

HOLY GRAIL OF CLOUD COMPUTING – COMPARISON OF THREE IT GIANTS AMAZON, GOOGLE AND MICROSOFT

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Abstract--One of the most enticing technology areas in today's world is that of cloud computing. Cloud computing offers numerous advantages to its customers like low cost, ease of use and flexibility. Online storage services provide secure and easily accessible cloud storage that allows you to view and share your files from anywhere, anytime. You can free up space on your hard drive while ensuring you'll never lose your personal files. Online storage backup services should provide practical features that make uploading and sharing your files easy and convenient. Several cloud computing vendors including the established names in IT like Google, Microsoft and Amazon have already entered the world of cloud computing with their respective platforms. With so many cloud computing platforms already available and counting, it is getting extremely difficult for customers to choose the right cloud computing platform. This paper reviews the Google, Microsoft and Amazon cloud computing platforms. To help customers pick a cloud that fits their needs, we made a systematic comparison of cost, ease of access and help and support of cloud providers. With this comparison, the developers can better understand the Amazon, Google and Microsoft cloud computing platforms and can make a reasonable choice depending on the technology, storage data, bandwidth, and compute and storage access.

I. INTRODUCTION

Cloud computing refers to providing the software and services over the internet to the client without giving any information about the hardware and system's software running in the data centres that provides those services. It is easy to get started with cloud computing. Anyone with an internet connection and a credit card could use the same resources to host and build web applications that power Google or Amazon applications. Moreover, the "pay as you go" features of cloud computing makes it even more attractive to small businesses. The ability to pay only for the resources used enable companies to cut their expenditures significantly. Seeing this huge opportunity in cloud computing field, new cloud computing service providers are entering the cloud computing market every day. As more and more service providers join the race to tap the huge potential, it is getting extremely difficult for the developers to select the best platform. This paper will discuss and compare cloud computing platforms of three IT giants – Amazon, Google and Microsoft^[1]. This should enable developers to select the best platform out of these three. In the next section, we will discuss about key characteristics of cloud computing. Further discussion is about Amazon, Google and Microsoft cloud computing platforms and the comparison amongst the three cloud computing platforms based on cost, ease of access and help and support.

II. ADVANTAGES OF CLOUD COMPUTING

a. Ease of use: Unlike traditional business applications that require lot of resources and time to get an application up and running, cloud based applications can be up and running in few days.

b. Lower costs: With applications operating on Cloud, organizations don't need to have all the facilities, resources and people to run their business applications in-house and therefore, less cost.

c. Unlimited storage capacity: One of the biggest advantages of Cloud Computing is that it offers unlimited data storage. Storage space is available on demand and it ranges from few megabytes to hundreds of terabytes.

d. Highly automated: With Cloud Computing, organizations no longer need to worry about software updates, security and performance enhancements. It is the responsibility of the Cloud Computing vendors to install all the required updates and to perform system enhancements.

e. Allow businesses to shift focus: With cloud computing, vendors take care of your applications and therefore, an organization could use its existing resources to focus on other important things like new projects, research and innovation.

f. Scalability: With the advent of Cloud Computing, an enterprise has to no longer worry about the downtime due to enormous user load. Cloud computing offers dynamic addition or subtraction of resources/capacity as per the network load. Therefore, organizations neither have to face scenario where they have thousands of servers sitting idle nor the scenario where they are lacking resources. With cloud computing, organizations need to pay only for what they consume^[2].

III. COMPARISON OF CLOUD COMPUTING PLATFORMS

The features that count when hosting application on the cloud are:

- **Auto-scaling** – If there is an increased demand, it automatically allocates more resources to handle the requests. It is preferable to have auto-scaling and be sure that a service never dies because of high load.
- **Paywhat you use** – Option to choose smaller servers or bigger servers depending on the application size. Cloud enables to do this easily rather than reconfiguring remote machines.
- **Cloud infrastructure** – Enables us to deploy services and take care that the services are working. Therefore, instead of installing and configuring a message queue on machines, we can use an already installed and managed message queue, database, email service, or cache.
- **Management tools** – Consoles, command-line tools and web UIs for handling installations are available. This is both a plus (the tools are higher level than working with native commands), and a minus (there's a learning curve).
- **Load balancers** – All services offer these, what's the software and hardware of the load balancer is not important.

A. Amazon Web Services

Amazon Web Services (abbreviated **AWS**) is a collection of remote computing services (also called web services) that together make up a cloud computing platform. AWS offers a complete set of infrastructure and application services that enable you to run virtually everything in the cloud: from websites and mobile apps, to big data projects and enterprise applications^[7].

- **General flow:** Creation of an EC2 instance, which is a virtual machines, ssh to it and have full control. You can bring up and kill copies of your instance whenever there's higher load.
- **Flexibility:** Since you have root control over your machine, it is very flexible.
- **Usability:** The AWS console and the Elastic Beanstalk give you very nice UI for managing applications. With Beanstalk you can deploy applications without even opening a console, just drop a war file. In reality you will at least need to provide some configuration though.
- **Features:** In addition to the basic instance functionality, managed database, elastic IPs, DNS, cloud storage, CDN, mail service, message queue, cache are also provided. So instead of installing and managing these services on your instances, you can use the Amazon versions.

