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A Comparative study of Cloud Computing Service Selection

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Abstract: ***Cloud technology demand is rising on daily basis and offers on-demand services to its consumers which motivates the cloud service user to move their business on the cloud. The growing popularity of cloud, cloud providers and cloud services offered by them puts a challenge for user to select suitable services which meet their customized requirements and also maintaining quality standards for the services taken from provider. The service selection is considered a challenging process because it is not always feasible to provide services as per customized requirements. Various researchers proposed different techniques, framework, approaches and algorithm for helping the user in deciding for the services which can fulfill the requirements. The research paper comprises of exploration of different service selection techniques which are helpful in selecting cloud services. The comparisons among various proposed work of the author are discussed for bringing more clarity in the topic.***

Index Terms: Cloud Computing, Service Selection, Algorithm

I. INTRODUCTION

Cloud Computing service model facilitates the user by providing access to the offered services, application and resources through internet**. C**loud technology provides a feature to users for accessing various resources on rent from any location at any point of time [1]. Cloud technology is based on two different technical aspects which helps in achieving the above characteristics. The first Service oriented Architecture (SOA) [2] where the complete work is divided into equal sub-task performing independent functions. Another technical aspects involved is "Virtualization". The cloud resources are offered through virtual platforms where user carry out their computing tasks and use these resources through internet. Cloud is a computing model which facilitates a suitable, on demand access to a common list of different resources that are scalable in nature and can be taken and returned as per the requirements [3]. A Cloud computing environment is based on three major components which are clients, distributed servers and datacenter and these have their specific functions [4]. Clients are the medium facilitating user interaction with the cloud and is distinguished as thin client, thick client and mobile client [5]. Datacenter supports various applications through its servers and these applications are used by remote customers [6]. Distributed servers helps in hosting various applications by giving the feel to its users as if they are the sole owners of the applications [7].

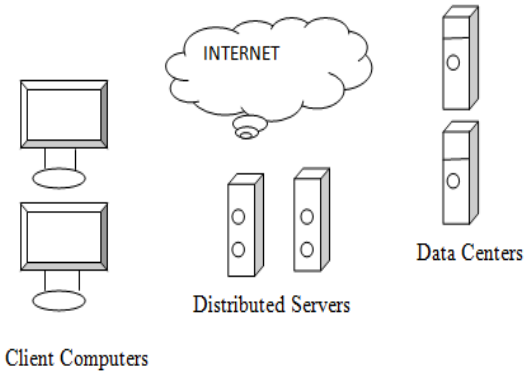

Fig. 1: Different components for cloud [4]

1.1 Cloud Service Models

According to customer's varied demands, different methods for selecting and ranking services are proposed and designed. Customization of such services are done according to the consumer need **[8]**. Everything in cloud environment can be considered "as a service" and customization of these services according to the consumer's needs is the requirement [**9**].

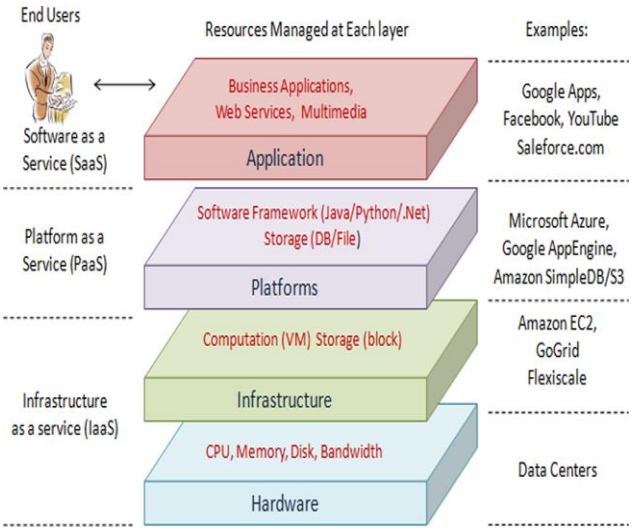

Fig 2 Categories of cloud computing services [9]

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Cloud services can be accessed through various deployment models requested by the customers who want to avail the resources. There are four major deployment models [10] public cloud, private cloud, hybrid cloud and community cloud [49]. Public cloud allows access to the user through internet at very minimal cost but there are variety of security issues to this type of model. In private cloud, one particular organization or individual can access the resources and no other organization is allowed to share this type of cloud resources. Community cloud is popular because user with similar background is allowed to access cloud resources. Hybrid cloud is one which have some features of private cloud and some features of public cloud.

