# A COMPARATIVE STUDY OF CLOUDS IN CLOUD COMPUTING

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**Abstract- Cloud computing has now become one of the rapidly growing technologies in computer science. Cloud Computing makes its greatest impact on the IT ecosystem. It refers to the delivery of services like hardware, software, storage and infrastructure over the internet. This is called the next generation of internet. The IT organizations, businesses and other customers can take the required services and resources from cloud quickly, easily and at affordable cost (pay as u go fashion). This paper describes the basic architecture, types and models of cloud computing it also gives us a comparative study of various clouds given by different providers. The comparison is simply based upon number of factors like products, services, languages support and many other parameters of clouds.**

**Keywords—**Cloud Technologies, Amazon AWS, Luna cloud, Rackspace cloud

## I. INTRODUCTION

Cloud computing shortly gains popularity in IT sector and also in academia. It provides services through internet. Whenever we store our data or photos online instead of storing them on their own computer systems and use social networking sites like Facebook, Orkut and accessing Web-mails then it means we are using cloud computing. It allows businesses and individuals to use hardware and software which are totally managed and under observation of third parties at remote centers [2]. Cloud computing is a price model that is based on the services or resources usage quantity and duration factor. Cloud computing provides number of clouds for providing services. As all clouds have some different features, storage capacities, billing systems and different methods to provide the services from other clouds. The recent problem is that the people are not aware that which cloud is suitable according to their requirements , they cannot able to choice the appropriate cloud for their services among the different clouds managed by different cloud providers [13]. So to facilitate these kinds of situations, this paper helps in defining the comparison of some most popular clouds keeping in mind its all important aspects which can help a normal customer, business organizations and academics to choice the particular cloud according to their needs [1]. This paper structured as follows: (1) Introduction to cloud computing. (2) Discuss the current scenario of the cloud computing. (3) Discuss the various service models provided by cloud computing –IAAS, PAAS, SAAS. (4) Discuss about the different deployment models of cloud computing which are private, public and hybrid clouds. (5) Comparison between different clouds of cloud computing. (6) At last it discuss some threats and attacks which effects the cloud computing continuously. Fig 1 shows the basic structure of cloud computing.

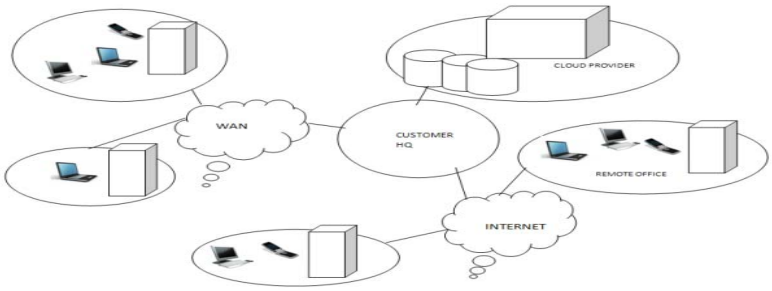


Figure 1. The Basic Infrastructure of a cloud computing

## II. CURRENT STATUS OF CLOUD

According to a survey report the implementation status of cloud computing over the world is 80 percent of the total process are under progress or have already deployed and the remaining 20 percent are plan to deploy [16]. Fig 2 Shows the division of the present status of cloud computing.

