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Dynamic SLA Management from a Cloud Consumer Perspective: Issues, Challenges and Next Steps

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***Abstract*—**Cloud Consumers and Cloud Providers represent the key stakeholders in the Cloud Computing world. While Cloud Providers, provide the infrastructure, service and QoS, Cloud Consumers need to access those services to fulfil their user needs. This paper looks at the challenges Cloud Consumers face w.r.t Managing, Monitoring, Alerts, Penalties, Viewing the Policy Changes w.r.t SLA's. Currently there are very few tools and mechanisms that help Cloud Consumer to get this data. This Paper proposes different solutions, a. Directly by Cloud Provider, b. By a Agent via Cloud Provider, c. By an Agent with less interaction from Cloud Provider. This paper presents best solution i.e. By an Agent via Cloud Provider and also provides suggestion to develop a web interface tool that covers the entire SLA Life cycle.

***Keywords*—**Cloud Consumer, Agents, SLA, Dynamic SLA, Cloud Providers, QOS

I. INTRODUCTION

In Cloud Computing both Cloud Consumers and Cloud Providers work together to ensure the SLA which was promised is met. [1], [2]. There are many stages at which SLA's are agreed upon, Defined, Negotiated, and Monitored etc. Currently most of the papers discuss on the mapping studies for SLA [1], Selecting providers based on the SLA (MinChao Wang et all) but don't discuss on the tools or mechanisms that can be used to simplify the process. This paper looks at tools available for Cloud Consumer through which one can get all details related to SLA Management. Also, this paper looks at issues with these tools, mainly with dynamic updation of SLA's based on the policy changes at the Cloud Provider end and also editing/customizing the standard SLA templates that will save a lot of time for both Cloud Providers and Consumers. Note that this paper does not involve the discussion of Dynamic Provisioning via Mathematical equations.

Our contributions in this paper are as follows:

1. Proposing a generic approach on how an Agent can help a Cloud Consumer too dynamically monitor the SLA's that are being met by the Cloud Provider.

Processes involved which can help SLA Monitoring to be seamless to the cloud consumer

The rest of the paper is organized into the following sections. Section 2 presents related works. Section 3 presents Methodology and discusses the Issues in Managing SLA by a Cloud Consumer and Proposed Solutions, Section 4 presents Results via the Evaluation of the current tools and what a new tool should be capable of, finally, Section 5 covers conclusion.

II. RELATED WORK

Current work on SLA management revolves around systematic studies and also on Frameworks for Cloud Hosted Databases, but there are not many papers that talk about the tools that a Cloud Consumer can use (Via a Agent) which can be used for SLA management and dynamic updates to SLA whenever the policies change from the Cloud provider end

Table 1

Author	Techniques	Strengths	Limitations
Saad Mubeen et all	Management of SLA for Cloud Services in IoT : A systematic study	A systematic mapping study that categorizes SLA into SLA Management, SLA Definition, SLA Modelling, SLA Negotiation, SLA Monitoring, SLA Violation and trustworthiness	Doesn't propose any study for tool support for various complexities w.r.t technical classifications

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		, SLA Evolution	
Liang Zhao et all	A Framework for Consumer-Centric SLA Management of Cloud-Hosted Databases	The framework continuously monitors the application-defined SLA and automatically triggers the execution of necessary corrective actions (scaling out/in the database tier) when required	Framework proposed is DB platform agnostic but doesn't take about other platforms in general w.r.t SLA Performance Requirements, SLA Violation etc
MinChao Wang et all	A Conceptual Platform of SLA in Cloud Computing	Reputation System to evaluate the reliability of providers or resources to address challenge of selecting the most reliable providers or resources	There are no models or implementation done to test the proposed platform, also there is no details mentioned on the Dynamic Price or Billing model

III. METHODOLOGY

Let's look at a typical SLA Life cycle (5):

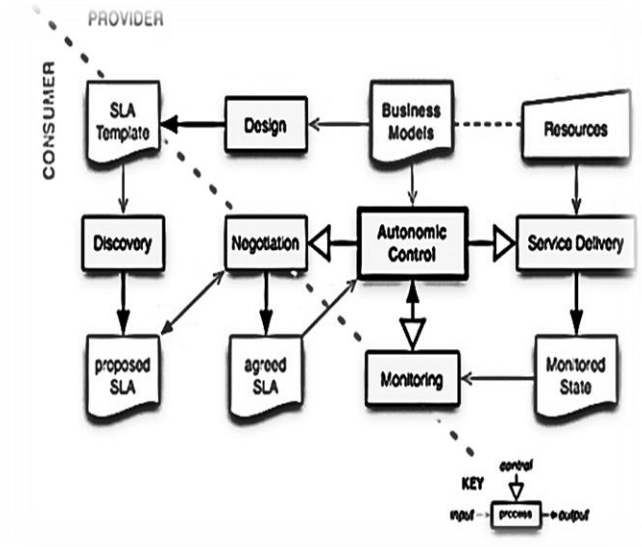

Fig. 2

Above diagram clearly establishes a view of the SLA life cycle between a Cloud Consumer and Cloud Provider. As seen a SLA template is generated which lists key SLA details (a sample template is presented below (4))

- Data backup for each database shall be retained up to 10 days. Copy of the log files will be retained up to 90 days
- Cloud Service <<<Name>>> shall be available for 23.5 hours in a 24 hour day, except during times of service maintenance. We intend to achieve a target service availability goal of 98% except during scheduled service maintenance
  - Service maintenance may cause errors however our Cloud Service <<<Name>>> shall try to limit the efforts to Severity level 1 errors to two hours per month

