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CLASSIFICATION OF SMI BASED QOS ATTRIBUTES FOR SOFTWARE AS A SERVICES

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***Abstract*— Cloud computing is a model to produce the computing resources such as infrastructure, platform and software over the internet in on-demand requirements. As Cloud computing creates huge opportunities and value in business domains, the usage of cloud is creeping up day-by-day. Services models (IaaS, SaaS, PaaS) of the cloud computing is on fast mounting. In this paper, we have compared and classified the key QoS attributes required for software as a service based on Service Measurement Index framework.**

*Keywords— **cloud computing, SaaS, QoS, Service Measurement Index (SMI)***

I. INTRODUCTION

Teaching, Nursing, Police, Doctors, Military, army and so on are the example for service oriented job to our society and country likewise Cloud computing will also provide services to our society and world as infrastructure, platform, software. Cloud computing is a shifting of paradigm from old processor environment to the client architecture [2]. Clouds are developed on large center to store the data hosted by a single institute that provides services to many institutes. These service helps the customer in flexible, on insist and on a pay-per-use foundation. Cloud computing has received growing attention from enterprises since its inception [3]. Cloud service providers are offering a wide range of solution to businesses or stakeholders. Enterprise businesses are moving their IT services, platform, applications and infrastructure to cloud-based architecture. Perception of different expert, provider and professional about cloud computing is somewhat differs. "Clouds are essentially large distributed computing services that make available to their services"[1]. The proposed system is Classification of the SaaS QoS Attributes based on the SMI framework. This classifies the SaaS attributes based on user perspective and service provider perspective and both the needs. These would helps to choice SaaS service for the small scale industry. Small scale industry would not trust on the cloud and these attributes will improve service level agreement. For example LinkedIn**,** Salesforce**,** ServiceNow

II. TYPES OF CLOUDS

Cloud computing are classified in to four key types depending on our need and the network and ownership. They are described below.

1) ***Public cloud***- A Public cloud can access by the any customer, subscriber from anywhere and anytime via internet connection and use their cloud space.

2) ***Private cloud*** –A private cloud can be accessed by only particular member which would establish with I organization and accessed by certain number of member or group only.

3) ***Community cloud*** – A community cloud is like a private cloud. This could be access by the certain number groups like same company would have different branch to communication only their branch company.

4) ***Hybrid cloud*** – A Hybrid cloud is nothing but combination any two types of the cloud.

III. CLOUD SERVICE MODELS

Cloud computing is delivery of computing where scalable IT-related ability are provided ―as a service over the internet to numerous external clients [8]. This term effectively reflects the facts of the Cloud Computing which can be found at different infrastructure levels [6]. Cloud Computing is broadly classified into many type services like Application-as-a-service, Information-as-a-service, Storage-as-a-service, Database-as-a-service, Process-as-a-service, Platform-as-a-service(PaaS), Education-as-a-service(Eaas), Integration-as-a-service(IgaaS), Senser-as-a-Service, Security-as-a-service(SeaaS), Infrastructure-as-a-service(IaaS), Management/Governance-as-a-service, Testing-as-a-service(Taas)are some cloud service models. Majorly Cloud can be classified into three types shown and described below.

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***1) IaaS (Infrastructure as a service)*:** The main idea behind this service model is virtualization in which user have virtual desktop and consumes the property like storage, virtualized servers, routers, network and so on, supplied by service provider. Usage fees can be calculated depends on per CPU hour, data stored memory required per hour, network bandwidth obsessive, network communications used per hour, value added services used, e.g. allocating, monitoring, scheduling, flexible, auto-scaling etc. Examples: Storage services provided by Amazon EBS.

2) SaaS (Software as a service): Through this service relief model end users consume software application services straight over network according to on-demand center. For example, Gmail is a SaaS where Google is provider and we are consumers. Other well-known examples of PaaS include billing provided by Arial system, open source. Financial services: Concur, workday, Backup and recovery services and so on [11].

