Fuzzy Metering-A New Dimension for Cloud Computing

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ABSTRACT
Cloud computing provides the facility to access shared resources and common infrastructure. It offers services on demand over the network to perform operations that meet changing business needs. A huge investment may be required for a company to enter in to the new business. While the traditional IT procurement process has long been based on making large initial purchases of hardware, software, and services. The company may not have an idea about the investment required for the computing resources. The proposed work adds a fuzzy dimension to the metering system of cloud resources. It will help the company to know about their cost model, so that company can make a financial arrangement to start the new business.

Keywords
AWS(Amazon Web Service), Cloud Computing, Fuzzy Metering

1. INTRODUCTION
John McCarthy opined in the 1960s that "computation may someday be organized as a public utility". This public utility, named as cloud technology, was firstly introduced by the Amazon, who has made the test version of its Elastic Computing Cloud (EC2) public, right after 46 years of the statement by the John McCarthy.The basic idea behind cloud is sharing the resources instead of making investment. With a subscription based model companies can start small, with virtually no up-front costs, and then scale up as business needs dictate. This makes Cloud Computing an attractive option for company who are focused on financial predictability and project accountability. The ability to pay as you go minimizes both implementation and financial risks because customers can both scale based on results and ensure that vendors are held accountable throughout the entire implementation and support lifecycle.

Furthermore, the lack of a large upfront investment also prevents the client from being locked into any single technology or vendor. With today's economy being unpredictable, may make the difference between surviving the next economic crisis and closing the doors forever. With the lack of an upfront investment, and the ability to scale as needs dictate, Cloud Computing gives company the advanced technology they desire without parting with the capital that they need to comfortably conduct day to day operations.

2. LITERATURE REVIEW
IT is an always happening field, where we can always see the arrival of new technologies. After grid the new technology was introduced - CLOUD COMPUTING. Al bento and Regina bento [1] have given detail introduction about Cloud Computing. The architectural details and the comparision [2] with other technology are briefed by Srinivasa Rao V,Nageswara Rao N K, E Kusuma Kumari. The technology has certain advantages and also the challenges, they are discussed by Liladhar R. Rewatkar and Ujwal A. Lanjewar [3]. Balvinder Singh and Priya Nain in [4] talks about the problem of bottleneck in Cloud Computing. They have revealed the negative side of the cloud implementation. Moreover because of the advantages cloud technology has gained popularity. Karamjit Singh, Isha Kharbanda, Navdeep Kaur have discussed about data security issues and solution of cryptography in [5]. Rana Majumdar, Satyanarayana Garimella in [6] put a light on present view of the futuristic stance of Cloud computing.

3. CLOUD COMPUTING
The term cloud computing can also be used as synonym for utility computing which can be explained as utilizing the various resources like CPU time, processor, data storage, bandwidth. The origin of the term cloud computing is obscure, but it appears to derive from the practice of using drawings of stylized clouds to denote networks in diagrams of computing and communications systems.

Cloud service provider offers services on demand over the network to perform operations that meet changing business needs. Users of Cloud Computing do not "touch" the Cloud, which is housed in data centers and server farms located in far-flung places. The location of physical resources and devices being accessed are typically not known to the end user. It also provides facilities for users to develop, deploy and manage their applications 'on the cloud', which entails virtualization
of resources which maintains and manages itself. The fig. 1 shows general implementation of Cloud.

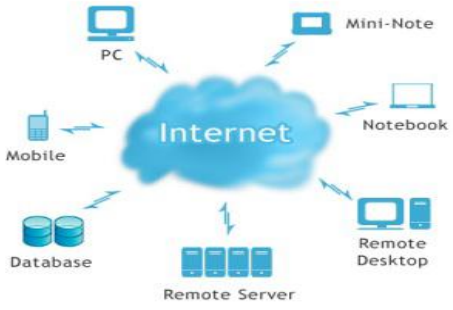

Fig 1 Implementation of Cloud

The services provided by cloud can be accessed from any type of node, with minimum computing capacity, having internet connectivity. The ubiquitous availability of high-capacity networks, low-cost computers and storage devices as well as

the widespread adoption of hardware virtualization, service-oriented architecture, autonomic, and utility computing have led to a tremendous growth in cloud computing.
Some generic examples of implementation of cloud include Amazon's Elastic Computing Cloud (EC2), Amazon's Simple Storage Service (S3), force.com, salesforce.com etc.

3.1 Delivery models for cloud

The Cloud Providers offer services that can be grouped into three categories.

