

Classification and Evaluation Criteria for the Selection of Cloud Service Providers with QoS based on SLA

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Abstract:

Cloud computing is revolutionizing the IT industry by enabling them to offer access to the infrastructure and application services on a third party basis. Due to the vast diversity in the available Cloud services, from the customer's point of view, it has become difficult to decide whose services they should use and what are the criteria for the selection? There are two types of QoS requirements which a user can have: functional and non-functional. Some of them cannot be measured easily given the nature of the Cloud. Attributes like security and user experience are not easy to quantify. Moreover, deciding which service matches best with all functional and non functional requirements is a decision problem. The Fundamental issue to handle such a problem is Quality of Service (QoS) parameters. Many SLA languages and frameworks have been developed as solutions; however, there is no overall classification and the criteria for these extensive works. Therefore, the aim of this research is to present a comprehensive study that how SLAs are created, managed by fulfilling the QoS in cloud computing environment.

Keywords: Quality of Service, Service Level Agreements, Cloud computing, Total Cost of Ownership

I. INTRODUCTION

In the present scenario of using the latest tool, cloud computing is one of the emerging technology which emphasize on lower Total Cost of Ownership (TCO), that pay as you go for the cloud services. Cloud computing entrusts services with a customer's data, software and computation over a network. A cloud is an interactive application on the Internet which is composed of two parts: a cloud client and a cloud service. Common applications of a cloud client are based on web pages and mobile applications. Cloud services examine the four kinds of cloud services which are: SaaS, PaaS, IaaS, and Storage as a Service. Quality of service (QoS) represents functional attributes of the given service based on quantity or quality. It represents the ability of a network or system for presenting better services. Represented services in cloud computing environment have qualitative attributes such as accountability, agility, cost, performance, assurance, usability, security and privacy. With the growth of public cloud offerings, for Cloud Customers it has become difficult to decide which provider can fulfill their Quality of Service (QoS) requirements. Each Cloud provider offers similar services at different prices and performance levels with different sets of features. While one provider may be cheap for storage services, they may be expensive for computation. SLA (Service Level Agreement) contains the agreed service, parameters of the level of service, the guarantees regarding the Quality of Service, and arrangements. The SLA is very significant as a contract that is held between the provider of the service and another party who could be one of following; consumer of the service, broker negotiator, or monitoring negotiator. SLA is a formal agreement to promise what is possible to provide and provide what is promised, Sun Microsystems Internet Data Center group (2002).

II. SLA CLASSIFICATION

An ideal SLA has the following components:

- **Service-level objectives (SLO):** In this the objectives of the different which is to be provided by the providers and the customer are approved. Some service level indicators such as availability, performance, and reliability etc.
- **Purpose:** The main aim of using the services of the cloud is defined i.e. why we are interested in SLA.
- **Restrictions:** The different restrictions are purposed by the customers and the CSP. These restrictions may be in the form of time, usage, cost etc.
- **Validity period:** SLA working time period is defined. Here the beginning of the project and its completion is determined from both ends.
- **Scope:** Services that will be delivered to the consumers and services that will not be covered in the SLA. SLA structure should illustrate the service that which levels the services is provided to the consumer.
- **Parties:** SLA is always between the two parties i.e. cloud service providers and consumer.
- **Penalties:** If delivered service does not achieve SLOs (Service-level objectives) or is below the performance measurement, some penalties will occur.
- **Optional services:** Services that are not mandatory but might be required as exclusion.
- **Administration:** Defines the procedures formed in the SLA to achieve and measure its goals.

- **Exclusions:** States what is not included in the SLA.
- **Service-level indicators:** These are the parameters which are used to measure the performance of the CSPs.