- **Pricing:** You are charged for the number of hours your instances are running.

B. Google App Engine (GAE)

Google App Engine is a platform as a service (PaaS) cloud computing platform for developing and hosting web applications in Google-managed data centers. Applications are sandboxed and run across multiple servers. App Engine offers automatic scaling for web applications—as the number of requests increases for an application, App Engine automatically allocates more resources for the web application to handle the additional demand^[3].

General flow: Creating an application and deploying it (through command line or IDE plugin). Server management is not possible. Remote login through ssh is also not possible because only the app is available. The app runs in a sandbox, and some proprietary APIs in order to store to a NoSQL store, MapReduce may be required.

- **Flexibility:** is low because deployment is done using sandbox. The configurations that admin UI offers is limited.
- **Usability:** the admin UI can be improved.
- **Features:** email, data store, task queue, memcached.
- **Pricing:** generally, the user is charged for the amount of resources consumed.

C. Windows Azure

Windows Azure is a Microsoft cloud computing platform for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. It provides both Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) services and supports many different programming languages, tools and frameworks.

- **General flow:** All it needs is to create a virtual machine and simple web sites can be deployed using php, asp or node.js.
- **Flexibility:** high for the VM, low for the PaaS
- **Usability:** the admin UI can be improved.
- **Features:** caching, database, service bus
- **Pricing:** fine-grained, pay-as-you-go or prepaid plans.

IV. CPU COST

The acquisition and installation of IT server clusters is growing significantly worldwide. Partly fuelling this growth is society's reliance on the Internet for collaboration, entertainment, and communication; the adoption by IT organizations of the concept of software as a service; and the use of simulation in scientific discovery and product development. Fig 1 shows the range of CPU usage charges by Amazon, Google and Microsoft respectively. It can be inferred that Amazon has a varying range of 0.02 to 3.68 \$ per

hour owing to the flexible options it provides for the users^[4].

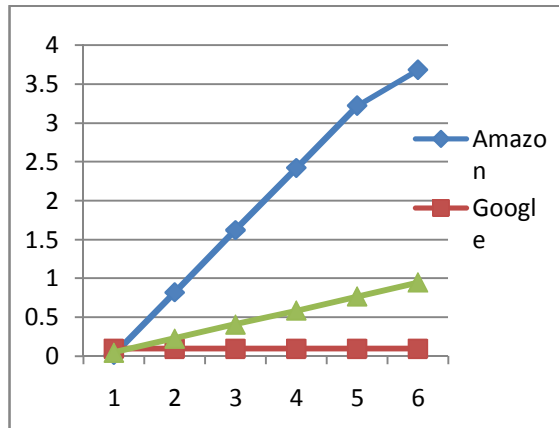


Fig 1: CPU Usage charges

Fig 2 depicts the storage usage charges levied on the users by the 3 companies listed below. It can be inferred that Amazon has a varying range 0.037 to 0.14 \$ per GB per month owing to its scalability. Google and Microsoft has a fixed value of 0.15 \$ per GB per month.

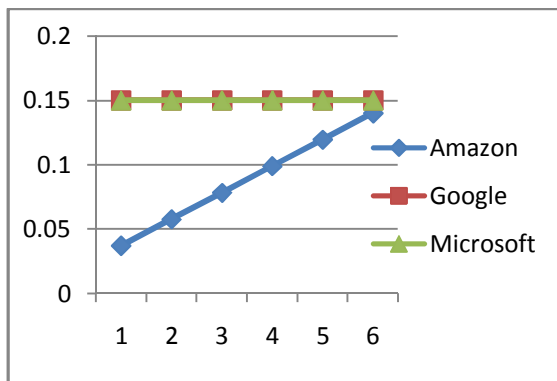


Fig 2: Storage Usage charges

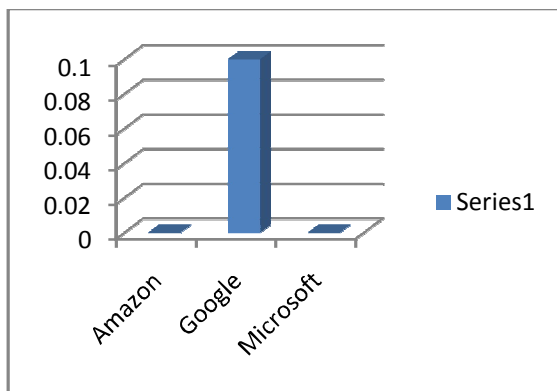


Fig 3: Incoming Bandwidth charges

Fig 3 and 4 depict the Incoming and Outgoing Bandwidth charges respectively of Amazon, Google and Microsoft. We can deduce that only Google charges for incoming i.e. 0.1 \$ per GB and for outgoing Amazon has a variable range from 0.05 to 0.106 \$ per GB whereas Google and Microsoft have fixed charge of 0.12 and 0.15 \$ per GB respectively.