3) PaaS (Platform as a service): It refers to the atmosphere that provides the runtime environment to the user, software deployment framework and component that pay user to enable the deployment of application assets or web applications. PaaS is platform where software can be developed, tested and maintained. It means life cycle of software can be operated on a PaaS. This service model is always enthusiastic to application developers, testers, deplorers and administrators. Examples: Azure, Smart Cloud, EC2, App Engine (GAE) and so on [12].

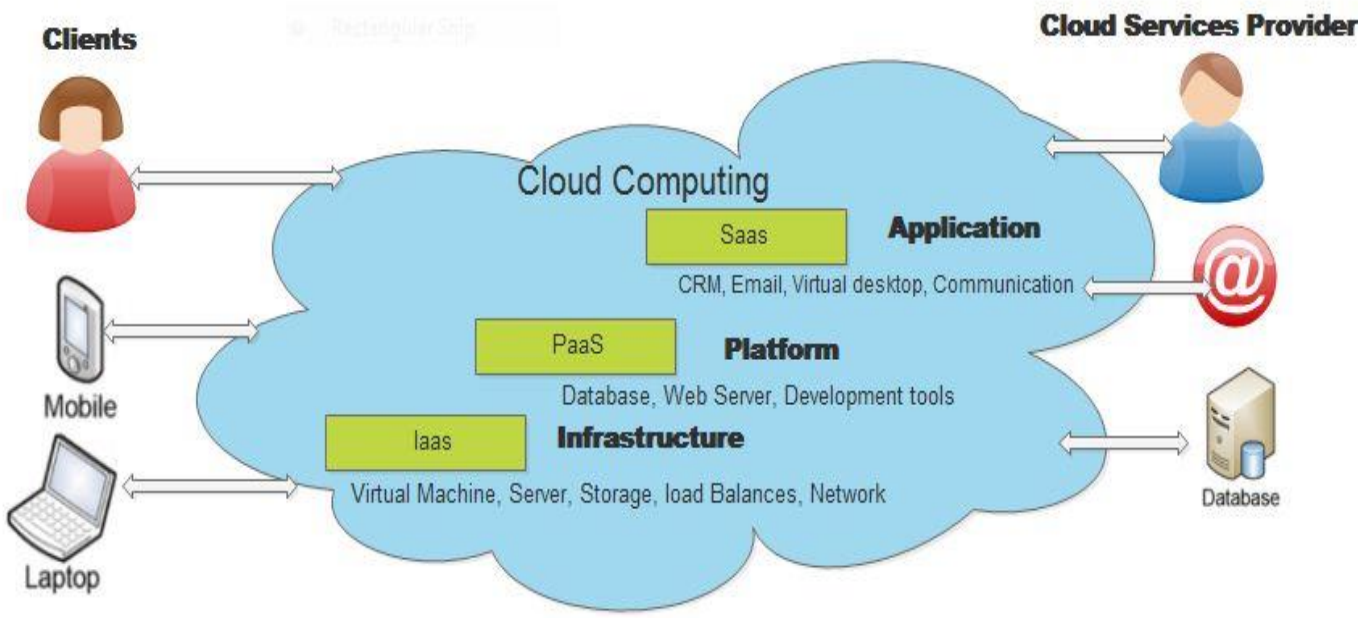

Figure 1 Cloud Service Models

IV. ESSENTIAL CHARACTERISTICS OF CLOUD COMPUTING

Essential characteristics have to be fulfilled by the provider and expected requirement of service end user has to been satisfied to provide Quality of service. Quality attributes has to be recognized that attributes has to be estimate by the different features. Amid this work we classify the different attributes based on the different providers [4].

