AN INTEGRATED FRAMEWORK FOR E-COMMERCE CLOUD SERVICE LEVEL AGREEMENT

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Abstract

Cloud computing recently became the key element of providing services via the internet. Cloud technology is new paradigm of computing where available computing resources are delivered as a service. These resources are generally offered under the concept of pay-as-you-use. Nowadays, some of e-commerce companies move to Cloud services. Cloud offers positive opportunities for ecommerce companies which are looking for more flexible and scalable infrastructure, to sell products and services to customers. As more and more e-commerce companies delegate their task to cloud providers, Services Level Agreement (SLA) became an important aspect between the e-commerce seller and cloud provider to protect end user, the dynamic nature of cloud computing needs to continue monitoring of the services. In this paper we propose a SLA framework based on Web services level agreement (WSLA) which is introduced by IBM. The framework integrated with nine parameters that verified and validated based on end user perspective. Data were collected from 105 students in University Technology Malaysia. Factor analysis has been used to minimize the redundancy between the parameters and grouped based on the inter correlation between them. The results indicate that all nine parameters are significant and important from end user point view. An e-commerce cloud SLA document designed and run time parameters defined using XML language. Adopting these parameters by e-commerce seller catalyze better protection to the end users during contracting with cloud services providers.

Keyword: SLA, SLA document, Cloud computing, ecommerce cloud.

1 INTRODUCTION

Cloud computing became an increasing trend. Many e-commerce companies and retailers have moved to cloud services due to the many benefits .This shift offers in regards to secure and easy access storage options, elastic computing and infrastructure. According to Gartner group report, in 2013, 40 % of e-commerce companies use a complete cloud services (SaaS) solution. It appears that cloud computing is set to change the ways in which businesses operate (Motahari-Nezhad, Stephenson et al. 2009). From a business perspective, cloud computing offers a great number of benefits, including reduced infrastructure and maintenance cost. Cloud computing away from the traditional costs associated with client-based computing which requires the use of servers, software prescriptions, on-going updates, and regular maintenance (Kshetri 2010). Given the range and diversity of cloud computing options, challenges arise between the cloud services providers and e-commerce seller, in regards to the exact nature of their agreement. It is therefore important to establish an agreement between cloud providers and e-commerce seller to guarantee that the correct services are delivered by cloud providers as requested by clients.(Alhamad, Dillon et al. 2010) pointed out that "cloud consumers need service-level agreement (SLA) before they decide to shift their infrastructure to cloud data centres to feel satisfied regarding the resources provided and to be able to reach the desired level of productivity" .On the other hand, cloud service providers also need an SLA to illustrate the quality of services they provide.

However, with this reliance on outside services, there are a number of risks raised especially from the end users perspective. As mentioned in our previous work(Busalim, Hussin et al. 2013),It is necessary to address the SLA problems in order to improve the existing B2C e-commerce Cloud, .These issues are related to the lack of the SLA for B2C e-commerce Cloud which consider the risks and the challenges facing the most important player in ecommerce cloud (the end user). The data of the end user will be stored in cloud, this data are very sensitive. They contain the credit card information, e-mail and the address. Currently there is no clear service level agreement to explain how the data of the user stored in cloud and who will take the responsibility if these data are lost or taken by someone else. For e-commerce cloud companies, the end user is an important capital; therefore the satisfaction of the end user is a major goal of e-commerce cloud websites. However, this paper addresses this new angle of end user perspective and how considering end-user in SLA design will influence the relation between the e-commerce seller and cloud services provider.

Due to the need for e-commerce cloud services contract that best suit a particular business , lack of clarity in service descriptions and lack of confidentiality and security guarantees, all these disadvantages emphasize the methods to explore and establish an effective SLA framework for e-commerce cloud services from an end user's perspective. The contribution of this paper is twofold. First we provide validated parameters which can protect the end users. Second, for practical use to theses parameters, we design the SLA in cloud context which provides suitable platform for e-commerce seller when conducting a contract with cloud provider. This paper is organized as follows. Section two illustrates the literature review, Section 3 explains the methodology used in this paper, Section 4 will cover the results and discussion of the paper, then conclusion of this paper will be in Section 5.

