Cloud Computing Fundamentals: A Review on Cloud Computing Service Providers

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Introduction

The reality that technology today has a significant effect on the industry is apparent. Not too long ago, enterprises had to build and manage their server environment to host and operate applications on their premises. We have cloud infrastructure now, which is revolutionizing industries and their practices. This comparatively modern technology has been the backbone of corporations' digital transformation. The report will discuss the comparative evaluation and opinions of different cloud-computing platforms concerning Amazon EC2, Google Cloud Platform and Microsoft Azure.

Literature Review

a)   Comparative Evaluation

According to Al-Dhuraibi et al. (2018), the distribution of numerous resources and tools via the "Internet" is cloud computing. Computer storage, servers, networking, databases, and applications are included in these resources and tools. Cost-effectiveness is one of the critical advantages of cloud computing. This advantage may be a game-changer from a market viewpoint (Al-Samarraie and Saeed, 2018). Cloud computing is a technology that delivers services on-demand to enterprises. Cloud computing is a subscription-based platform, ensuring there is no expense of ownership, labor, or maintenance. Users will easily avoid paying for it if the user does not desire to use the service anymore (Bhowmik, 2017). There are several cloud service providers in the market. The most prominent service providers are Amazon EC2, Microsoft Azure, Google Cloud Platform, Alibaba Cloud, IBM, Dell Technologies/VMware, Hewlett Packard Enterprise, Cisco Systems. Below there will be a comparison among Amazon EC2, Google Cloud Platform, and Microsoft Azure.

Amazon Elastic Compute Platform (Amazon EC2) is a software-based service that helps organizations manage Amazon Web Services (AWS) public cloud application systems (Dang et al., 2019). Amazon EC2 helps a developer to spin up virtual machines (VMs) that provide IT ventures and cloud workloads to operate on global AWS data centres with computing capability. Using the Amazon EC2 web interface or an application programming interface (API), an AWS user may increase or decrease instance capability as necessary in minutes (Hashem et al., 2015). A developer can automatically code an application with AWS Auto Scaling to scale instances. A developer may also describe a policy and group for autoscaling to handle several instances at once. EC2 was the invention of Chris Pinkham, an architect who developed it to scale Amazon's internal infrastructure (Khan et al., 2020).

The Google Cloud Platform is a provider of computer resources for web site deployment and service (Yang et al., 2016). The specialty is to provide people and businesses with a way to create and operate apps, and it uses the internet to communicate with the software's users. The Google Cloud Platform (GCP) is a collection of cloud computing resources provided by Google that works on the same technology utilized internally by Google for its

end-user products, such as Google Search, Google Drive, Gmail, and YouTube. On April 7, 2008, Google Cloud Platform launched (Varghese and Buyya, 2018).

Azure is a public cloud computing platform that can be used for services such as analytics, automated computing, storage, networking, and much more, with options that include Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Software as a Service (SaaS) (Subramanian and Jeyaraj, 2018). It was launched in 2010.