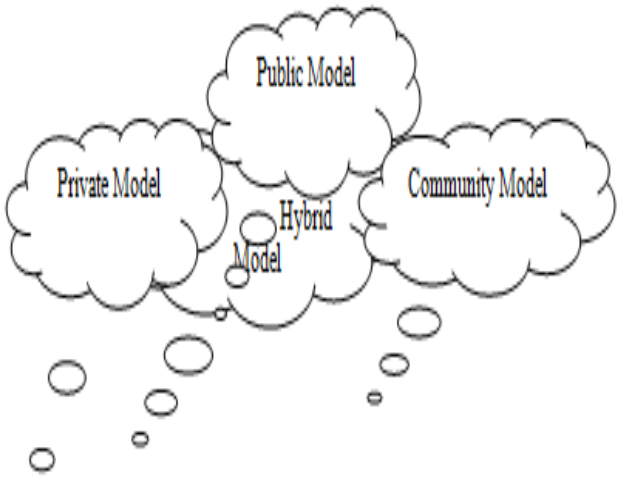

Fig. 3: Deployment of Cloud Services through various Model [10,49]

The computation in cloud offers diversity of service through its deployment models therefore selection of services in cloud is very challenging in comparison to the traditional web service selection. In cloud a single solution for the service selection is not applicable for different types of service selection due to the different service requirement for different users. The single solution can not efficiently meet users with different requirement. Due to increasing demand of cloud services which are rapidly increasing puts a challenge in front of user for selecting service according to the user customized requirement and has become a research issue [11]. The above challenge related to the selection and ranking of and finding optimal solution is considered to be NP hard problem [12] is addressed the by many researchers in form of proposed approaches, techniques and algorithms by keeping in mind (QoS) [13] constraints. The focus of research is development of these techniques to get right services according to their requirement by the provider

The research paper gives a literature review of various cloud service selection and optimization techniques which helps in easing down the decision making process of service selection and ranking. The table based taxonomy is designed which comprises of various technique and algorithm used in service selection in cloud environment. The discussion on the literature will help the researchers in identifying the areas where there are still open research challenges and this will motivate them to explore the untouched or less touched area in selecting and ranking of services in cloud. The quality of service parameters are studied during the review introduces the quantitative parameters, quantitative parameters, important parameters and less frequently used parameters. The objective of research is identifying different cloud services, techniques, approaches and algorithm required for effective cloud service selection and optimization. The research also includes the identification of QoS datasets which is used in evaluating methods for various literature studied in detail

The figure 4 shows the framework and the procedure for cloud service selection. The framework also shows different components which are helpful to the decision maker in analyzing the service selection