2 LITRITURE REEVIEW

2.1 Service Level Agreement(SLA)

To achieve high quality and performance goals in services or products, it may need the enterprise to establish and manage service level agreement (SLA) between the enterprise which provides the business service or product and the consumers, companies are responsible for its shareholders, expectations of the

level of service to be offered (Group 2004). The main goal of establishing SLA process is to improve the Quality of Experience of the service or product to the enterprise customer and reach the satisfaction level. SLA is a document that describes the level of service expected by a customer from a services provider, based on the metrics or policies by which that service is measured, and if there are penalties, should the agreed-upon levels not be achieved. Usually, SLA is between companies and external suppliers(Greiner and Pau 2009).Service level agreement can be an extremely effective communication tool for creating a common understanding between two parties regarding services, expectation, responsibilities and priorities (Karten 2008).

2.2 Web Service level Agreement (WSLA)

Monitoring and enforcing SLA became increasingly important for both enterprises and consumers. Web Service Level Agreement (WSLA) framework introduced by IBM, is targeted at defining, Specifying and monitoring Service Level Agreement (SLA) for Web Services(Keller and Ludwig 2003). Basically, WSAL consists of an XML-based definition language and an architecture which can support the whole SLA lifecycle. This hierarchical language defines the SLA parameters from resource through business objectives(Torkashvan and Haghighi 2012). Although WSLA has been designed for a Web Services environment, it can also be used in any inter-domain management scenario, for instance business process and service management, or systems and applications in general(Keller and Ludwig 2003).

2.3 E-commerce Cloud

Cloud services and e-commerce are well known nowadays. Both of these terms are cost effective. Cloud computing services can save the cost of IT infrastructure in organizations, and allows doing business without buying a shop entity. Nowadays, most of e-commerce companies move to Cloud services. Cloud offers positive opportunities for ecommerce companies which are looking for more flexible and scalable infrastructure, to sell products to customers. Nowadays, customers need faster online services that meet their daily demands, they want to use different channels, and for example Web, Mobile, TV, and customer support services

2.4 Cloud SLA Frameworks

There is no unique rule for creating an SLA. As the focus of the different cloud services differ, we claim that the SLA parameters would also be different among the cloud services. This is because as we go from the IaaS to SaaS the responsibilities are shifting from the cloud consumer to the cloud service provider. For the cloud service the obligations and the responsibilities of providers and consumers differ based on the type of the cloud service they are offering or using respectively, and thus the quality requirements for each of the cloud services also differ(Rady 2012). Ghosh (2012) claimed that the SLAs provided by cloud providers are relatively biased towards cloud providers and do not provide any formal method of verifying if the guarantees are complying or not.

Many studies have been conducted regarding SLA in cloud computing environment. Some models of cloud computing are proposed, in order to maintain the reliability among cloud providers and consumers involved in the negotiation process. Some others focus on the revenue and Quality of Services. (Wang, Wu et al. 2011) introduced a conceptual platform of SLA in cloud computing. In this platform they proposed a Reputation System for evaluating the reliability of providers, and they also they propose a SLA template pool in order to make the SLA negotiation process between cloud providers and cloud consumers more fair and transparent. The platform allows the Cloud provider to promote their services which would be easy for the consumers to find the services that meet their demands. (Patel, Ranabahu et al. 2009) proposed a framework to manage SLAs in a cloud environment by using Web Service Level

Agreement (WSLA). The framework has been developed for monitoring and enforcement of SLA in a Service Oriented Architecture (SOA).They argue that consumers move towards adopting the Services-Oriented- Architecture(SOA), which lead to the importance of the service quality and reliability. The proposed architecture for managing cloud consumer and provider SLAs, based on the WSLA specification, which is consist of three main services: measurement services, condition services and management services. Another framework is also used the WSLA introduced by (Torkashvan and Haghighi 2012), the framework proposed SLA negotiation language for cloud computing environment and epically the inter-cloud environment. However the framework provides only the availability as an important parameter.