Amazon EC2 provides IaaS, PaaS, and SaaS (Stergiou et al., 2018). In contrast, GCP only provides PaaS and Iaas. In contrast, Azure offers three primary cloud computing platform services: PaaS, SaaS, IaaS. After that, Amazon EC2 offers a broad range of optimized instance types to suit multiple use cases. Instance types provide various memory, CPU, storage, and networking skill combinations and allow developers the freedom to select the right mix of resources for the applications (Ruparelia, 2016). One or more example sizes are included in each instance type. These are categorized into general-purpose instances, Linux accelerated computing instances, compute-optimized instances, storage optimized instances, memory optimized instances (Pierleoni et al., 2020). In contrast, for any use, from small general-purpose instances to massive memory-optimized instances with up to 11.5 TB of RAM or fast computing-optimized instances with up to 60 vCPUs, GCP's Compute Engine provides predefined virtual machine configurations. In contrast, Azure VM instance types are categorized into general-purpose instances, GPU, High performance compute, compute-optimized instances, storage optimized instances, memory optimized instances (Ouda, 2020). Then, an Amazon EC2 Windows instance generated from an Amazon Machine Image (AMI) has an Amazon EBS root volume by default of 30 GB gp2 (General Purpose SSD). In contrast, For specific items stored in Cloud Computing, there is a maximum size cap of 5 TB. The overall size of a single upload request is also 5 TB in GCP. In contrast, a single storage account can hold up to 500 TB of data and consumers can take advantage of the pay-per-use billing model, like every other Azure service. Then, Amazon EC2 runs on Windows server, Ubuntu, Amazon Linux AMIs, SUSE Enterprise Linux. In contrast, GCP runs on Windows server, Ubuntu, Amazon Linux AMIs, SUSE Enterprise Linux, CentOS, Debian, RHEL (Kumar, Raj and Jelciana, 2018). In contrast, Azure runs on both Windows and Linux. For security, Azure utilizes unparalleled security intelligence to help identify rapidly evolving threats early. Unify security management of Azure also enables threat protection. In contrast, GCP security fundamentals include having high visibility of the environment, disaster recovery plans, using identity access management (IAM) tools, monitoring logs of cloud activity, encrypting data at all times and utilizing automated services. In contrast, the global AWS network security procedures defined in Amazon Web Services are followed by Amazon EC2 (Khan et al., 2020). After that, to ensure consistent, predictable efficiency at the lowest possible expense, Amazon EC2 Auto Scaling tracks applications and automatically adjusts capacity. With recommendations that help users maximize efficiency, costs, or match between them, Amazon EC2 Auto Scaling allows scaling simple. In contrast, an Azure virtual machine scale set can increase or decrease the amount of VM instances running the application automatically (Hyseni and Ibrahimi, 2017). This automatic and elastic behaviour decreases the overhead of management to track and maximize the application's output. In contrast, GCP's Compute Engine includes Auto Scaling to introduce or remove VM instances dynamically from a controlled instance category dependent on load rises or decreases. Auto-scaling helps the applications to manage changes in demand gracefully, and where the requirement for resources is smaller, it lowers costs (Hashem et al., 2015).

Moreover, the next-generation IaaS framework, GCP's Google Compute Engine, delivers resource performance stability through a number of recent developments in engineering. Those are: advanced resource isolation technologies, customized virtualization under KVM and so on (Dang et al., 2019). In contrast, to run browser programs, several people use Azure VMs and have had a successful experience doing so. The good aspect of Azure is that users get loads of methods available to sustain optimum efficiency. Such as security groups for the network, availability sets, recovery options etc (Bhowmik, 2017). In contrast, monitoring is an important feature for ensuring the consistency, compatibility and efficiency of instances of the 'Amazon Elastic Compute Cloud' and AWS solutions. Due to the same free tier options and extra packaging, Amazon ES2 and Azure have about the same rates. Due to its very low computation price ($0.0000025) relative to AWS and Azure, Google Cloud Functions emerges as the cheapest provider for serverless computing. There are about 6 times higher rates for AWS and Azure than for Google (Al-Samarraie and Saeed, 2018).

Furthermore, Amazon EC2 tools are SageMaker, Comprehend, Lex, Polly, Machine Learning, IoT core, Greengrass, Deep Learning AMIs, Tensor Flow and so on. In contrast, GCP tools are Cloud machine learning engine, Cloud natural language, Cloud speech API, Dialogflow enterprise edition, etc (Al-Dhuraibi et al., 2018). In contrast, Azure tools are, machine learning, Azure bot service, cognitive services, time series insights and so on. Following the traditional security paradigm of detecting, assessing, diagnosing, stabilizing, and Closing, Microsoft Azure emphasizes security (Yang et al., 2016). This model, combined with adequate cybersecurity controls, has helped Azure obtain several security certifications, all of which identify Azure as an IaaS protection pioneer. The platform is not only secure, but Azure also shields the end consumer (Subramanian and Jeyaraj, 2018). This multi-level defence is crucial as security threats begin to multiply worldwide regularly, targeting end consumers and placing the organization's data at risk. Azure offers easy, user-friendly services for enhanced security, such as multi-factor authentication and password specifications for applications (Varghese and Buyya, 2018).

