

# Representative Service Providers and their Selection in Cloud Computing Domain

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## ABSTRACT

The popularity of cloud computing is growing owing to its large data storage capacity and high computation power. It provides online, on-demand, scalable application solution, removes hardware and software barriers for non-specialist, rapidly integrates and deploys desired and necessary facilities, supports quick upgrading and addition of features. Users get benefitted with the selection of the appropriate cloud computing platform for their projects. Here, our paper provides a comprehensive overview of the services provided to the users by the most common cloud computing service providers. This paper could be used as a reference while selecting the best service provider based on the requirements of the projects.

## Keywords

Cloud computing; data storage; users; service provider; software; hardware

## 1. INTRODUCTION

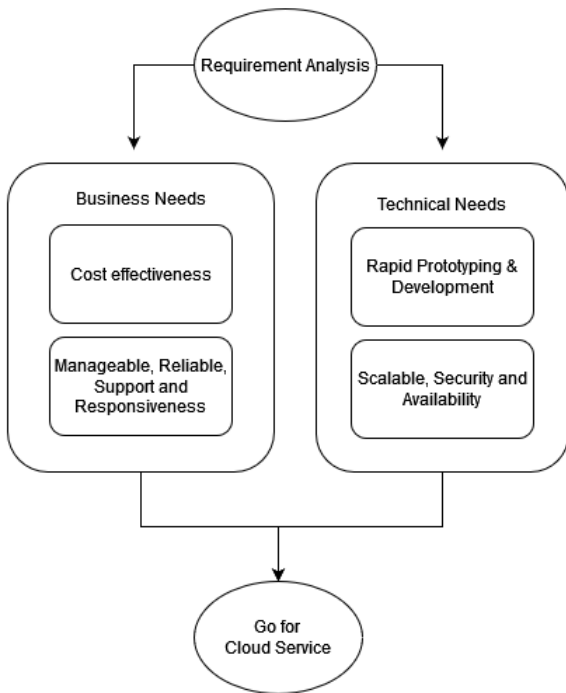
The underlying concept of cloud computing has a long history. It provides online, on-demand, scalable application solution, removes hardware and software barriers for non-specialist, rapidly integrates and deploys desired and necessary facilities, supports quick upgrading and addition of features. It provides services like data storage, computation power including software, hardware, or platform. Service provided through cloud computing can be public, private, or hybrid. The particular company providing cloud computing services to its customers/users/clients is indicated as service provider in technology domain. Therefore, we will also use the term service provider to refer those company and customer/clients as the user in this paper. We discuss about the service provided to the user by the service provider in this paper. There are multiple reasons for the positive inclination of people towards service providers. The prominent being their cost effective features. Service providers on demand facilitates to add or remove required resource for the application development. This makes the user flexible enough to use and pay only for the most necessary and used resource and does not force the user to buy the physical computing resources [5]. In case of need, users can utilize the hardware/software/server resource provided by the service providers at any point of time. In addition, the platform provided by the service providers has security functions enabled by default. They follow industry standard security protocols and also keep updating the service (like Database) with the latest patches. Users can also utilize the extra security facility services for the application [6]. Furthermore, users can have full control over the services. They can either scale up the resource or scale down as per the need of the application. Users need not worry about the physical changes required while up scaling or down scaling the services. One example of

scaling is to increase or decrease the storage size of computing instance. Software service (SaaS), Platform service (PaaS), and Infrastructure service (IaaS) are some of the most commonly provided services by the service provider. When the service provider is providing software services to its user, the services can be utilized to develop, improve, and upgrade the software application for user's own usage. Although there are challenges [2], users can focus on the business process rather than the software development process using this service. Under platform service, the provider provides a platform to develop, maintain and test the application developed using the services. Users can focus on applications rather than maintaining servers or networks. Providers provide servers, virtual machines (VM), and operating systems for usage to the user when providing the infrastructure services. VM is like computing device inside a host server which has its own operating system [3]. The host server can be fully utilized when many VM is operated under the same host server. The user needs to pay as per the usage of the service. Another service provided by service provider is serverless architecture [11]. Here, the application of the user is hosted by the service provider in the cloud. This architecture eliminates the process of managing hardware or software platform and is executed when necessary. Only the functional part of the application is required for execution. This increase the focus of application in business needs and also may decreases the application development time. Although most of the serverless architecture have execution limitation, using this architecture, development cost can be reduced since it only runs when required without any other costing server. To utilize the services provided by the service provider, user can use a user interface, command-line options, application programming interface or system development kit provided by the service provider. The service provider have proper documentation, best practices and multiple approaches to develop application in their platform.