3 Methodology

This section illustrates the activities for every phase in the research, which will be carried out for this paper. This paper follows the research design steps adapted by (Kuechler and Vaishnavi 2008) to develop the framework, and validate the parameters integrated with this framework. As can be seen in fig 1, there are four phases in this research method. From the literature review phase we have found out some potential limitations in the SLA parameters and frameworks provided by cloud services providers, especially in the context of the e-commerce cloud. The current SLAs mention only the availability of the service and the performance level of the services.

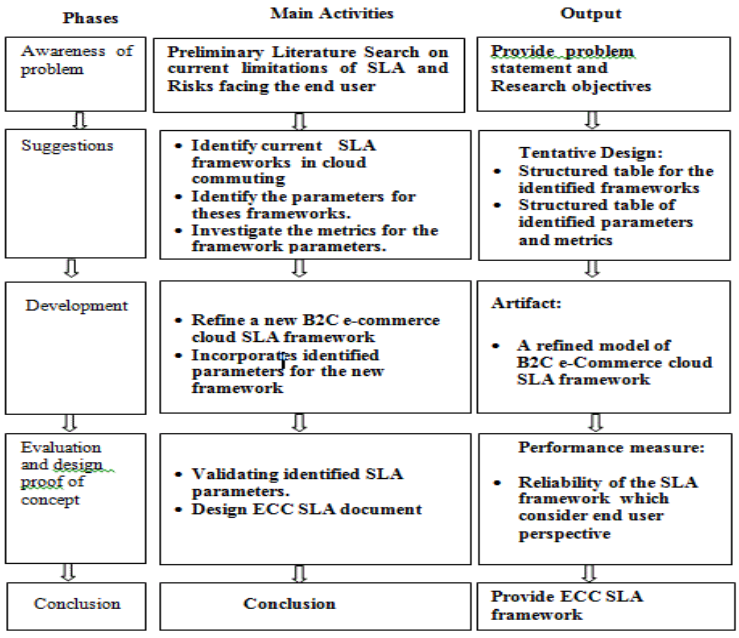

Figure1. Research design steps based on (Vaishnavi and Kuechler, 2008).

3.4 Data collection

After identifying the main SLA parameters which is based on the risks facing the end-user in e-commerce cloud which has been addressed in our previous paper (Busalim and Hussin 2014). A questionnaire is constructed to verify the end user perceptions regarding the importance of these parameters. This research is using quantitative method for collecting data. The questionnaire consists of two parts, the first part is the demographic part. The second part is questions that relate to parameters.

Content validity process has been conducted before distributing the questionnaire, by asking two cloud commerce experts in the faculty of computing in Universiti Teknologi Malaysia (UTM), to make sure that the questionnaire is well organized and the questions are easy to understand. The final modified questionnaire has been distributed online using "SurveyMonkey" tool (www.surveymonkey.com). The sample size of the respondents after distributing the final questionnaire are 105 students. The time for collecting the data was around two weeks. The target respondents are postgraduate and undergraduate students of computing faculty in one of the Malaysian universities. Figure 2 revels the parameters derived from the literature based on the risks facing the end-user. SPSS Software used to conduct the data analysis.

Parameters	Description	Reference
Availability	The uptime of the services for the user in specific time	(Ben Pring 2010, Baset 2012) (Alhamad, Dillon et al. 2010) (Rady 2012) (Ghosh and Ghosh 2012) (Chauhan, Chaudhary et al. 2011) (Nie, Xueni et al. 2012)
Scalability	Ability to increase and decrease the storage space	(Nie, Xueni et al. 2012) (Rady 2012) (Alhamad, Dillon et al. 2010)
Portability	The services working on different devices or different platforms	(Nie, Xueni et al. 2012) (Rady 2012) (Alhamad, Dillon et al. 2010)
Performance	The duration of time to respond on user's requests	(Ben Pring 2010) (Chauhan, Chaudhary et al. 2011) (Rady 2012) (Alhamad, Dillon et al. 2010) (Baset 2012) (Chakraborty and Roy 2012)
Security	The security of user data and the safety of the environment in the cloud	(Ben Pring 2010) (Rady 2012) (Alhamad, Dillon et al. 2010)
Reliability	Services ability to operate over the time without failure	(Nie, Xueni et al. 2012) (Rady 2012) (Alhamad, Dillon et al. 2010)
Usability	The ability of the service to be attractive ,understandable, learnable, operable	(Rady 2012) (Nie, Xueni et al. 2012) (Alhamad, Dillon et al. 2010)
Backup & Recovery	How the Service store the image of user data and the ability to recover data in disaster.	(Ben Pring 2010) (Alhamad, Dillon et al. 2010) (Baset 2012) (Chakraborty and Roy 2012)
Data location	Availability zones in which the data are stored	(Alhamad, Dillon et al. 2010)