- **On demand self services:** Cloud services such as online shopping, email, network, applications or service from the server can be given without requiring human interaction with each different service provider. Cloud service provider provide on demand self services include AWS, IBM, Google and New York Times, Microsoft and NASDAQ are examples of companies using AWS (NIST) [4].
- **Broad network:** Cloud Capabilities are available over the network and accessed through standard mechanisms that encourage use by various slight or

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broad client platforms such as Computers, mobile phones, laptops and PDAs.

- **Resource pooling:** Computing assets are pooled together to serve multiple end users using multiple-tenant model, with different hardware also virtual process dynamically assigned and reassigned based on end user demand. The resource include among others database, information storage, processing, memory, network bandwidth, virtual systems and email services [4][5]. The collection which together of the resource builds economies of scale (Gartner).
- **Rapid elasticity:** Services can be quickly and elastically equipment, in some cases mechanically, to quickly scale out and released to scale in. End user have capable provisioning often appear to be abundant and can be brought in any amount at anytime and anywhere over the internet.
- **Measured service:** Computing resource usage can be calculated, controlled, and reported providing intelligibility for both the service provider and end user of the utilized service. Services use a metering facility which enables to manage and optimize resources. This just like air, electrical energy, time or town water IT services is charged per usage metrics – pay per use [4]. The more you utilize the superior of a bill. Just as utility industries sell power to user and telephone companies' voice and data, IT services such as network security, data center hosting or departmental billing can now be easily delivery service.
- **Multi-Tenacity:** This is the 6th individuality of cloud computing advocated by the Security Alliance. Cloud refers to the need for policy-driven governance, service levels, enforcement, segmentation, isolation, and chargeback/billing models for different end user constituency. End users might utilize a public cloud service provider's offers or actually be from the same institution, such as different business units rather than distinct managerial entities, but would still share infrastructure.

V. SERVICE MEASUREMENT INDEX (SMI)

A Global team is rising a standard dimension skeleton called the Service Measurement Index (SMI)[13]. SMI attributes are designed based on International Organization for Standardization (ISO) standards by the CSMIC consortium [14]. It consists of a set of business-relevant KPI's that provide a uniform method for measuring and comparing and classifying a business service. The SMI provides a holistic view of QoS needed by the end users for selecting a Cloud service provider based on: ***(IaaS, SaaS, PaaS)*** [9]. SMI will address a total of 51 attributes. Which based on high and low level attributes categories, such as Accountability, Assurance, Agility, Financial, Security and Privacy, Performance, Usability [13]. Based on those SMI attributes we compare and classified the most relevant attributes required for IaaS, SaaS and PaaS service models. This gives the right decision in picking up the appropriate services based on their quality attributes, which can be measurable.
Table.1 illustrates the classification of the attributes for service models.

S No	Functionality	Attributes	Iaas	PaaS	SaaS
1.	Accountability	Audit ability			
		Compliance			
		Ease of doing business			
		Governance			
		Contracting experience			
		Data ownership			
		Ownership			
		Supplier business stability	X		X
		Supplier certifications			
		SLA verification			
		Provider ethicality			
		Provider personnel requirements			
		Provider supply chain			
		Security capabilities		X	X

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		Sustainability	X		
2.	Agility	Adaptability	X		
		Capacity			
		Elasticity	X		
		Extensibility			X
		Flexibility	X		X
		Portability	X		
		Scalability		X	X
3.	Assurance	Availability	X	X	X
		Data geographic / political			
		Maintainability		X	X
		Recoverability		X	
		Reliability	X	X	X
		Resiliency / fault tolerance			X
		Service stability	X		X
		Serviceability			X
4.	Financial	Acquisition & transition cost	X		
		On-going cost	X		
		Profit or cost sharing			
5.	Performance	Accuracy	X	X	X
		Functionality			X
		Interoperability	X		
		Service response time	X		X
		Data geographic / political			
		Access control & privilege management			
		Data integrity	X		X
		Data privacy & data tools	X		X
		Physical & environmental security			
		Proactive threat & vulnerability management			
		Retention / disposition			
7.	Usability	Accessibility			X
		Client personal requirements			
		Installability	X		
		Learnability	X		X
		Operability	X	X	X
		Suitability		X	X
		Transparency	X		
		Understandability	X	X	

Table 1. Comparison and Classification of QoS Attributes based on SMI

VI. SAAS QOS ATTRIBUTES DEFINITIONS

Software as a Service (SaaS): End users rent software hosted by different vendor. e.g. Google forms, Google Docs, Google slides.