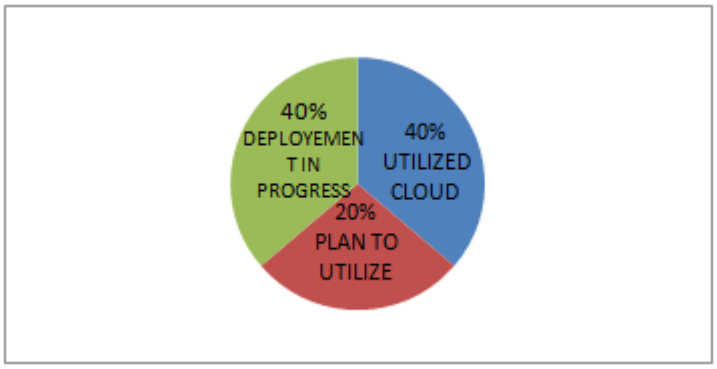


Figure 2. Implimentation Status of cloud computing

## III. SERVICE MODELS OF CLOUD COMPUTING

*IAAS*- Infrastructure-as-a-service offers computing resources like storage or processing which can be acquired as a service. Basically it provides the raw hardware and virtualized infrastructures. Today IAAS services are provided by **AMAZON EC2** and **SIMPLE STORAGE SERVICE (S3).** These are the web services from which we can even access the Operating Systems (Linux, Solaris and windows) also and other hardware supported services by paying rent according to the usage of services.

*PAAS*- Platform-as-a-service provides the platform or the environment in which the developers can develop the software and applications. The developers can write the codes or programming according to the particular platform's specifications. PAAS layer is a kind of abstraction layer which is present in between the IAAS and SAAS layers. The latest examples of PAAS are **GOOGLE APPLICATION ENGINE** and **MICROSOFT AZURE**. These are the web services which provide the platform for developing various applications and services.

*SAAS*- Software-as-a-service is the service where the actual development of software and applications takes place on the platforms provided by the PAAS layer. SAAS layer is mainly concerned with end users because end users can access and use these applications which were made by cloud providers. Customers need not purchase or install the required software on their own data centers they can just access them from cloud via SAAS. The latest service of SAAS are **GOGRID**, **SALESFORCE.COM** which is a web service offers number of products and services like CRM (Customer Relationship Management) [2]. Table1 shows the details of these three delivery models.

TABLE1. CLOUD SERVICE DELIVERY MODELS

| **MODELS** | **SERVICES AVAILABLE** | **USED BY** | **WHY USE IT?** | **EXAMPLES** |
|---|---|---|---|---|
| SAAS | Email,office automation,website testing,wiki,virtual desktop, blog,CRM. | Business users | To complete business tasks | Salesforce.com , Animoto , Oracle on demand, Windows Office Live |
| PAAS | Services, applications tests, development, integration and deployement. | Developers and deployers | Create or deploy applications and services for users | Google Application Engine, Microsoft Azure ,Coghead, Force.com,Yahoo Developer Network |
| IAAS | Create platforms for srvice and application test, development integration and deployment | System manager | Create platform for service and application test, development,integration and deployment | Amazon EC2 , Simple Storage Service (S3), Go-grid. |

## IV. DEPLOYEMENT MODELS

As we know that the cloud computing contains three types of services which also called deployment models. There are 3 deployment models that cloud computing has - Public clouds, Private clouds and Hybrid cloud. They are used according to the customer's requirements [4]. Table2 gives the description and examples of these three deployment models.

TABLE2. DEPLOYMENT MODELS OF CLOUD COMPUTING

| DEPLOYEMENT MODELS | DESCRIPTION | EXAMPLES |
|---|---|---|
| **PUBLIC** | Public clouds are not restricted to any particular customers or organizations. They provide services to the public all over the world without any limitations. But they are not as secure as private clouds. | • Amazon Elastic ,<br>• Google App Engine,<br>• Blue Cloud by IBM and<br>• Azure services Platform by Windows |
| **PRIVATE** | Private clouds provide services to the customers of the particular organizations for the sake of security and confidentiality of their personal data. The fact is that whether these private clouds are owned and controlled by customers but they are built and installed by the third parties. | • VMware<br>• Microsoft<br>• Amazon EC2<br>• Eucalyptus |
| **HYBRID** | Hybrid clouds are the combination of both public and private clouds. The organizations and other people can take benefits of both public and private cloud by using hybrid clouds. Like some of the companies set their own private clouds and they take services from it but if they need some services from public cloud also then this facility comes under hybrid clouds only. | • CTERA<br>• Red hat open hybrid cloud |

## V. COMPARISON BETWEEN THREE DIFFERENT CLOUDS:-

There are number of clouds which are used presently, like Go-grid cloud, Luna cloud [6], Amazon web services [5], Rackspace [7], Hostway cloud, Green house cloud, Go2cloud, GigeNET cloud and many more clouds so choice is difficult among number of clouds for customers. So I compare some important and commonly used clouds to make choice easier according to the customer's requirements [14].Table3 shows the detailed comparison of these three clouds.