Table 1. Derived Cloud SLA Parameters.

4 RESULTS

4.1 Factor Analysis

Factor analysis is data reduction technique, which used to structure large number of items in the questionnaire. Most researchers use factor analysis to search for the smaller set of factors to represent the larger set of variables (Henson and Roberts 2006). Factor Analysis also used to minimise the redundancy between items and to group them based on the inter correlation between these items. Since this study to identify the main important parameters for SLA cloud commerce, factor analysis has been used to remove

the inappropriate items which are not suitable or don't belong to any parameters. The first output of factor analysis showed in table 2 is a Kaiser-Meyer-Olkin measure of sampling adequacy. The KMO result was .732 which means the sample is adequate and suitable for applying factor analysis.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.732
Bartlett's Test of Sphericity	Approx. Chi-Square	2149.043
	df	465
	Sig.	.000

Table2. KMO sampling results.

The second output from factor analysis is the total variance explained. In Total variance explained, the total variance represents the percentage of total variance in every item by a component in table 3 the total components are 13. The components represent the number of the factors. The Initial Eigenvalues illustrates the percentage of variance that each factor contributed from the total variance, For instance factor 1 contributes to 46.265% of the total variance. Then in this analysis extract all the factors which have Eigenvalues value greater than 1, in this case only the first 6 factors will be retained. The second Column labeled Extraction Sums of Squared Loadings. The values in this column displayed same as before the extract for the first 6 factors. Last column in table that labeled with Rotation Sums of Squared Loadings, displayed the eigenvalues of the selected factors after rotation. The rotation has effect of optimizing the factors structure and the importance of each factor, However for the analysis above, factor 1 has more variance than the remaining factors with 21.757% , while the rest of the factors, 16.413, 12.875, 11.248, 5.475, 5.158.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.342	46.264	46.264	14.342	46.264	46.264	6.745	21.757	21.757
2	2.603	8.396	54.662	2.603	8.396	54.662	5.088	16.413	38.170
3	2.051	6.616	61.277	2.051	6.616	61.277	3.991	12.875	51.045
4	1.391	4.487	65.765	1.391	4.487	65.765	3.487	11.248	62.293
5	1.162	3.747	69.512	1.162	3.747	69.512	1.697	5.475	67.768
6	1.058	3.414	72.926	1.058	3.414	72.926	1.599	5.158	72.926
7	.909	2.931	75.857						
8	.833	2.687	78.544						
9	.739	2.382	80.926						
10	.701	2.260	83.186						
11	.621	2.003	85.190						
12	.573	1.847	87.037						
13	.504	1.627	88.664						
14	.466	1.469	90.133						
15	.384	1.240	91.373						
16	.350	1.129	92.503						
17	.319	1.030	93.533						
18	.271	.876	94.409						
19	.256	.826	95.234						
20	.245	.790	96.025						
21	.212	.683	96.707						
22	.171	.551	97.258						
23	.155	.500	97.758						
24	.146	.472	98.230						
25	.127	.410	98.640						
26	.115	.370	99.010						
27	.105	.338	99.347						
28	.089	.286	99.634						
29	.056	.179	99.813						
30	.045	.146	99.959						
31	.013	.041	100.000						

Table 3. Total variance explained.