b) Opinions

As for Amazon EC2 advantage, the EC2 has a broad set of settings for computers. EC2 can have proper system setups based on whether the expected solutions are memory heavy, CPU heavy, GPU heavy or IO heavy. EC2 does have many machine images to customize the OS and applications needed (Pierleoni et al., 2020). It also enables user to build users' own disk image. It makes it easy for the consumer to stop the EC2 instance without losing the work. This tends to decrease the bill (Subramanian and Jeyaraj, 2018). In order to resume from the same place from where it was left, the image can be added to EC2 again. The disadvantage is It takes too long often to construct images of instances of EC2. For the additional time, this keeps the EC2 up. The UI for the EC2 service is a little confusing and lacks detailed description in specific ways. This service is a little challenging to use. To utilize this service successfully, new customers require a significant learning curve (Ouda, 2020).

As for Google cloud platform, the pros of GCP is good documentation (Kumar, Raj and Jelciana, 2018). A pretty detailed reference guide is provided by GCP. There are also reasonable prices in GCP. 99.99999999999 percent of item durability over a specified year is provided through Google Cloud Storage (Khan et al., 2020). This implies that even in the case of the mutual destruction of two disks, data survives—also, $300 free credit to get started within the first year on every GCP product. Then, 5 GB of free storage is free to have indefinitely. As for the

disadvantage, availing GCP support is quite hefty. Also, downloading data from google cloud storage is expensive. Also, the SDK APIs seem less stable than Amazon EC2 (Hyseni and Ibrahimi, 2017).

The Microsoft Azure cloud provides high flexibility and replication in data centres on a global scale than most providers. Azure will deliver a 99.95 percent service level agreement, or SLA about 4.38 hours of downtime per year, which cannot be accomplished for other entities (Hyseni and Ibrahimi, 2017). As for the disadvantage, Azure requires extensive management. Also, Azure requires expertise, unlike local servers, to guarantee that all moving parts operate correctly together (Bhowmik, 2017). Over-provisioning cloud computing is a frequent error by enterprise managers who are not thoroughly interested in how well (or poorly) their cloud servers work (Al-Dhuraibi et al., 2018). Although a common error, servers' computing power on the premise does not translate equivocally in the cloud, costing organizations thousands of dollars per year (Al-Samarraie and Saeed, 2018).

Thus, the selected cloud service provider for our group's software development is **Microsoft Azure**. Azure allows convenient accessibility and a consistent, secure on-premise and public cloud platform. To boost accessibility and efficiency, Azure offers a broader variety of hybrid connections, including caches, virtual private networks (VPNs), ExpressRoute connections and content delivery networks (CDNs). Additionally, Microsoft-dependent companies such as Office 365, Outlook and SharePoint are investing in a cloud platform that integrates well with Microsoft products. Using Azure will simplify our processes by using the same Windows and Linux on-premise virtual machines. Also, Microsoft's pay-as-you-go model will enable us to pay for what we use to build or extend resources using Azure services. As the infrastructure is taken care of by Microsoft on Azure, this reduces IT management costs to a minimum. It conveniently links data centres to the cloud connecting 42 regions. Lastly, to build cloud-native applications, popular tools such as ASP.NET, Visual Studio, and programming languages such as C++, Visual Basic, C#, etc. are used, so it will be easy for us to develop cloud-based business applications.