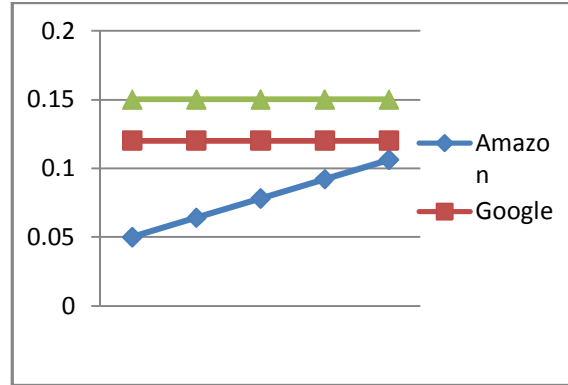


Fig 4: Outgoing Bandwidth charges

V. STORAGE SPACE

One of the most important things to consider when researching online document storage services is the allotted storage space. The best cloud services are those that provide unlimited storage for a flat monthly fee. This means you can store as many files as you want without the service ever capping your limit. If storage space isn't your top priority, opt for an online data storage service that delivers a low cost per gigabyte^[6].

VI. EASE OF USE

Look for online storage services that are powerful yet simple enough for the average consumer to understand and use. A clean, intuitive account interface fosters easy navigation. Uploading files and software installation, if required, should be straightforward. A good online storage service will allow you to begin uploading files to your account within a few minutes. Fig 5 shows that all the 3 companies fare well in being user friendly^[5].

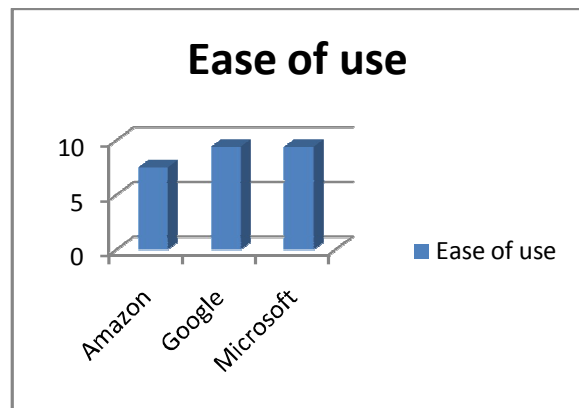


Fig 5: Ease of Use

VII. HELP & SUPPORT

Even the most user-friendly online storage services should be supplemented with useful help and support options. Troubleshooting and technical resources should be available, including video tutorials and a comprehensive

knowledgebase. Direct customer support should also be offered via telephone, email or live chat.

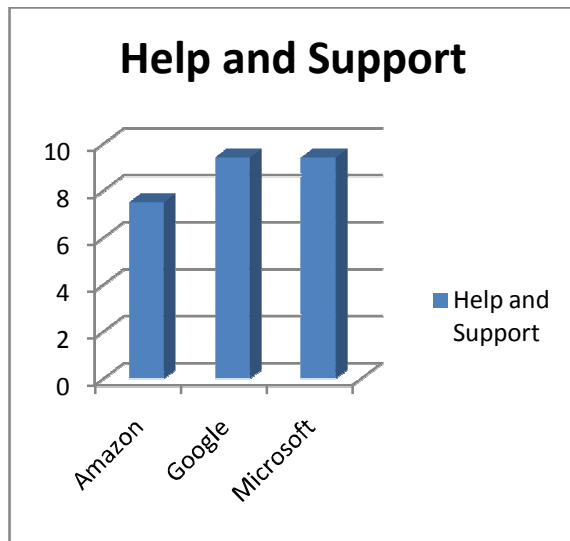


Fig 6: Help and Support

Fig 6 shows that Amazon, Google and Microsoft are prompt to customers' needs and provide efficient help via interactive media.

VIII. CONCLUSION

The following conclusions about the top providers of cloud computing today given their current pricing and feature sets are provided below:

1. **Amazon is currently the lowest cost cloud computing option overall.** At least for production applications that need more than 6.5 hours of CPU/day, otherwise GAE is technically cheaper because it's free until this usage level. Amazon's current pricing advantage is entirely due to its reserved instances model.
2. **Windows costs at least 20% more to run in the cloud.** Both Microsoft and Amazon offer almost identical pricing for Windows instances while Google App Engine is not

even a player in Windows compute clouds. There are undoubtedly cheaper offerings from smaller clouds but they are less likely to be suitable for enterprise use, though certainly there are exceptions.

3. **Better elasticity does not confer major price advantages.** GAE is one of the most granular of the cloud computing services, only requiring for you to pay for what you actually use (for example, you have to commit to at least an hour of compute time at a time from Amazon) but does not provide a major cost advantage for large applications.

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