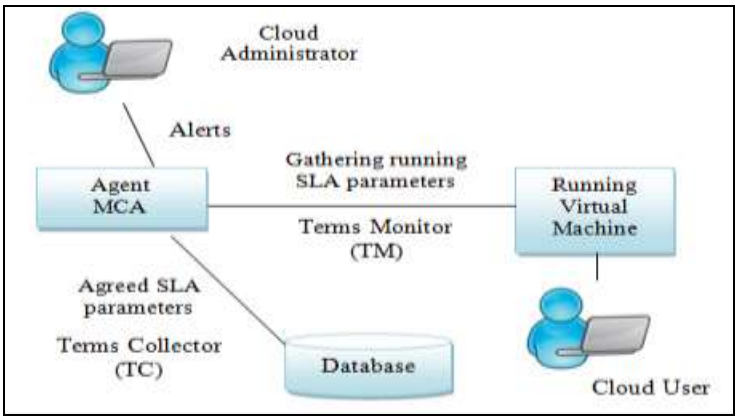

Figure 1: Proposed Architecture Of Agent Based MACSLA

This will help Cloud provider to ensure QoS as well as increase resources if required and provisioned in SLA. Cloud user will also have monitoring mechanism to avail services. The MCA monitors and controls the agree SLA parameters continuously so long as services are provided.

IV MULTILEVEL SLA

Various research-works on SLA parameters have been studied and identified in detail. The identified parameters are organized into three levels. Level 1 (L1) contains are basic SLA parameters being negotiated between Cloud service provider and Cloud User. Level 2 (L2) classifies these parameters into three groups: Infrastructure as a Service (IaaS), Platform as a Services (PaaS), Software as a Service (SaaS).

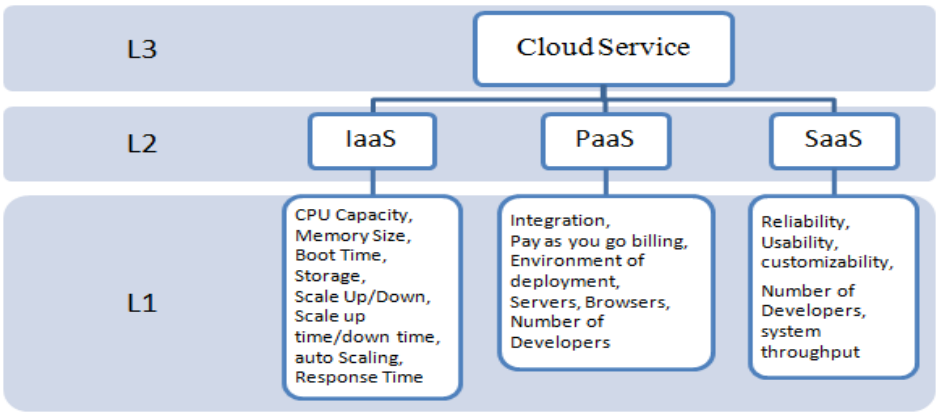

Figure 2: Multilevel SLA parameters

IaaS parameters are number of CPU cores, Memory size, booting time required to start Virtual Machine (VM), storage size, Scale up/down (maximum/minimum number of VMs for one user), Scale Up time/down time(time to increase/decrease a specific number of VMs), Auto Scaling i.e. user can scale up/down or not, Response time to complete and receive the process. PaaS parameters are Integration (Integration between services and other platforms), Pay as you go billing (charging based on resources or time of service), number of Developers using platform simultaneously etc. SaaS parameters are Reliability (ability to keep system operational in most of time), usability (easy built-in user interfaces), customizability (flexible to use with different type of users), number of users using software simultaneously, and system throughput (system response speed). All these parameters at L2 are further grouped into higher level i.e. L3 to know the overall QoS and named Cloud Service Parameter. The three levels and parameters at each level are shown in figure 2.

V DESIGN OF MACSLA

Based on model described in previous section, MACSLA agent has been designed. The designing includes Database Design, Agent Design and Process Design.