TABLE 3. COMPARISON BETWEEN THREE DIFFERENT CLOUDS

| CLOUD NAMES | LUNACLOUD | AMAZON AWS | RACKSPACE |
|---|---|---|---|
| *CLOUD PROVIDER* | LUNACLOUD | AMAZON WEB SERVICES | RACKSPACE |
| *FOUNDATION YEAR* | 2011 | 2006 | 1998 |
| *SERVICE MODEL BELONGS TO* | PAAS | IAAS | IAAS |

| | | | |
|---|---|---|---|
| *CONTROL INTERFACE* | • S3 COMPATIBLE API<br>• WEB BASED APPLICATION/CONTROL PANEL<br>• COMMAND LINE<br>• GRAPHICAL USER INTERFACE | • S3 COMPATIBLE API<br>• WEB BASED APPLICATION/CONTROL PANEL<br>• ROLE BASED ACCESS CONTROL<br>• COMMAND LINE<br>• GRAPHICAL USER INTERFACE | • WEB BASED APPLICATION/CONTROL PANEL<br>• API |
| *PRICING DESCRIPTION* | 512GB + 1vCPU + 10GB<br>Per hour = $0.019<br>Per month=$13.68 | 1.7GB + 1ECU + 160GB<br>Per hour = $0.077<br>Per month=$55.44 | 512GB + 1vCPU + 20GB<br>Per hour = $0.022<br>Per month=$16.06 |
| *MAXIMIUM SIZE OF RAM* | 512 GB TO 96 GB | 512 GB TO 68.4 GB | 512 GB TO 30 GB |
| *O.S AND WINDOWS SUPPORT* | • RED HAT LINUX<br>• FEDORA<br>• CENT O.S<br>• DEBIAN GNU/LINUX<br>• OPEN SUSE<br>• SUSE LINUX ENTERPRISE SERVER<br>• UBUNTOO LINUX<br>• WINDOW SERVER 2008 R2 SP1 WEB EDITION<br>• WINDOW SERVER 2008 R2 SP1 STANDARD | • RED HAT LINUX<br>• FREE BSD<br>• FEDORA<br>• CENT O.S 5.4<br>• DEBIAN GNU/LINUX<br>• GENTOO LINUX<br>• OPEN SUSE<br>• OPEN SOLARIS<br>• SUSE LINUX ENTERPRISE SERVER<br>• UBUNTOO LINUX<br>• WINDOW SERVER 2003<br>• WINDOW SERVER 2008 | • OPEN STACK O.S<br>• ARCH 2009.02<br>• CENT O.S<br>• DEBIAN<br>• GENTOO LINUX<br>• FEDORA<br>• UBUNTOO LINUX<br>• RED HAT ENTERPRICE LINUX<br>• WINDOW SERVER 2003<br>• WINDOW SERVER 2008 |
| *LANGUAGES SUPPORT* | ALL( ROOT ACCESS SERVER) | ALL( ROOT ACCESS SERVER)<br>• JAVA<br>• JAVA SCRIPT<br>• PHP WINDOW AND .NET<br>• RUBY<br>• PYTHON | ALL(ROOT ACCESS SERVER) |
| *PRODUCTS* | • CLOUD SERVER<br>• CLOUD STORAGE<br>• CLOUD APPLIANCE<br>• CLOUD MANGO | • AMAZON EC2<br>• AMAZON ELASTIC MARKETPLACE<br>• AUTOPLACING<br>• AMAZON VIRTUAL PRIVATE CLOUD(VPC) | • CLOUD SITES<br>• CLOUD FILES<br>• CLOUD BLOCK STORAGE<br>• CLOUD DATABASE<br>• CLOUD BACKUP<br>• CLOUD DNS |