- Software as a Service (SaaS): In this model, a complete application is offered to the customer, as a service on demand. A single instance of the service runs on the cloud & multiple end users are serviced.
- Platform as a Service (Paas): Here, a layer of software or development environment is encapsulated & offered as a service, upon which other higher levels of service can be built. The customer has the freedom to build his own applications, which run on the provider's infrastructure.
- Infrastructure as a Service (Iaas): Iaas provides basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment, data centre space etc. are pooled and made available to handle workloads.

3.2 Deployment models for cloud

The cloud computing environment can consist of multiple types of clouds based on their deployment and usage.

- Public clouds: This environment can be used by the general public, includes individuals, corporations and other types of organizations. Typically, public clouds are administrated by third parties or vendors over the Internet, and services are offered on pay-per-use basis.
- Private Cloud: This cloud computing environment resides within the boundaries of an organization and is used exclusively for the organization's benefits.
- Hybrid Cloud: This is a combination of both private and public cloud computing environments.

4. FUZZY TECHNIQUE

Fuzzy sets are sets whose elements have degrees of membership. It is an extension of the classical notion of set. In classical set theory, the membership of elements in a set is assessed in binary terms according to a bivalent condition — an element either belongs or does not belong to the set. By contrast, fuzzy set theory permits the gradual assessment of the membership of elements in a set; this is described with the aid of a membership function valued in the real unit interval [0, 1].
A fuzzy set is a pair (A, μ) where A is a set and for each, μ (x) is the grade of membership of x. If A = $\{x_1,...,x_n\}$ the fuzzy set (A, μ) can be denoted $\{\mu(z_1) / z_1,..., \mu(z_n) / z_n\}$.Fuzzy set is thus defined by a function that maps objects in a domain of concern to their membership value in the set. Such a function is called the Membership Function and is usually denoted by the Greek symbol μ. The domain of membership function, which is the domain of concern from which elements of the set are drawn, is called the Universe of Discourse.

4.1 Fuzzy logic and natural language?

Fuzzy Logic can be used for any application which uses kind of natural language processing. Following are some reasons for which fuzzy logic found to be most suitable technique:
1.Vague predicates don't have sharp cutoff points.
2.It perhaps can be argued for in terms of comparatives.
3. Truth values behave compositionally.
4. Easy to model the real life situation
5. It is useful for approximate reasoning

5. METERING FOR CLOUD SERVICES

Everyone is familiar with utility services such as phone services, cable TV, and electricity, which are provided to the users on the basis of metering, pay-per-use model. The metering for these services is provided by the service provider itself, but measured using tamper-proof electricity installed at the user side. These meters are under the control of the service provider themselves, even though they are installed at the "client-side" i.e. at people's homes. These meters are generally trusted by consumers, because they are familiar, established, and provide feedback on usage.
Different cloud services provided by the cloud service providers may include:

- Virtual server- Virtual machine
- CPU-hour - The time that a CPU is allocated to virtual server
- RAM GB-hour 1GB RAM allocated to a virtual server/hour
- Storage GB hour - 1GB of storage allocated to virtual server/hour

For providing these services, the provider charges the user as per use. As a utility service the user is charged depending on the usage of the services. The table I explain different services provided by AWS, which will help user to make estimation for the business.
The rates may differ from provider to provider, but there has been found very small difference in the rate for each kind of service.

Table 1 RATE CARD

Resources	Subscription Virtual Server Plans				
	Plan1	**Plan2**	**Plan3**	**Plan4**	**Plan5**
MONTHLY SUBSCRIPTION (ex GST)	$200	$500	$1,000	$2,000	$4,000
CPU (CPU-HOURS)	2 CPUs (1,500 CPU- hours)	4 CPUs (3,000 CPU-hours)	8 CPUs (6,000 CPU-hours)	16 CPUs (12,000 CPU-hours)	32 CPUs (24,000 CPU-hours)
RAM (GB-HOURS)	4GB (3,000 GB-hours)	8GB (6,000 GB-hours)	16GB (12,000 GB-hours)	32GB (24,000 GB-hours)	64GB (48,000 GB-hours)
STORAGE (GB-HOURS)	100GB (75,000 GB-hours)	201GB (150,000 GB-hours)	537GB (400,000 GB-hours)	1,344GB (1,000,000 GB-hours)	3,360GB (2,500,000 GB-hours)
INTERNET USAGE (GB TRANSFERRED IN/OUT)	40GB	200GB	500GB	1,000GB	2,000GB
PUBLIC IP ADDRESSES	2 IP (1,500 IP-hours)	4 IP (3,000 IP-hours)	8 IP (6,000 IP-hours)	16 IP (12,000 IP-hours)	32 IP (24,000 IP-hours)

User pays two types charges for availing the cloud services– Upfront cost and Hourly Charges. There are two types of services provided by the AWS, on demand & reserved instance. If user does not want to reserve the instances of the services he can use the on demand services which are charged depending on the hourly usage. On the other hand for reserved instances user needs to pay upfront cost. For measuring the usage on hourly basis, different types of server side meters are implemented at client place.