5.1. Database Design

The purpose of database is to store information on Cloud user, the agreed parameters and desired levels. The design of MACSLA has been shown in figure 3 as Entity Relation Diagram (ERD). It has four entities: user, virtual machines, running SLA and SLA. SLA contains SLA parameters and their desired levels. Virtual Machine contains parameters on which it has been created and provided to Cloud user on demand. Running SLA contains information on resources being used by virtual machine provided to Cloud user. User contains profile of Cloud user. User can have multiple agreed SLA parameters. User can demand machine for use. The responsibility of agent MCA is to store resource information continuously and compares with agreed SLA. On finding any deviation, MCA will send alerts. The tables have been designed based on Entity Relationship diagram in MySQL.

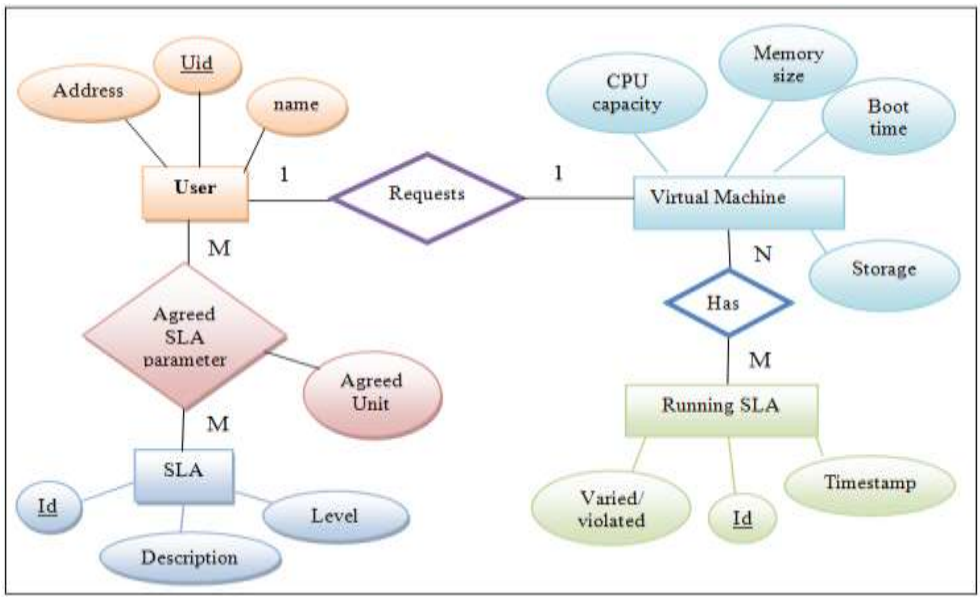

Figure 3: Entity Relationship Diagram

5.2. Agent Design

The roles and responsibilities of agent MCA has been identified and described in Figure 4. MCA agent has two major roles to play: Term Collector (TC) and Term Monitor (TM). The responsibilities of each role have been given below.

- As Term Collector, MCA gathers agreed SLA parameters from the Cloud Service Provider whenever a new resource has been allocated.
- As Term Monitor, MCA continuously monitors the current SLA parameters for the resource being used and compares with the agreed SLA parameters.

MCA performs three tasks. These are:

- Keeps strict vigil on new upcoming resource i.e. creation/initialization of Virtual Machine, Cloud user activating or booting new/existing VM.
- Monitoring/retrieving agreed SLA parameters.
- Gathering SLA parameters of VM in action or running VM.

It takes input as agreed SLA parameters, SLA's currently being provided to Virtual Machine and compares the parameter values and generate alerts as an outcome.