| | | | |
|---|---|---|---|
| | | • AMAZON RELATIONAL DB SERVICE (RDS)<br>• AMAZON DYNAMO DB<br>• AMAZON STORAGE GATEWAY<br>• AMAZON ELASTIC BLOCK STORAGE (EBS)<br>• AMAZON SIMPLE STORAGE SERVICE(S3)<br>• AWS IMPORT/EXPORT | • MANAGED VIRTUALIZATION<br>• MANAGED CLOUD<br>• CLOUD SERVER<br>• CLOUD LOAD BALANCERS<br>• CLOUD MONITORING<br>• MANAGED STORAGE<br>• MANAGED COLOCATION<br>• RACKCONNECT |
| *SERVICES* | • PHONES<br>• QUICK RESPONSE<br>• ONLINE RESOURCES<br>• KNOWLEDGE BASE<br>• LIVE CHAT<br>• OLINE GUIDANCE SUPPORT VIDEOS AND GAMES | • FREE TRIALS<br>• 24*7*365-CUSTOMER SERVICES<br>• DOCUMENTATION, WHITE PAPERS, BEST PRACTICE GUIDES<br>• ACCESS TO TECHNICAL SUPPORT<br>• SUPPORT FORUMS<br>• PRIMARY CASE HANDLING<br>• IAM(IDENTITY ACCESS MANAGEMENT) | • PHONE<br>• SUPPORT FORUMS<br>• 24*7*365 SUPPORT<br>• URGENT RESPONSE<br>• ONLINE RESOURCES<br>LIVE CHAT |
| *LATEST DEVELOPMENTS* | • LAUNCHES A *MANGO DB* AS A SERVICE A POWERFULL NOSQL DATABASE IN THE WORLD.<br>• LUNACLOUD HAS BASE ITS SERVICES ON A RELIABLE BRAND *PACI* (PARALLEL AUTOMATION FOR CLOUD INFRASTRUCTUR | • ADD NEW SERVICE *LOGIN WITH AMAZON* FOR AUTHENTICATION<br>• AMAZON ROUTE 53 ADD ELASTIC LOAD BALANCER INTEGRATION FOR DNS FAILOVER THAT CAN HELP DETECT AN OUTAGE OF YOUR WEBSITE. | • RACKSPACE INTEGRATE WITH ***AKAMAI*** (POWERING A BETTER INTERNET SERVICES)<br>• THEY START A NEW CONTROL PANEL NAMED ***NEW CLOUD CONTROL PANEL*** OR CLOUD CONTROL PANEL |
| *SOME GENERAL DIFFERENCE* | • FLEXIBLE IN NATURE<br>• PROPRIATARY<br>• LOW LATENCY<br>• NO CDN<br>• HOT RESIZING | • FLEXIBLE IN NATURE<br>• PROPRIATARY<br>• LOW LATENCY<br>• CDN<br>• NO HOT RESIZING<br>• PLATFORM:-CUSTO | • NOT FLEXIBLE AS ITS STACK IS FIXED<br>• OPEN CLOUD(OPEN STACK)<br>• MORE LATENCY<br>• CDN<br>• NO HOT RESIZING<br>• **PLATFORM**:- |

| | | | |
|---|---|---|---|
| *S* | • PLATFORM:- VMWARE VCLOUD<br>• HYPERVISOR:- VMWARE<br>• HIGH AVAILABILITY<br>• GRANTED CPU<br>• FREE INT. BACK UP /SNAPSHOTS FEATURE<br>• INT.LOAD BALANCING<br>• FAILOVER FEATURE<br>• USE ADVANCED FIREWALLS<br>• FREE PERSISTANCY FEATURE | • HYPERVISOR:-XEN<br>• LOW AVAILABILITY<br>• GRANTED CPU<br>• FREE-INT.BACK UP/SNAPSHOTS FEATURE<br>• INT. LOAD BALANCING<br>• FAILOVER FEATURE<br>• USE ADVANCED FIREWALL<br>• PAID PERSISTANCY FEATURE | CUSTOM<br>• **HYPERVISOR**:-XEN<br>• LOW AVAILABILITY<br>• NOT GRANTED CPU<br>• PAID-BACK UP/SNAPSHOTS FEATURE<br>• NOT ALLOW LOAD BALANCING<br>• NO FAILOVER FEATURE<br>• NO USE OF ADVANCED FIREWALLS<br>• FREE PERSISTANCY FEATURE |

## VI. THREATS AND ATTACKS OF CC

*1. THREATS*

*ABUSE AND NEFARIOUS USE OF CLOUD*- As we know cloud computing providers provides IAAS and PAAS services to their customers. People have to pay for these services according to their usage. Sometimes cloud providers offers free limited trials for demo or the publicity of their products. But these trial versions give a great opportunity to the adversary or attackers to attack into the cloud's data. They can hack the passwords and can execute malicious codes or commands. The example is to using the botnets which can also damage the cloud's data.