S.No	Attributes	Definitions
1)	Availability	Service of SaaS can be calculated using uptime
2)	Compos ability	SaaS can Combine two or more another service called compos ability.
3)	Reliability	SaaS services keep working and execution without breakdown in a given time phase.
4)	Resiliency	SaaS services can keep on running even in the time of failure in its one or more mechanism.
5)	Accuracy	SaaS services can stick to its obligation.

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6)	Performance	SaaS services utilize system to perform its function.
7)	Response Time	A specific time between a service call and a service reply.
8)	Stability	SaaS services is challenging to change or dislocation.
9)	Functionality	General/comprehensive are the service's features.
10)	Scalability	SaaS providers can support growth in the services scale
11)	Security	SaaS services controls on service data and access to the services.
12)	Adaptability	SaaS provider can adjust the changes with end user's requirements.
13)	Extensibility	Provider can add new features to current SaaS service
14)	Flexibility	Supplier can add or remove skin texture from services
15)	Maintainability	Supplier can repair services to keep them in a good condition to work
16)	Serviceability	SaaS service provider can perform Service maintenance and correcting
17)	Data integrity	SaaS provider can keep the created data in its correct form to satisfy users confident regarding to accuracy and validity of data in transit
18)	Data privacy & data tools	SaaS providers should provide for users over their data
19)	Accessibility	Service is usable by user with different disabilities
20)	Learn ability	User can learn and understand the SaaS services
21)	Operability	SaaS service can be performed by users
22)	Suitability	The ability of service is competition by user's requirements

Table 2. QoS Attribute Definitions of SaaS

VII. SAAS QOS ATTRIBUTES BASED ON USER AND PROVIDER PERSPECTIVES

In SaaS service model, we classifies the QoS attributes based on user and provider perspectives based on service measurement index (SMI) which will improve the service level agreement(SLA) in the efficient manner between the user and provider . Table.3 illustrates the classification of the attributes for SaaS service models.

S. No	Attributes	User Side	Provider Side	Both Side
1)	Availability	X	X	X
2)	Compos ability	X	X	X
3)	Reliability	X	X	X
4)	Resiliency	X	X	X
5)	Accuracy	X	X	X
6)	Performance	X	X	X
7)	Service Response Time	X	X	X
8)	Stability	X	X	X
9)	Functionality	X	X	X
10)	Scalability		X	
11)	Security capabilities		X	
12)	Adaptability		X	
13)	Extensibility		X	
14)	Flexibility		X	
15)	Maintainability		X	
16)	Serviceability		X	
17)	Data integrity		X	
18)	Data privacy & data tools		X	
19)	Accessibility	X		
20)	Learn ability	X		
21)	Operability	X		
22)	Suitability	X		

Table 3 QoS Attributes for SaaS Model Base on SMI

VIII. CONCLUSION

Cloud computing is one of the most important model for outsourcing various needs of IT organizations. Presently, there are various cloud providers who suggest different cloud services with different attributes. Therefore, the cloud service measurement index (SMI) proposed the classification based on common features of cloud services.

Amid of this work is to define each QoS attributes given in the framework and a relative index for comparing different cloud services. We believe the SMI quality attributes classification on service models represents a significant step towards enabling QoS measurement and we classified QoS attributes for SaaS based on the consumer side and provider which helps to all small scale industry to believe the QoS of service and inverse in the cloud and this will improve service level agreement for service providers.

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