Table 4 shows the Rotated Component Matrix output for factor analysis. The main reason of applying rotated component is to reduce the variables which have no significant relation among each factor. The

rotation automatically loads every variable into its specific factor. The higher value of variable in each row indicates that the variable belongs to that factor. According to table 5.10 above, the variables (SEC1), (SEC2), (SEC3), (SEC4) are loaded into factor number 3, while variable (SEC5) belongs to factor number2.

	Component					
	1	2	3	4	5	6
SEC1	.299	.085	.771	.069	.127	.059
SEC2	.234	.262	.616	.420	.286	.123
SEC3	.223	.271	.609	.473	.318	.117
SEC4	.349	.203	.595	.407	.095	-.025
SEC5	.109	.629	.583	-.146	.271	.113
SEC6	.153	.300	.702	.109	.339	.111
SEC7	.365	.171	.331	.128	.633	.147
PRF1	.829	-.018	.358	-.029	.022	.092
PRF2	.761	.247	.229	.283	.196	.039
PRF3	.776	.023	.184	.129	.276	.205
PRF4	.577	-.017	.108	.187	.528	.217
PRF5	.741	.182	.134	.350	.156	.202
PRF6	.659	.159	.138	.143	.422	.243
USE1	.667	.330	.104	.376	.218	.019
USE2	.533	.632	-.003	.216	.155	-.013
USE3	.688	.194	.186	.224	.458	.048
AVL1	.444	.263	.321	.486	.349	-.118
AVL2	.294	.262	.324	.472	.435	.112
DLC1	.068	.382	-.090	.069	.015	.750
DLC2	.088	-.066	.341	.374	-.106	.669
BKRC1	.331	.302	.343	.585	.069	.193
BKRC2	.116	.814	.256	.155	.052	.160
BKRC3	.073	.805	.194	.262	.132	.139
BKRC4	.106	.831	.112	.143	.123	.095
RBY1	.550	.059	.272	.357	.312	.093
RBY2	.360	.124	.117	-.019	.235	.634
RBY3	.454	.237	.201	.486	.163	.027
SBLY1	.297	.194	-.016	.689	.353	.299
SBLY2	.488	.266	.216	.451	.304	.187
PROT1	.418	.210	.268	.272	.670	-.101
PROT2	.359	.216	.322	.232	.688	-.007

Table 4. Rotated Component Matrix

In order to organize the related items under each factor, After Grouping them based on their loading, Next step is assigning name to each group of items. Most of the items in one factor are related to each other, from this, we assign a name to represent the whole items in each factor, . For example all the items in factor 1 relate to the quality and performance of the cloud services, so factor 1 items can be named as Quality of service. Table 5 shows the represented names for factors.

Factor	Name of the group
Factor 1	Quality of Service Parameters
Factor 2	Backup and Recovery Parameters
Factor 3	Security Parameters
Factor 4	Availability and Scalability Parameters
Factor 5	Portability and user's data Privacy Parameters
Factor 6	Data Location And provider Reliability

Table 5. Extracted Factors with representing name.

Figure2 shows the final B2C ecommerce cloud SLA framework which is adopted from (Patel, Ranabahu et al. 2009),(Wang, Wu et al. 2011) (Torkashvan and Haghighi 2012) and published in previous work(Busalim, Hussin et al. 2013). The ECSLA framework follows the same concept of lifecycle

introduced by (Keller and Ludwig 2003). Where, step (1) A definition and negotiation between cloud provider and e-commerce consumer, the importance of this step is that the e-commerce consumer provide the parameters with the objectives which should be included in the SLA document to consider the end user perspective. After the negotiation, SLA document will be deployed in step (2); which covers monitoring, condition and evaluation. The measurement step (3) is used to measure the runtime parameters of the provided services. Based on the date provided from the measurement services, condition evaluation in step (4) checks where the parameters is over/equal/under the Services level Objectives(SLO) which are defined for the SLA parameters.