Financial Penalties for SLA violations:

Service Maintenance Times (Day)	**Service Maintenance Times (Hours)**
Monday to Friday	8am to 5pm (PST)
Saturday and Sunday	10am to 3pm (PST)

- In the Event Cloud Service <<<Name>>> fails to meet the guarantees, we will refund 5% of the customer monthly fees for every 30 minutes of downtime experienced.
- All SLA claims shall be communicated to Cloud Service <<<Name>>> via our Cloud Dashboard or emailed to customer support within 7 days with all relevant information like Cloud Name, IP Address, Full Summary of the incident, logs as applicable

Once the SLA is proposed, few rounds of negotiations happen between the Consumer and provider via an Agent and finally a SLA is agreed.

Following are the key issues:

1.1 Issues

a. Tools that provide Templates for SLA Generation for simplifying the work during negotiation

b. Cloud Provider does enable monitoring and dashboard, but how fast and to what extent a cloud consumer can refer to the reports via the agent is a major challenge

c. Understanding any changes by Cloud Provider to the QoS and / or policies that may impact the overall SLA
E.g. During Negotiation, Availability of the VM's is one of SLA (as per the sample SLA template), which was promised by Cloud Provider as 96%, however due to lot of maintenance and power issues, he changed it to 94.5%, Cloud Consumer should immediately be able to know this and also

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assess the impact of this on his applications and services.

d. Tools that provide data on penalties for any SLA violation, how can a cloud consumer be able to provide the data quickly to provider (as it has its own SLA) and with all information automatically without wasting time
e. Versioning of templates (offers) and archiving of SLAs, monitored data, SLA state & negotiation histories, and any other information that may prove useful to the design of future service offers.

1.2 Proposed Solutions

One solution is to have Cloud Provider give direct access to all tools developed by themselves without an Agent.

Advantage is Cloud providers can monetize these tools as part of their contract, Cloud Consumers can also get all details pertaining to Reporting, Template Generation etc.
Disadvantage is that Providers can provide tools that are not effective, even if they do they won't be able to share all Monitoring activities / update to their policies immediately.

Second solution is to have an Agent communicate with the Cloud Consumer, however agent can provide more details to Cloud Consumer

a. Agent can share SLA Monitoring with a 24 hour lag, of course the pricing model should be decided during the SLA initiation
b. Agent can share changes to policies within a 8 hour lag to Cloud consumer, so that they can come back if they foresee any risk to the contract and to their application uptime
c. Agent can give access to parts of the dashboard again with lag in time, This should be customizable at the Cloud Provider based on discussions during SLA initiation
d. Agent can let Cloud consumer give feedback on when SLA is breached based on delayed data provided.
e. Agent can let cloud consumer know (with the agreement from Cloud provider) when policy changes were done and how the SLA template got modified and if it's a negotiation. Also SLA should have a cap on number of policy changes Cloud provider can do in a given period of time.

One more solution is to have agent have tools developed at their end, which can be done separately by them or with the help of Cloud Consumers. SLA Monitoring Agent, Pay per use agent etc. kind of functionalities can be developed. Major drawback is Cloud provider may not agree with this kind of arrangement, given the amount of risks involved

Hence Solution two with the agent being mediator and providing delayed SLA services to Cloud Consumer is feasible.

IV. Results and Discussion

1.3 Current Tools

There are currently no tools that provide complete SLA life cycle, like template generation, SLA Monitoring, SLA Dashboard, SLA breach, Policy changes and Impact etc. Cloud providers with agents can develop a web interface that covers all of these features in one single tool.

E.g.https://www.idera.com/it-infrastructure-management-and-monitoring/sla-management-tools – This tool provides SLA Monitoring, alerting, reporting, SLA Dashboard but doesn't provide SLA template generation, Viewing and Policy changes and impact etc

Note that this paper does not involve the discussion of Dynamic Provisioning via Mathematical equations and it proposes the idea of build a web application to dynamically provision SLA Results and Policy changes to the consumer.

1.4 Results

Cloud Consumer requires new tools and inputs from agents to understand the services provided and also policies that have been changed

There is a need to develop new tools available that will give all capabilities SLA Monitoring, alerting, reporting, SLA Dashboard, SLA template generation, viewing and Policy changes etc. Hence a new web interface needs to be developed which can be used by Agent in the following ways :

a. Create a SLA template which can be used Cloud Provider to fill in all details, a automation notification Is sent to Consumer to accept the proposal or negotiate
b. Provide various dashboard reports after a time lag to monitor the policy changes, monitor the SLA etc
c. Tool should ensure Dynamic SLA Management by routing feedback from provider to the consumer on the impact to consumer applications
d. Tool should ensure that any policy changes displayed in the dashboard and needs proper negotiation is notified to the provider via tool as applicable. Note that Agent should be sent notification and initiate the discussion between the Provider and Consumer accordingly

V. Conclusion and Future Scope

In this paper we discussed on Issues involved from a Cloud Consumer Perspective in Monitoring SLA's and dynamically updating the SLA's. We looked at 3 solutions of which,

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Agents acting as a mediator and sharing less sensitive data with a delay to Cloud Consumer seemed to be more feasible. It's highly important that the Cloud Consumer gets required data which won't affect the Contract nor Compromises any of the policies or compliance from Cloud Provider perspective.

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