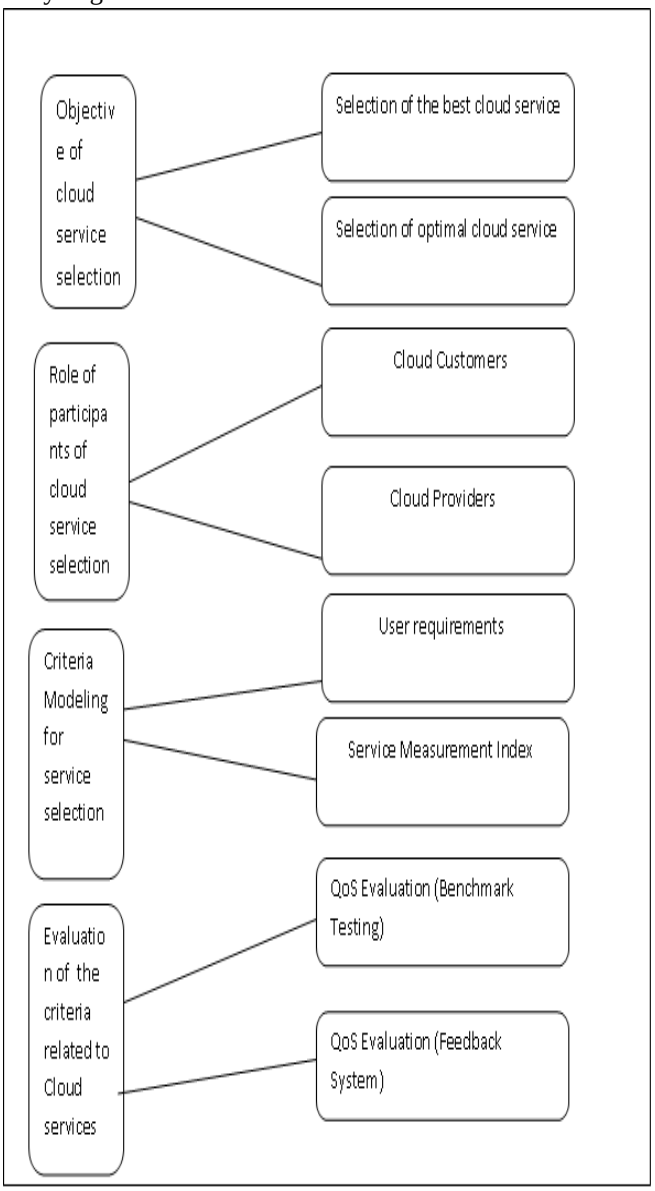

Fig 4 : Process for cloud service selection

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Research paper is arranged as following: The study of most of existing cloud service selection techniques and ranking methods in section 2. Comparisons and extensive discussions on objective of investigated research, the service selection techniques is shown in section 3. Research challenges and future research directions are summed up in 4 section.

II. EXISTING CLOUD SERVICE SELECTION TECHNIQUES

Cloud service selection and ranking involves a study of various proposed work , techniques , methods. The service selecting and ranking methodology is evaluated and talked in detail under various categories mentioned by various researchers. The categorization related to service selection under various techniques will help future researchers in understanding existing work. Decision making approaches of service selection and ranking is done by identifying the services that best meets the customer requirements. Multi–criteria decision making approaches (MCDM) [9] is very basic technique and is used when the decision criteria and alternatives numbers are measurable. The popular MCDM techniques including Analytic Hierarchy Process (AHP) [15], Simple Weighted Sum [16], TOPSIS [17], ELECTRE [18]. Optimization based service selection includes dynamic programming [19], greedy algorithm [20], Particle Swarm Optimization [21] and genetic algorithm [22]. Various other approaches such as Trust based [23] and incentive based approaches[24].

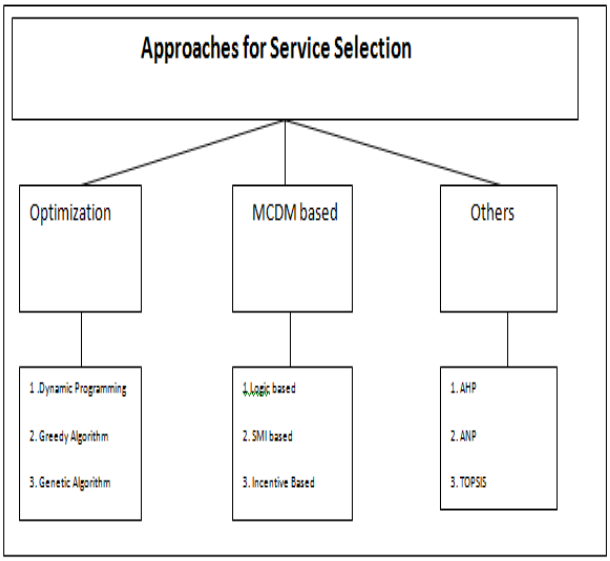

Fig 5:Taxonomy of various approaches of service Selection

III. DISCUSSIONS

The objective of research is achieving a comprehensive view of different approaches of cloud service selection. Different approaches and techniques are used for ranking the cloud services and cloud provider which facilitates the decision maker in identifying the optimal services that fit into the necessity of user and business. Table 1 below gives a brief overview of various researches done by the using various technique and if the framework or any other technique or algorithm has been used for calculating the best result.

3.1 Approaches Applied in Service Selection

The applied and the proposed approaches used in service selection are divided into five distinct categories including MCDM approach, Optimization technique, Trust based service selection, Incentive based service selection and others . All the five different approaches are discussed in detail and are summarized in table 2 and figure 4 from which it can be inferred that MCDM approach is the used by the researchers while making decision in the service selection in cloud environment. Second highest approach used its applied approaches is Optimization Technique. Trust based selection and Incentive based selection approach are almost equal.