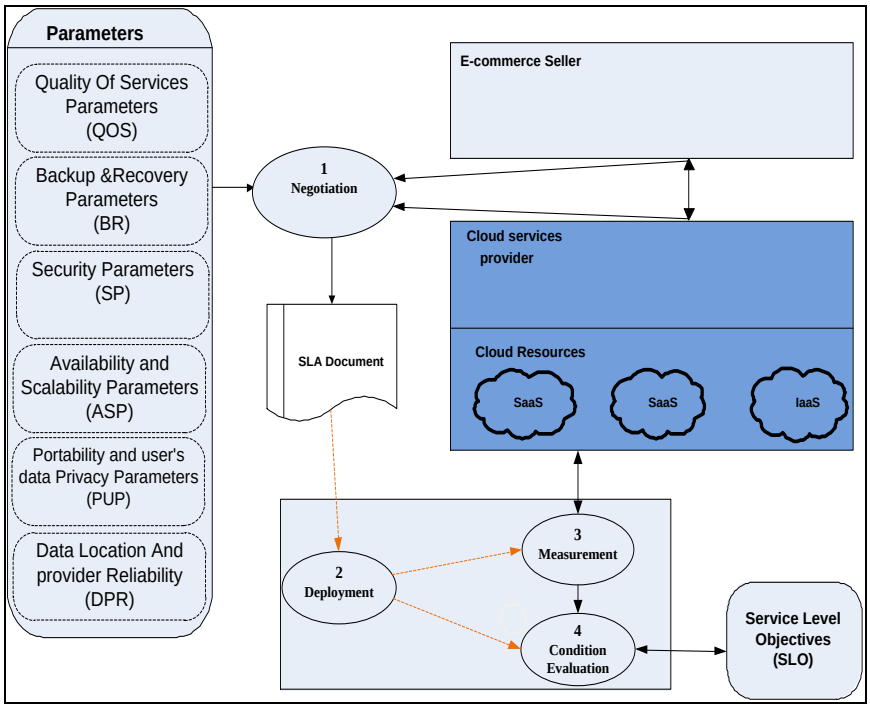

Figure 2. Ecommerce Cloud Service Level Agreement Framework.

4.2 Design E-commerce cloud SLA Document

This section revels the structure of our Ecommerce cloud SLA document, by following the most popular SLA document structure introduced by IBM named as WSLA language(Keller and Ludwig 2003) which based on XML language. WSLA is hierarchical language to define the parameters from resources until the business objectives (Torkashvan and Haghighi 2012). There are three sections in WSLA Document; Parties, services description and obligations. The structure of the Ecommerce Cloud SLA document is XML-based language, and consists of two parties; Cloud services Provider and Ecommerce Seller, and there is no third party. Figure 3 illustrates class view of the ECC SLA document structure and the relationships between the objects.