Conclusion

The study paper is related to cloud computing platforms. Since its development, cloud-computing has travelled a long way. Today, it is no longer the issue of whether or not companies have to use cloud computing, and the issue now is which cloud platform to choose. Numerous cloud service providers are currently flooding the cloud computing market, but the top three slots are proudly held by AWS, Azure, and Google Cloud Platform (GCP). From the above explanation of the three cloud computing platform, it has been understood that digital technology progresses is rapidly transforming. Thus, this report will help the readers to understand the effectiveness of different cloud platform services.

References

1. Al-Dhuraibi, Y., Paraiso, F., Djarallah, N. and Merle, P., 2018. Elasticity in Cloud Computing: State of the Art and Research Challenges. *IEEE Transactions on Services Computing*, 11(2), pp.430–447.

2. Al-Samarraie, H. and Saeed, N., 2018. A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment. *Computers & Education*, 124, pp.77–91.

3. Bhowmik, S., 2017. *Cloud computing*. Cambridge New York, Ny Port Melbourne Delhi Cambridge University Press.

4. Dang, L.M., Piran, Md.J., Han, D., Min, K. and Moon, H., 2019. A Survey on Internet of Things and Cloud Computing for Healthcare. *Electronics*, [online] 8(7), p.768. Available at: <https://pdfs.semanticscholar.org/1533/e26f210a1aacdd5015ec6edbe73827e28bbb.pdf> [Accessed 14 Mar. 2020].

5. Hashem, I.A.T., Yaqoob, I., Anuar, N.B., Mokhtar, S., Gani, A. and Khan, S.U., 2015. The rise of "big data" on cloud computing: Review and open research issues. *Information Systems*, 47, pp.98–115.

6. Hyseni, L.N. and Ibrahimi, A., 2017. *Comparison of the cloud computing platforms provided by Amazon and Google*. [online] IEEE Xplore. Available at: <https://ieeexplore.ieee.org/abstract/document/8252109/> [Accessed 18 Jan. 2021].

7. Khan, I., Dewangan, B., Meena, A. and Birthare, M., 2020. *Study of Various Cloud Service Providers: A Comparative Analysis*. [online] papers.ssrn.com. Available at: <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3672950> [Accessed 18 Jan. 2021].

8. Kumar, P.R., Raj, P.H. and Jelciana, P., 2018. Exploring Data Security Issues and Solutions in Cloud Computing. *Procedia Computer Science*, [online] 125, pp.691–697. Available at: <https://www.sciencedirect.com/science/article/pii/S1877050917328570> [Accessed 20 Aug. 2019].

9. Ouda, G.K., 2020. Cloud computing service providers: A comparative study. *Samarra Journal of Pure and Applied Science*, [online] 2(1). Available at: <https://www.iasj.net/iasj?func=article&aId=176845> [Accessed 18 Jan. 2021].

10. Pierleoni, P., Concetti, R., Belli, A. and Palma, L., 2020. Amazon, Google and Microsoft Solutions for IoT: Architectures and a Performance Comparison. *IEEE Access*, 8, pp.5455–5470.

11. Ruparelia, N.B., 2016. *Cloud computing*. Cambridge, Massachusetts ; London, England: The Mit Press.

12. Stergiou, C., Psannis, K.E., Kim, B.-G. and Gupta, B., 2018. Secure integration of IoT and Cloud Computing. *Future Generation Computer Systems*, 78, pp.964–975.

13. Subramanian, N. and Jeyaraj, A., 2018. Recent security challenges in cloud computing. *Computers & Electrical Engineering*, 71, pp.28–42.

14. Varghese, B. and Buyya, R., 2018. Next generation cloud computing: New trends and research directions. *Future Generation Computer Systems*, 79, pp.849–861.

15. Yang, C., Huang, Q., Li, Z., Liu, K. and Hu, F., 2016. Big Data and cloud computing: innovation opportunities and challenges. *International Journal of Digital Earth*, 10(1), pp.13–53.