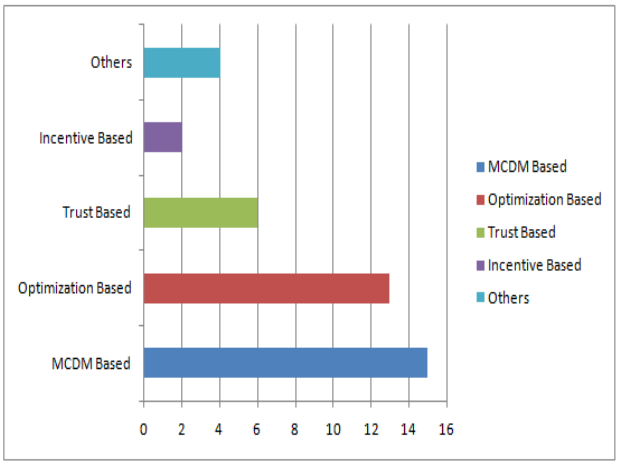

Fig 6 Study of the number of approaches in the literature

3.2. Quality of Service Parameters

QoS values of the parameter are essential for identifying relevant services. The literature review conducted in the research papers identifies all the QoS parameters which researchers think are important in their approaches and considers them important in doing analysis about making decision for the service selection by the decision maker. Figure 7 shows different QoS parameters like cost, trust, throughput, Availability, reliability, Uptime, Risk, Efficiency, Reputation, Security and Scalability. The frequency of QoS parameter is evaluated in the fig below to see the frequency of occurrences of these parameters. The graph below shows different QoS which are considered more important than others and are taken by most of the researcher in their studies.

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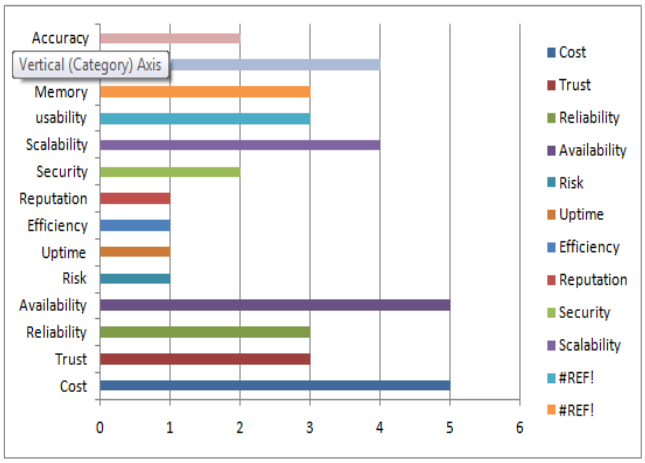

Fig 7: Quality parameters according to their relevance

Table 1: Review of approaches in Cloud Services

Reference	Technique / Algorithm	Framework	QoS Parameters	Cloud	Literature	Approach
Godse and Mulik (2009)	AHP	Case study based approach for Saas application related to sales force automation used by professionals is studied	Functionality Architecture Usability Vendor Reputation Cost	SaaS	[25]	MCDM
Karim et. al. (2013)	AHP	Case Study Based Approach Author proposed a new rules for mapping the complete Process	QoS Attributes	SaaS, IaaS	[13]	MCDM
Goncalves et.al(2015)	AHP	Results are deployed in Amazon	Non Functional QoS attributes (Efficiency-Time Behavior and Resource utilization, Response Time – CPU and Memory Utilization, Cost)	SaaS	[26]	MCDM
Menzal etl al (2011)	AHP	Framework (MC2)2	Cost, Benefits , opportunities and Risk	IAAS	[27]	MCDM
Boutkhoum	FAHP and PROMETHEE	Fuzzy logic is applied to Analytic Hierarchy Process(FAHP) and PROMETHEE (Preference Ranking Organization method for Enrichment Evaluations) for helping in analyzing and ranking the best cloud	QoS Attributes		[28]	MCDM