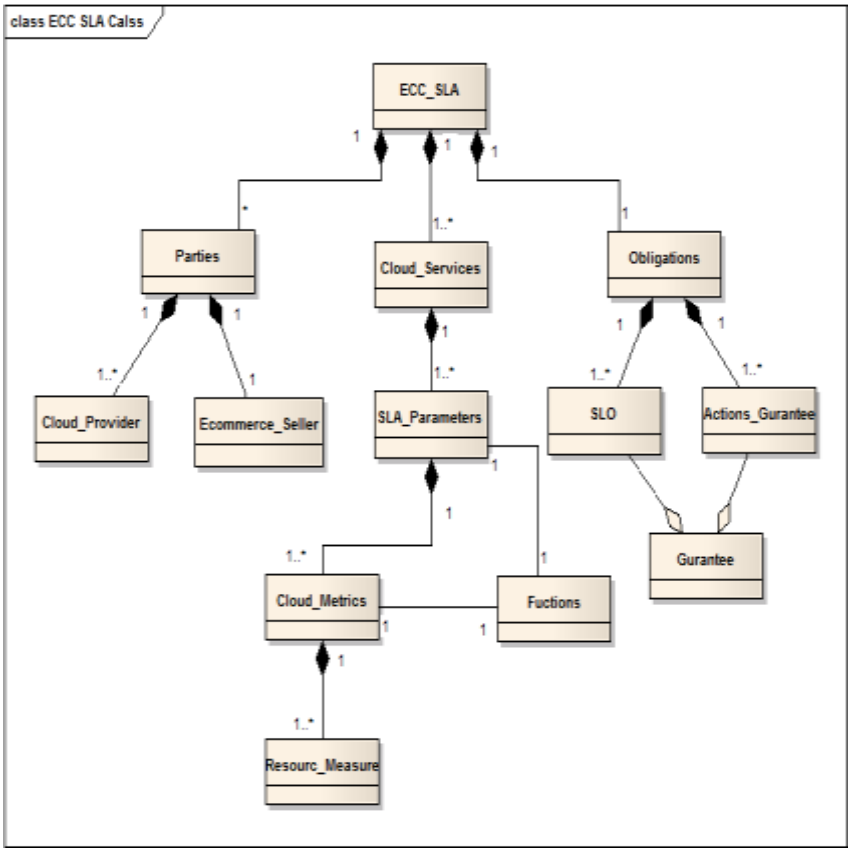

Figure 3. Ecommerce cloud SLA Document Structure.

The three sections of ECC SLA document, Parties Cloud Services and Obligations. The first section defines the two signatory parties in the SLA which are Cloud services Provider and Ecommerce Seller (services Consumer), if there is another supporting part in the SLA it will be defined in this section as well, for instance some signatory parties involve a third party to measure the parameters and evaluate the condition of the services provided.

The next section is the cloud services. This section defines the hierarchical structural of cloud services provided and the parameters need to be measured. Each ECC SLA has one or more cloud services, and each cloud service contain one or more SLA parameter to measure the service, each SLA parameters directly define one or more cloud metric or use appropriate function and each cloud metric or function will be mapped to one or more resources measure to, finally the resource measured can generate the physical measurement values.

The last section in the ECC SLA document is Obligation section. This part contains two kinds of obligations: Services level objectives (SLO) which are the guarantees of particular cloud services parameters, the second type of obligations is the action guarantee which are the promise or the steps to be taken in any situation. For example, if there is any violation, what is the action to be taken by each party, the information in this section is used by condition service to evaluate if there is any violation in services level objectives during provision the services.

4.3 Defining Parameters of ECC SLA document

From the approved parameters in table 5 above, the run time parameters need a continuous monitoring such as the quality of services and availability parameters. Table 6 shows the run time parameters will be defined using XML Language.

Parameters	Description	ID
Quality of Service Parameters (QOS)	Response time to user request	QOS1
	Services throughput Capabilities	QOS2
Availability and Scalability Parameters(ASP)	Availability of the services	ASP1

Table 6. ECC SLA Parameters need to be defined.

Figure 4 explains the output of the hierarchal structure for the availability and scalability parameters. The structure in figure is XML-based, where the cloud services provided (SaaS) is assigned to the quality of service parameters, which has list of parameters, one of them is the Availability which is defined in this case, the availability parameter assigned the metric Uptime ratio which defined independently to measure to uptime ratio of the services, the uptime ratio assigned the metric Status Time Serious, which measure the periodically presence of the virtual machine provide the SaaS. The measurement services in charge of computing the two metric.

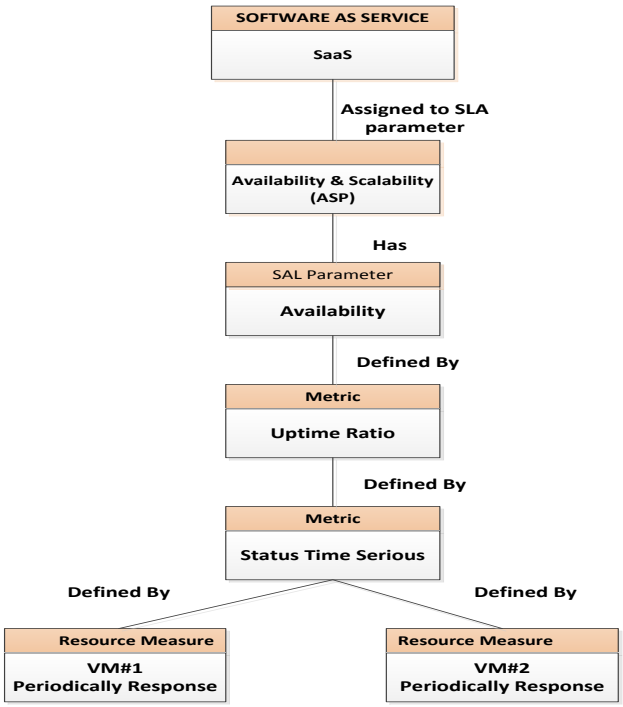

Figure 4. Structure of defining Availability parameters.