5.1 The problem with Traditional Metering

The novice user planning to start a new business can't decide upon the initial investment required. Because the user is not sure about what resources required and how many are required for business. So the investment required for the business would be approximate. So here fuzzy would be the best option where input has approximate value as well as the output would be approximate. The user can check and select the cost model depending upon the resource requirement. For Finding the solution to above stated problem the paper proposes the design using fuzzy technique which helps user to make better selection, take a decision.

There are four models currently being used across various organizations in order to cost out their cloud solutions. The organization can choose one of them:

- Weighted cloud costing.
- Tiered cloud costing.
- Costing that differentiates service and infrastructure.
- Consumption cloud costing.

6. DESIGN OF THE SYSTEM

The cloud service provider gives a specification about the metering rate for the services they provide. It contains all numerical data. Any customer looks at the information provided by the vendor, and he wants to know his cost model for availing the cloud services. The customer may find it difficult how much he has to pay for availing the cloud service. The proposed system will help customer to know what his cost model is. So for a company who is starting a new business, cloud services is a best choice. The cloud service will reduce the upfront cost for the business.

The design of the system includes following Input Parameters for creating a Fuzzy Inference System

- CPU
- RAM
- Storage
- Bandwidth

And one output Parameter as Cost Model

The specification of the Parameters used for Metering the Cloud Service in the proposed system is provided in the Table 2.

Table 2 SPECIFICATION OF PARAMETERS

Parameter Name	**Type of Parameter**	**Total Number of Membership Function**
CPU	Input	4
RAM	Input	3
Storage	Input	4
Bandwidth	Input	3
CostModel	Output	4

The detail description of all parameters is given in the following code.

```
[Input1]
Name='CPU'
Range=[1 100]
NumMFs=4
MF1='Less':'trimf',[-38.6 1 35.96]
MF2='AboveAverage':'trimf',[34.4 62.94 90.4]
MF3='High':'trimf',[69.75 100 140]
MF4='Average':'trimf',[9.89 41.8 71.32]
```

[Input2]
Name='RAM'
Range=[1 100]
NumMFs=3
MF1='Minimum':'trimf',[-38.6 1 40.6]
MF2='Average':'trimf',[10.9 50.5 90.1]
MF3='Maximum':'trimf',[60.4 100 139.6]

[Input3]
Name='Storage'
Range=[1 100]
NumMFs=4
MF1='Small':'trimf',[-38.08 1.524 41.12]
MF2='High':'trimf',[29.63 63.83 91.23]
MF3='VeryHigh':'trimf',[64.77 103 143]
MF4='Medium':'trimf',[10.7 42.51 75.3]

[Input4]
Name='Bandwidth'
Range=[1 100]
NumMFs=3
MF1='Minimum':'trimf',[-38.6 1 40.6]
MF2='Avergae':'trimf',[10.9 50.5 90.1]
MF3='High':'trimf',[60.4 100 139.6]

[Output1]
Name='CostModel'
Range=[1 100]
NumMFs=4
MF1='Compact':'trimf',[-38.6 1 40.6]
MF2='Medium':'trimf',[40.34 70.54 98.14]
MF3='High':'trimf',[60.1 99.60 139]
MF4='Small':'trimf',[8.86 41.46 71.06]

Figure 2 shows the FIS rules are on the inputs and gives a defuzzified output that is CostModel. The inference rules designed decides the preferred cost model for the company. So the company can make financial arrangement for the new business.