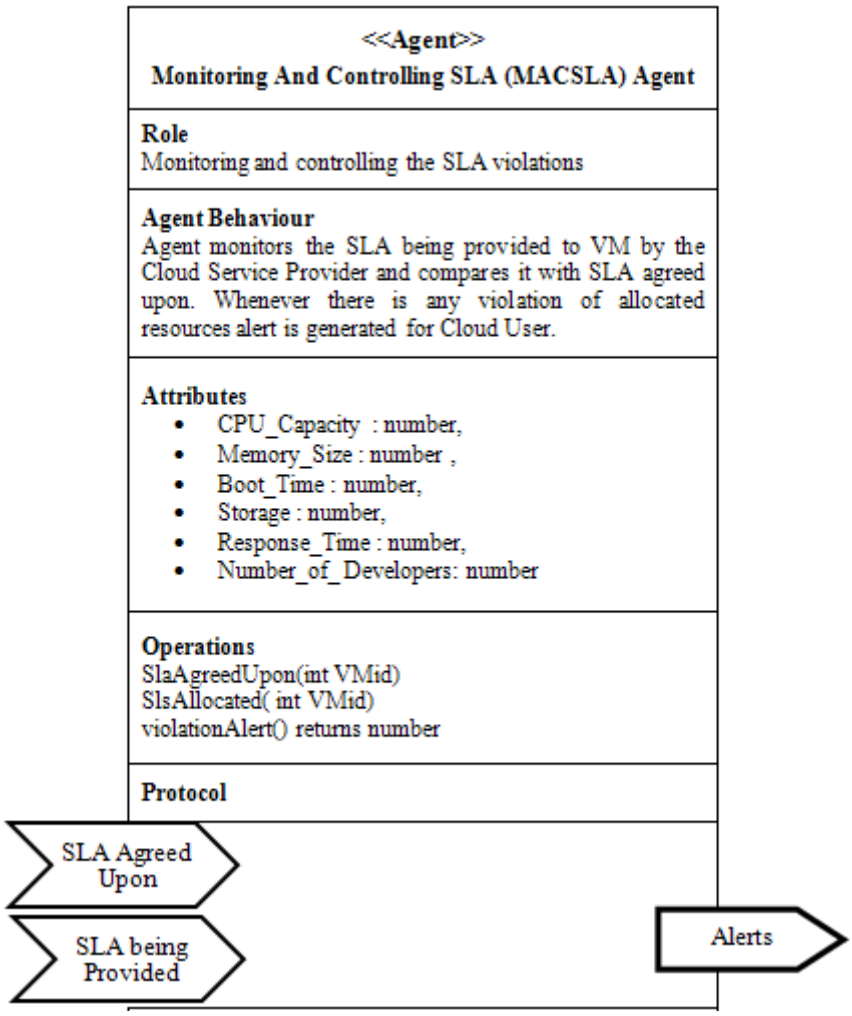

Figure 4: Description of MACSLA Agent

5.3. Process Design

The Activity Diagram shown in figure 5 describes flow of various activities being carried out by MAC agent. Agent comes into action when Cloud Service provider starts allocating resources to Cloud users. Agent looks for running virtual machine (VM) it gathers agreed SLA parameters and running level of SLA parameters. It then compares these values and on finding any deviation, alert is generated and reported to Cloud user and Cloud provider.

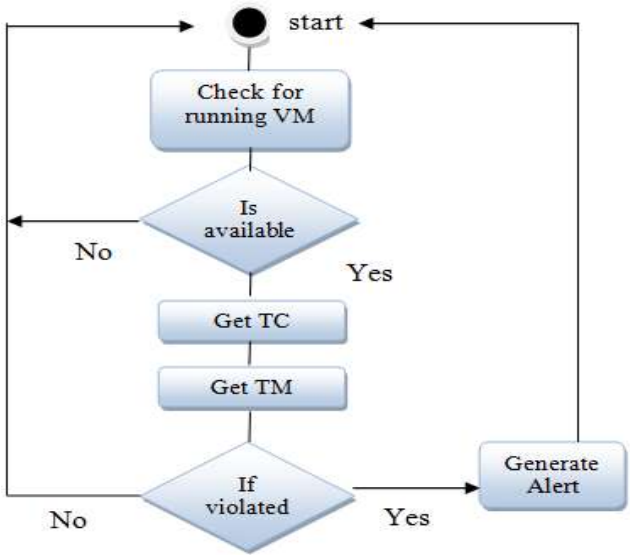

Figure 5: MACSLA Activity Diagram

VI CONCLUSION AND SCOPE FOR FUTURE WORK

The proposed design of Agent based Monitoring And Controlling SLA (MACSLA) will ensure quality of services in terms of maintaining agree levels of SLA in Cloud Environment. The agent, MCA, dynamically generates alerts to in case of deviation and sends to both Cloud provider and Cloud user. The functional SLA parameters used by agent are also identified as hierarchy of three levels. The designed three levels SLA will help in quantifying quality of services at individual parameter level, service level and Cloud provider level. The scope for future work includes: implementation of design of MACSLA in Cloudsim environment based on Agent technology, verification and validation of tasks performed by agent.

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