### 1.1 Selection of the service provider

Selection of the service provider depends on many factors (Figure 1, Table 1-8). Most common factors being cost, scalability, development time. Cost is the prime factor that determines the selection of the service provider in most of the cases [7]. Selection also depends upon the application requirement and usage [8]. Users can figure out the estimated cost using the cost calculator service available. Scalability is another factor that impacts in the service provider selection process. Deployment services, feasibility of scaling up/down the application hosted in the provider will decide the selection. Similarly, users think about the accessibility, easiness in pre-processing the data while selecting the service provider, users select no coding option if they want the service provider to support no code feature for their data processing. Users want to perform all the necessary operations

be executed using drag and drop options. In addition, user's app/tool may not need high computing servers. Users can check if user's tools/apps can be executed in browsers without being dependent on servers and utilize the exact service of the service provider.



**Fig 1: Different business and technical need to go for cloud service provider**

**Table 1: Name of most popular cloud service providers**

Name of Service Provider
Amazon Web Services (AWS)
Google Cloud Platform (GCP)
Azure
Digital Ocean
Linode
Alibaba
Oracle
IBM Cloud

**Table 2: Popular service provider based on the computing instance, file storage, serverless feature details. Service providers have not been ranked or kept in any order based on any particular feature**

Service Provider	Computing Instance	File Storage	Serverless
AWS	Elastic Compute Cloud	Simple Storage Service	Lambda
GCP	Compute	Cloud Storage,	Cloud Functions

	Engine	FileStore	
Azure	Virtual Machine	Azure Files, Azure Blob Storage	Azure Functions
Digital Ocean	Droplets	Space Object Storage, Volumes Object Storage	Digital Ocean Functions
Linode	Virtual Machines (CPU Based)	Block Storage, Object Storage	Function as a Service
Alibaba Cloud	Elastic Compute Service	ElasticBlock Storage	Function Compute
Oracle	Virtual Machine	Oracle Cloud Storage	Oracle Functions
IBM Cloud	Virtual Workloads	IBM Cloud Storage( File, Object, Block)	IBM Cloud Functions

Computing instance means remotely available computing device i.e. server (Table 2). Providers provide low computing as well as high computing servers. User can use this computing instance to develop, test, and run applications, models, or products. The performance of the executed application depends on the system configuration. Depending upon the needs and requirements, we can select low computing instances or high-speed computing instances. In addition, service providers have self-managed service. In this service, the user need not worry about the system configuration. The provider's platform automatically increases or decreases the user's system capacity as required [9]. This increases user's development process and reduces the system maintenance time. The platform also provides technical support where the requests or queries of the user is fulfilled. When a user develop an application, the user uses service provider's services to execute application and store information. The application needs file storage services which is cost effective to store or retrieve information [10]. File storage is about the data including data upload, download, transfer and storage. There could be multiple options provided by service provider on how data could be stored. One option is data can be stored based on how frequently the data needs to be accessed. Users can decide about the file storage based on 3 essential parameters like file type, stored file query frequency, necessity of caching files.

**Table 3: Popular service provider based on their computing instance feature details. Service providers have not been ranked or kept in any order based on any particular feature**

Computing Instance	Low Range Instance	High Range Instance	Self-Managed Service
AWS	1 vCPU, 0.5 GB	64 vCPU, 256 GB	Yes
GCP	2 vCPU, 8 GB	96 vCPU, 1360 GB	Yes
Azure	0.5 GB, Balanced CPU-to-memory ratio	128 vCPU, 3,800 GB	Yes
Digital Ocean	1 vCPU, 0.5 GB	32 vCPU, 256 GB	Yes
Linode	1 vCPU, 1 GB	32 vCPU, 192 GB	Yes
Alibaba Cloud	2 vCPU, 8 GB	104 vCPU, 768 GB	Yes
Oracle	2 vCPU, 1 GB	64 GB, 128 vCPU	Yes
IBM Cloud	1 vCPU, 2 GB	64 vCPU, 512 GB	Yes

**Table 4: Popular service provider for geospatial database. Remote sensing and GIS projects mostly work with geospatial database and most providers support to the geospatial database Service providers have not been ranked or kept in any order based on any particular feature**

Service Provider	Geo-spatial DB Name
AWS	Amazon Athena, Document DB
GCP	Big Query
Azure	Azure Cosmos DB
Digital Ocean	None
Linode	None
Alibaba Cloud	Apsara DB
Oracle	Spatial Database
IBM Cloud	Informix Server

## 1.2 Load balancing, Scaling and Deployment

One way of increasing application capacity is to deploy more server and application in it. While a server has limited resource capacity and can process in limitation, a load balancer works to divide the user request to multiple server [24]. Round robin is the most common algorithm to distribute the work process in load balancer. Service provider provides

this facility where the application is deployed to multiple server and the rest of the process is handled by the load balancer itself. In auto scaling, the capacity of the server is increased. Assuming the running server is crossing the provided threshold, the service provider platform auto increases the resource capacity. For example, if the server has 1GB of RAM, the new RAM of scaled server is set greater than 1 GB of RAM. The resource of the scaling system is increased based on the limit user have set for that specific resource. During the application development, the application needs to be continuously developed and deployed. Using the auto deployment service developer can make sure no any steps is missed and deployed correctly using the correct successful build. This service takes the application code from the source, works on to follow process to make server deployable ready and then deploys the application on mentioned server.