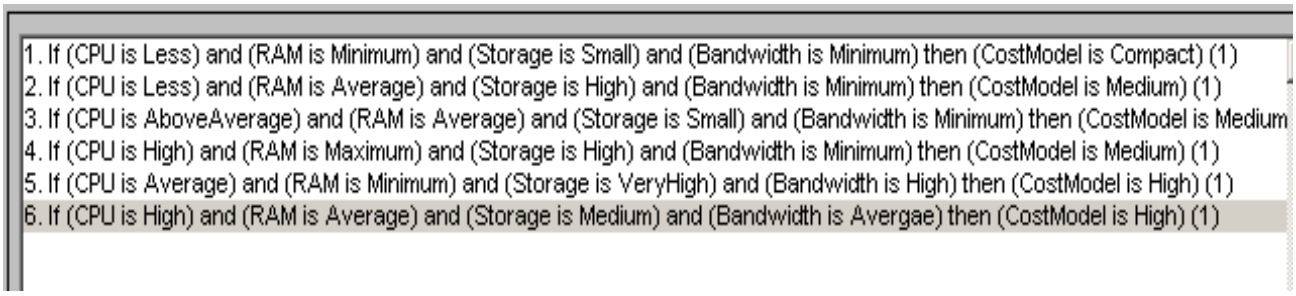

Fig 2 Fuzzy rule base

Figure 3 shows the surface view of the proposed FIS. The view shows the relation between CPU and bandwidth parameter used in Fuzzy Metering System.

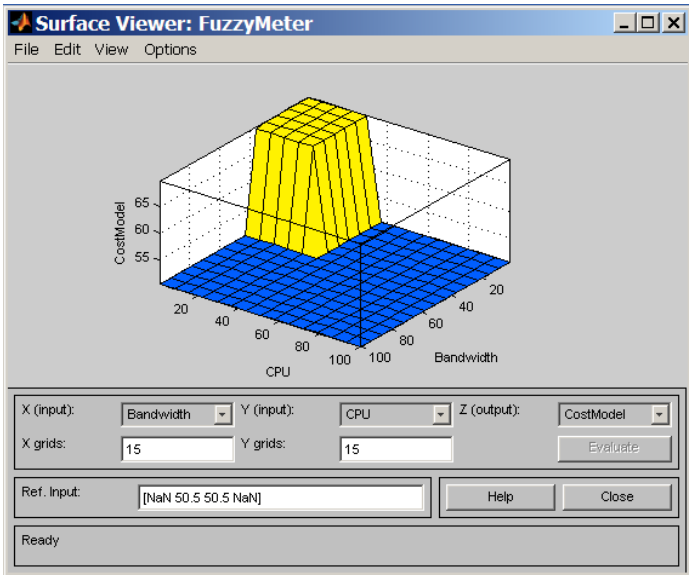

Fig 3 Surface View for Fuzzy Meter

7. DISCUSSION

The basic idea behind the proposed system is to make exact use the approximation feature of fuzzy technique. Today, almost any business or major activity uses, or relies in some form, on IT and IT services. The proposed design can be implemented and used as an application on internet; so that a company wants to start a new business can take a decision about the initial investment required. The design uses

potential of approximation of fuzzy techniques. Furthermore the fuzzy number concept can also be incorporated in this design.

8. CONCLUSION

By adopting the recent trends of IT business may spread throughout the world. Cloud, the recent developed IT Computing technique is the beginning of "network based computing" over internet in force. As the company wishes to start a new business would require the approximate investment amount. In that case fuzzy would be the best option for approximate reasoning. The company also can't be sure about the resources required to start the business. For the purpose the business has to follow the advanced technologies, this addition of fuzzy dimension for metering the cloud service will change the facet of Cloud Technology.

REFERENCES

[1] Al Bento, Regina Bento "Cloud Computing: A new phase in information technology management", Journal Of Information Technology Management, pp. 39-46, Volume XXII, November 1, 2011 [2] Srinivasa Rao V, Nageswara Rao N K, E Kusuma Kumari "Cloud Computing: An Overview" Journal Of Theoretical And Applied Information Technology,pp. 71-76, 2005 – 2009

[3] Liladhar R. Rewatkar, Ujwal A. Lanjewar "Implementation of Cloud Computing on Web application", International Journal of Computer applications(0975 – 8887), pp.28-32,Volume 2 – No.8, June 2010

[4] Balvinder Singh, Priya Nain "Bottleneck Occurrence in Cloud Computing", National Conference on Advances in Computer Science and Applications with International Journal of Computer Applications, pp. 1-4, 2012

[5] Karamjit Singh, Isha Kharbanda, Navdeep Kaur "Security issues occur in Cloud Computing and there Solutions" International Journal on Computer Science and Engineering (IJCSE) ISSN : 0975-3397 Vol. 4 No. 05 May 2012

[6]Rana Majumdar, Satyanarayana Garimella " Features, Benefits, Futuristic Projections of Cloud and Inter-Cloud Extensions to the Internet" Special Issue of International Journal of Computer Applications (0975 – 8887), 3rd International IT Summit Confluence 2012 - The Next Generation Information Technology Summit