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Khowfa and Silasai	Association Rules technique and AHP method	finding out relations among various items in the database	QoS Attributes		[29]	MCDM
Lo et.al. (2013)	TOPSIS	calculating weights of diverse criteria and provides rating of alternate service	Scalability, Capability,Performance, Reliability and Availability		[17]	MCDM
Chamzini et.al (2013)	Fuzzy ELECTRE	Tunnel construction of projects	Risk (Delay and Failure) are at lowest rank Damages, unsafe working , accidents of machinery	Other	[30]	MCDM
Silas et. al.(2012)	ELECTRE	SSM_EC middleware	Subjective (turnaround time, Service Cost, Trust, Reliability)	IaaS	[31]	MCDM
Chou et.al. (2007)	Fuzzy Simple Additive Weighting	Framework for solving problem related to location selection	Subjective and Objective attributes	Other	[32]	MCDM
Saripalli and Pingali (2011)	MADMAC framework	Decision areas cloud switch, cloud type are taken into consideration	Subjective and Objective	PaaS, IaaS and SaaS	[33]	MCDM
Upadhay and Nitin [2017]	MCDM framework	Cloud Service Evaluation and Selection	quality of service	IaaS PaaS SaaS	[34]	MCDM
Yu and Lin (2005)	Dynamic Programming Algorithm (Combinatorial approach, Graph approach)	An algorithm for selecting service by QoS brokers	Response Time, Cost, Service Availability, Service Reliability	SaaS	[35]	Optimization Appraoach
Goscinski and Brock (2010)	Dynamic Programming	Resource Via Web Services Framework	Time and effort	SaaS PaaS IaaS	[36]	OT
Zheng et. al. (2013)	Greedy Algorithm	A framework is designed for QoS ranking prediction	Subjective parameters are	SaaS	[37]	OT
He et.al. (2012)	Greedy algorithm	MSS Optimiser (Multi-tenant SaaS Optimiser)	Cost, response Time, Availability, Throughput	SaaS	[38]	OT
Wang et. al. (2013)	PSO	Cloud –based web services (CWS) composition approach	QoS Parameter	SaaS	[39]	OT
Kang et.al. (2012)	PSO	PSO-GODSS dynamic web service selection	QoS	SaaS	[21]	OT
Yang (2014)	Hybrid PSO	Hybrid PSO approach for checking parameters	Functional and Non functional parameters	SaaS	[40]	OT

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Ye et. al (2011)	Genetic algorithm	QoS model , genetic Algorithm	Time , price, Availability and Reputation	SaaS	[39]	OT
Klein et al. (2012)	Genetic Algorithm	Network alert approach	Scalability	SaaS	[40]	OT
Tang and Ali (2010)	Genetic Algorithm	Hybrid Genetic algorithm	QoS	SaaS	[41]	OT
Pan et. al. (2015)	Trust Approach	Trust Modelling Method	QoS Parameters	IaaS , PaaS, SaaS	[23]	Trust Approach
Josang et. al. (2007)	Trust Apprach	Discussions on literatureabout TA	Security and Trust	IaaS , PaaS, SaaS	[42]	Trust Approach
Wu et. al. (2013)	The novel unfair rating filtering method	Reputation revision algorithm	Trust, Reliability	IaaS , PaaS, SaaS	[43]	Trust Approach
Ghosh et. al (2014)	SELCSP Framework	For Computing the interaction risk between cloud provider and cloud consumer.	Trustworthiness, Risk	IaaS , PaaS, SaaS	[44]	Trust Approach
Jurca and Faltings (2003)	Feedback System	Incentive compatible reputation mechanism	Positive ratings , Negative ratings	IaaS , PaaS, SaaS	[45]	Incentive Based
Jurca et. al.(2007)	collision-resistant feedback payment system	Novel QoS monitoring Mechanism	Availability Correctness	IaaS , PaaS, SaaS	[46]	Incentive Based
Achar and Thilagam	Weights and TOPSIS	SMI measurement	QoS	IaaS , PaaS, SaaS	[47]	Other
Srivastava and Sorenson	Hypothetical Equivalents and In equivalents methods	will show the comparison between the user ratings and real QoS performance	QoS	IaaS , PaaS, SaaS	[48]	Other

IV. CONCLUSION AND FUTURE WORK

The comprehensive study and analysis after the literature review shows various approaches, frameworks and algorithms which are proposed by various researchers over a period of time. The graphs and the table in the paper shows different approaches and their sub-approaches proposed by researchers and on which QoS parameters. Different work proposed in the area of cloud is discussed in details and the role of QoS parameters helps in deciding the relevant services. The study of existing literature done in research in form of proposed work of various authors is done and discussed on various parameters. The limitations in the existing literature lays a groundwork for potential research directions. Authors can also explore multi- objective optimization problem and approaches for selecting services when considering multiple criteria at time of service selection in which traditional approaches are not considered as proficient method for service selection.

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