All of the mentioned service provider provides load balancing, scaling and deployment services.

**Table 5: Research grants provided by the popular service provider**

Service Provider	Research Grant Availability (Credits)
AWS	Upto 5000 Hrs
GCP	Upto \$5000
Azure	Based on research and application
Digital Ocean	Based on research and application
Linode	NA
Alibaba Cloud	NA
Oracle	Starting from \$1000
IBM Cloud	Based on research and application

**Table 6: Training materials and courses provided by the popular service providers**

Service Providers	Documentation and Tutorials	Link
AWS	Yes	<a href="https://docs.aws.amazon.com/index.html">https://docs.aws.amazon.com/index.html</a>
GCP	Yes	<a href="https://cloud.google.com/docs/">https://cloud.google.com/docs/</a>
Azure	Yes	<a href="https://docs.microsoft.com/en-us/azure/">https://docs.microsoft.com/en-us/azure/</a>
Digital Ocean	Yes	<a href="https://docs.digitalocean.com/">https://docs.digitalocean.com/</a>
Linode	Yes	<a href="https://www.linode.com/docs">https://www.linode.com/docs</a>
Alibaba Cloud	Yes	<a href="https://arthas.aliyun.com/doc/en/">https://arthas.aliyun.com/doc/en/</a>
Oracle	Yes	<a href="https://docs.oracle.com/en/">https://docs.oracle.com/en/</a>
IBM Cloud	Yes	<a href="https://cloud.ibm.com/docs">https://cloud.ibm.com/docs</a>

### 1.3 Research grant and training materials

Cloud computing services could be expensive to the researchers or individuals working on self-funded projects. Therefore, most of the discussed service provider also provide research grants to such individuals and researchers and encourage using their platform. Using the services from

multiple service providers [12-18] and its training materials, frequently usable applications has also been developed [19-24]. Table 5 gives more details about the grant and support information. In addition, there are training materials and course available for the beginners to learn about the cloud computing services. Table 6 provide more information about it.

**Table 7: Popular service provider based on their serverless feature details. Service providers have not been ranked or kept in any order based on any particular feature**

Service Provider	Serverless Name	Running Time Limitation	Configuration	Supporting Language	Connectivity to Provider's other services?
AWS	Lambda	15 Min.	Runs on Linux OS	Node JS, Java, Python, Ruby	Yes
GCP	Cloud Functions	60 Min. for HTTP functions, 10 Min. for event-driven functions	16GB Max function memory	Node JS, Python, Java, Ruby, Go, PHP, .Net	Yes
Azure	Azure Function	5 Min., 10 Min. or unlimited based on plan	Runs on Linux or Windows	C#, Javascript, Java, Python, PowerShell, TypeScript	Yes
Digital Ocean	Digital Ocean Functions	5 Sec	NA	Go, Node JS, PHP, Python	Yes
Linode	NA	NA	NA	NA	NA
Alibaba Cloud	Function Compute	600 Sec or pay as you go service	3072 MB max RAM with 100 MB package limit	Node JS, Python, Java, PHP, C#, Go, Ruby, Lua	Yes
Oracle	Oracle Functions	300 Sec Max, 2048 GB Max	Powered by Fn Project open-source engine	Java, Python, Node, Go, Ruby, C#	Yes
IBM Cloud	IBM Cloud Functions	600000 ms, 2048 MB	Code size limit 48 MB	Node JS, Swift, Java, Python, Ruby, Go, PHP, .NET	Yes

## 2. CONCLUSION

This paper provides computing information, storage facilities and serverless architecture available within cloud computing domain that can be useful while selecting the appropriate cloud computing platform. The information offered in this study will be helpful for researchers looking to advance cloud design as well as developers looking to deploy their content on multiple service providers. This paper provides baseline information to the users willing to learn about the cloud computing scope and it can be a touchstone for the researchers/users interested in learning about the cloud service usage design or architectural samples.

## 3. AUTHOR'S PROFILE

Conceptualization, PranishDahal, Ritika Prasai; writing-original-draft preparation, PranishDahal, Ritika Prasai; writing-review and editing, PranishDahal, Ritika Prasai

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## Declaration of competing interest

The authors declare no competing interest.

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