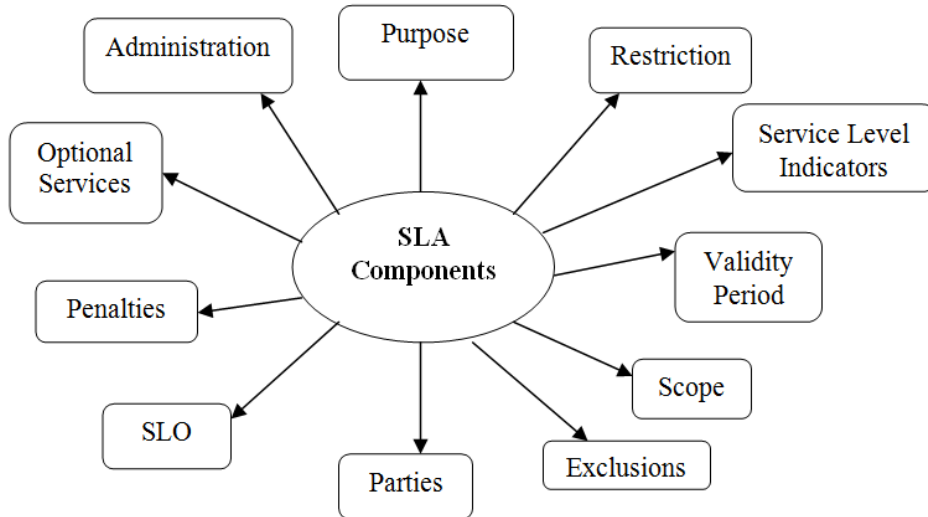


Figure1: SLA Components

SLA and Cloud Computing

It is the blueprint for the CSPs and the SLA that sets expectations for both parties and acts as the roadmap for change in the cloud services. It creates the roadmap with clearly defined SLOs. The different aspects of CC (Cloud Computing) will be taken into the account for architecting the Service level agreement. There is an article written for Educause Quarterly by Thomas J. Trappier”. In his paper he recommends that the contract in SLA and Cloud computing must be:

- Codifies the specific parameters and minimum levels required for each element of the service, as well as remedies for failure to meet those requirements.
- Affirms your institution’s ownership of its data stored on the service provider’s system, and specifies your rights to get it back.
- Details the system infrastructure and security standards to be maintained by the service provider, along with your rights to audit their compliance.
- Specifies your rights and cost to continue and discontinue using the service.

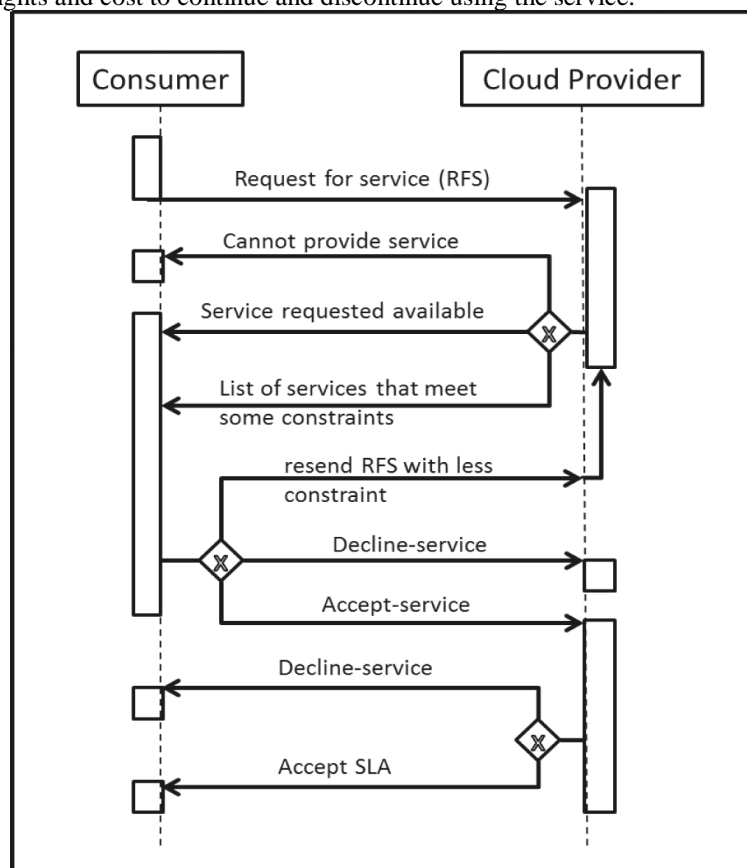


Figure2: SLA and Cloud Computing

Cloud SLA Metrics

1. SLA Metrics for IaaS

Most of the customers do not know which parameters must be taken into the account while declaring the infrastructure in SLA. The following metrics mentioned the significant parameters for customers in case of IaaS:

Table 1: Parameters used in SLA Metrics for IaaS

Parameter	Description
CPU capacity	CPU speed for VM (Virtual Machine)
Memory size	Cash memory size for VM
Storage	Storage size of data for short or long term of contract
Availability	Uptime of service in specific time
Response time	Time to complete and receive the process
Boot time	Time for MV to be ready for use

2. SLA Metrics for PaaS

Most of the customers do not know which parameters must be taken into the account while declaring the platform in SLA. The following metrics mentioned the significant parameters for customers in case of PaaS:

Table 2: Parameters used in SLA Metrics for PaaS

Parameter	Description
Integration	Integration with e-services and other platforms
Scalability	Degree of use with a large number of online users
Pay as you go billing	Charging based on resources or time of service
Number of developers	How many developers can access to the platform
Browsers	Firefox, Explorer, etc.

3. SLA Metrics for SaaS

Most of the customers do not know which parameters must be taken into the account while declaring the software constituents in SLA. The following metrics mentioned the significant parameters for customers in case of SaaS:

Table 3: Parameters used in SLA Metrics for SaaS

Parameter	Description
Reliability	Ability to keep operating in most cases
Usability	Easy built-in user interfaces
Availability	Uptime of software for users in specific time
Scalability	Used with individual or large organizations

4. SLA Metrics for Storage as a Service

The following metrics mentioned the significant parameters for customers in case of Storage as a Service:

Table 4: Parameters used in SLA Metrics for Storage as a Service:

Parameter	Description
Geographic location	Available zones in which data are stored
Privacy	How the data will be stored and transferred
Backup	How and where images of data are stored
Recovery	Ability to recover data in disasters or failures
System throughput	Amount of data that can be retrieved from system in a specific unit of time
Security	calculated Cryptography for storage, transferring data, authentication, and authorization

QoS Attributes:

1. **Service Response Time:** It refers how fast the service can be made available for usage. The service response time depends on average response time, maximum response time promised by service provider.
2. **Sustainability:** Sustainability can be defined as the life cycle of the service. It can be divided into two parts: Service sustainability and Environmental sustainability.
3. **Suitability:** Suitability means how much the customer's requirements are met by a Cloud provider and vice-versa.
4. **Accuracy:** It measures closeness to user expected actual value or result generated by CSPs using the services by the Customers. It is defined as the frequency of failure in fulfilling promised SLA.
5. **Availability:** It is the percentage of the time a customer can access the services which is provided by the CSPs to the consumer.
6. **Reliability:** It is the mean time to failure promised by the Cloud provider and the failures experienced by the users.
7. **Adaptability:** It is the time taken to adapt to changes or upgrading the service to next level.
8. **Usability:** The components of usability are operability, learnability, installability and understandability.
9. **Interoperability:** Interoperability is the ability of a service to interact with other services offered either by the same provider or by the other providers.

QoS Parameters emphasis on parameters like response time, SLA contravention, degree for the job, reliability, availability, stages of client variation and charge of service. In Cloud computing, additional QoS parameters require to be included like Security, Privacy and trust. On the other hand, most of the requirements are still the same for both kinds of services such as: Availability, Scalability, Security, and privacy, etc.

III. CONCLUSION

In this work, we examine the SLA for cloud computing services with QOS in depth, the challenge for Cloud customers to discover the "right" Cloud Service provider that can satisfy their requirements. A single data centre is unable to provide all the requested resources in order to satisfy the customers. We discussed the various components of SLA which is required to make the agreement between the CSPs and the consumers. We proposed metrics for SLA in clouds. Finally there is a very genuine need for the quality of service approach to handle SLAs in cloud computing. One important observation we made in the perspective of clouds with reference to the various parameters which is to be included like Security, Privacy and Trust. Although, it is applicable to accommodate several types of cloud interfaces by using a middleware, a universal set of metrics that aim at monitoring different cloud services is not yet implemented. Attempts to standardize a framework for SLA with QOS attributes by deploying the cloud services is really the challenge for the future work.

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AUTHOR PROFILE



Dr. Sarvjit Singh Bhatia is a researcher and Senior Faculty in PG Department of Computer Science at GSSDGS Khalsa College Patiala. He has 18 years of work experience in the field of teaching and 10 years of research experience. He has published 15 books and 6 research papers in International and 5 in National journals. His research work field is Implementation of Cloud based ERP in SMEs.



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