*INSECURE INTERFACES AND API*- Interfaces are those which provide the path between client and server, so the customers can easily interact with cloud services. So these API'S should be highly secured, authenticated and encrypted that no attackers can destroyed the cloud's data through these interfaces and API.

*MALICIOUS INSIDER*- Malicious insider are those employees who are not trustworthy at the user end and the provider's site. These employees pretend as they are responsible and honest but in actual they are harmful for cloud's data. Malicious insider can hack the passwords, encryption keys and other important files. They can steal the confidential data. Transparency is the main concept in case of security and management issues.

*DATA LOSS OR LEAKAGE*- Data loss or leakage refers to the loss of the credential data due to the number of reasons like operation failures, omission failure, and non-reliable data storage, non authenticated and unauthorized access into the sensitive data. Example is twitter which is often accessed by unauthorized users.

*UNKNOWN RISK PROFILE*- It is necessity for the employees or the users to estimates their company's security infrastructure. They should aware about the version of software, hardware they are using, coding structures, the overall security system, intrusion attempts. The users should also have knowledge that which external users or organizations sharing their infrastructure and where their data are actually stored [17].

*2. ATTACKS*

*WRAPPING ATTACK*- Whenever a user sends a request from virtual machine then this request received by a web server which generates a SOAP message which is exchanged between client and server and SOAP header contains the address of its destination. Wrapping attacks are performed during the translation of a soap message in the TLS (Transport Layer Service) and after that it can intrude in the cloud and can performs malicious attempts into the data.

*MALWARE INJECTION ATTACK-* In this the attacker can embeds the false commands, intrudes malicious code or can exchange the metadata into the correctly running system and appears to be valid. Now he/she is able to modify the data, can change the functionality of the system and it force the legitimate user to wait for completion of the task which is not requested by the user.

*FLOODING ATTACK PROBLEM-* As in a cloud infrastructure, the servers are working in such a manner that they communicate with each other easily. So whenever the load of a single server comes at its extreme level then server can offload itself by transferring some of its work to the nearer servers. In flooding attack the attackers sends useless and not required requests to the server to make it busy and overloaded so that, the server forced to transfer its tasks to other servers.

*DATA STEALING PROBLEM-* Data stealing as the name implies to steal the data, user accounts encrypted keys, files and passwords by any ways.

*ACCOUNTING CHECK PROBLEM-* Whenever a customer uses the cloud services then the duration in which he/she uses the service, and the amount of data he use or access , and number of CPU cycles per customer are all recorded. So, on the basis of these recorded information, the user has been charged and when an attacker sends the useless requests and data into the cloud to making the cloud engaged then it raise the consumption power of server which charges the legitimate user who is unknown from the malicious services [18].

## CONCLUSION AND FUTURE WORK

After reviewing or studying the number of journals, white papers, cloud computing articles and case studies, I come to know that cloud computing is the largest buzz in the world of computer now a days. It gains popularity in almost every field like in industry and in educational systems. This paper gives the knowledge of cloud computing introduction, its concepts, models and services. The paper also discussed the comparison of three popular clouds of cloud computing names- Amazon AWS, Luna cloud and Rackspace cloud in the form of a table. These clouds are compared with respect to the platforms supported, languages supported, storage capacity, services and products. No doubt cloud computing has a vast future scope but still it suffers from number of security issues which are also explained in this paper. Now the next step is to propose a model or a architecture which can detect and prevent the various threats, attacks and other security related issues which continuously depletes the efficiency and the productivity of the cloud.

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