Figure 5 Shows the second definition of the parameters in e-commerce cloud SLA document, the structure is also generated from XML code, where the cloud services provided is assigned to the Quality of services parameter which has two parameters, response time and throughput and each parameter has its own metric and function for the measurement the threshold based on agreed service level objectives

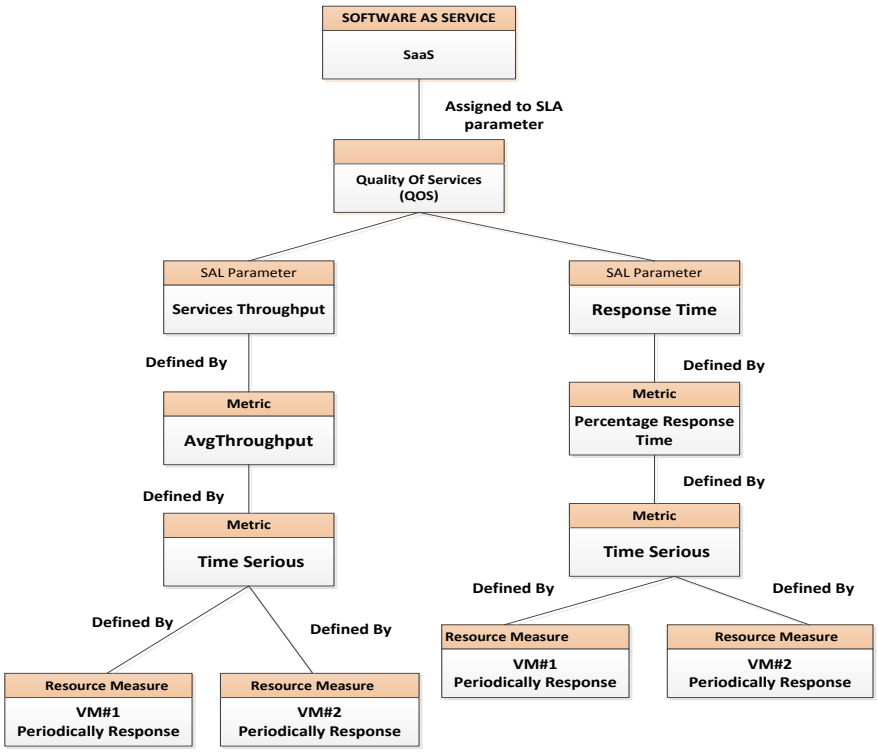

Figure 5. Structure of defining quality of services parameters.

5 Conclusion

This paper aims to provide validated parameters which consider the ecommerce end users' point view. As more e-commerce companies utilize the cloud computing services,. SLAs will have significant impact on performance of these websites and the customer relationship as well. By applying the appropriate parameters, SLA can guarantee the services provided to the ecommerce website users. Therefore, we introduced a Cloud SLA framework integrated with validated parameters for ecommerce seller. More and more companies shifting their focus to be customer-centric, the implications of considering the end user of perspective in the early stage of choosing the suitable cloud services provider, can act as a precursor to good customer relationship. The theoretical contribution of this paper, after reviewing the current literature we identified the critical parameters from the end user perspective. Moreover, this paper contribute to the practical field by design the SLA document and define its run time parameters using XML Language in order to ease the use of the document.

As future work, more parameters need to be added and enhanced to cover all aspects of each party in the agreement. More data need to be collected from different respondents in different environment other than

universities. The SLA document provided in this research needs to be tested in real world scenario, in order to examine the effectiveness of the parameters.

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