*Google Cloud Platform (GCP): Emerging Cloud Provider*

Pankaj Sharma,

Mo: 77280 95715

Email: pankaj.toshan@gmail.com

*Abstract*—This paper evaluates and analyses the security, cost, performance, scalability, and reliability of Google Cloud compared to other cloud providers like AWS and Azure. This paper highlights the growth and capability of GCP which will result in capturing more cloud market share than others cloud providers.

Keywords— Google Cloud Platform, GCP, Cloud Provider

# Introduction

As the cloud industry is growing every day. Google Cloud emerges as a formidable contender poised to capture an even greater share of the market. This paper delves deep into the distinctive features that set Google Cloud apart, shedding light on how these attributes not only meet but exceed the demands of modern enterprises. As we move will cover through the GCP’s cost-effective solutions, cutting-edge security measures, unparalleled performance benchmarks, and scalability.

# Ease of Use

## GCP History

After the successful launch of AWS and Microsoft Azure Google found out the potential opportunity in cloud, in 2011 GCP launched their first PaaS service know as App Engine to deploy serverless application with self-health check and monitoring. Post since this service launch it has been used by many companies like Airbnb, PayPal, Spotify, Intel etc.

## Continious addition of services

Since the launch of their first service GCP has kept on adding new services on a regular basis, resulting in the addition of compute, storage, networking, big data and ML services, and tools like developer, management, and logs tools.

# Categorisation

Before we begin for comparison, we have to categorize the major area of cloud like Networking, Virtual Machines, Serverless services, Containers & Kubernetes, Security, Access Controls.

We will analyze the data and will calculate the performance of GCP vs other major cloud providers.

## Networking

GCP provides a global virtual network i.e. VPC which means a user can create their own private network throughout different regions, this is a special unique useful feature which GCP has over other cloud providers. GCP has two core tiers in networking from where the data flows, these are Premium Tier and Standard Tier; in Premium data moves from a Google dedicated network which has low latency and high-speed data transfer, in another tier data moves through internet.

## Virtual Machines

* GCP provides Preemptible VMs which means short term VMs which is good for short term work like batch processing etc. this feature is special feature in GCP than other CSP like Azure.
* GCP provides cheaper prices than major of the CSP depending upon the type, additional discount on purchase of long-term purchase.
* Global VPC Support: VMs have VPC which requires live support, which GCP provides than other CSP.

These are some highlights which reflect GCP capable features which end user can use, which may result in GCP increase in cloud market shares.

## Serverless Services

GCP provides PaaS functionality, fully automated health check, full managed load balancer which work on a particular customized template.

Cloud functions and App Engine provides the feature of serverless computing in GCP, it supports multiple languages like Ruby, Java, Python, node.js, Go etc. These services are tightly coupled with other GCP services.

In terms of cost GCP have cheaper billing for serverless computing/ service. Billing is done on the basis of per request, or execution time etc.

Another FaaS provided by GCP is Google Kubernetes engine (GKE), which is a open source form google released in 2009 post this release GCP started using Kubernetes in service orchestration.

## Containers & Kubernetes

Container services enable developers to package software components such as frameworks, libraries, and dependencies together with their code in form of virtualization, adds additional levels of abstractions and are more lightweight making them an ideal solution to use together with the rapid elasticity.

GCP carves a niche for itself in the realm of containers and Kubernetes. Here's how GCP emerges as a compelling choice for your research paper, highlighting its unique strengths:

1. Born in the Kubernetes Core: Google's DNA is inextricably linked to Kubernetes. They spearheaded its development, contributing significant features and actively maintaining the project. This translates to a deeper understanding and seamless integration of Kubernetes within GCP, leading to:

a) Advanced Automation: GCP boasts built-in automation features like auto-scaling and self-healing, reducing operational overhead and simplifying Kubernetes management.

b) Enhanced Security: Google's security expertise shines through GKE (Google Kubernetes Engine), offering integrated threat detection and granular access control for containerized applications.

c) Streamlined Developer Experience: GCP emphasizes developer-friendliness. Tools like Skaffold and Cloud Build facilitate smooth container build, test, and deployment workflows.

2. Anthos: GCP's real game-changer is Anthos, a hybrid and multi-cloud platform. Anthos empowers you to:

a) Run Kubernetes Everywhere: Deploy and manage Kubernetes clusters across on-premises, edge locations, and multiple cloud providers with consistent tooling and APIs.

b) Unleash Portability: Break vendor lock-in by decoupling applications from underlying infrastructure. Anthos applications are portable, allowing you to move them seamlessly across clouds without rewriting code.

c) Simplify Hybrid Management: Bridge the gap between on-premises and cloud environments with Anthos. Manage and monitor hybrid deployments centrally, streamlining operations and fostering collaboration.

3. GCP constantly pushes the boundaries with cutting-edge features like:

a) GKE Autopilot: Serverless offering manage Kubernetes cluster infrastructure entirely, eliminating the burden of node management and scaling.

b) Istio Service Mesh: Gain unparalleled visibility and control over microservices architecture with Istio, natively integrated into Anthos.

c) Machine Learning Integration: Leverage Google's AI prowess to optimize and automate containerized workloads.

4. Cost-Effectiveness: GCP offers competitive pricing models and flexible. Anthos' multi-cloud capabilities can help you optimize costs by leveraging the strengths of different providers.

5. Strong Community: GCP boasts a vibrant and active community. Google readily contributes to open-source projects and actively engages with users, fostering a collaborative environment for learning and support.

GKE servers generally use Google's Container optimized operating system as the OS on which to run Kubernetes and its entities. Container-Optimized OS implements several advanced features for enhancing the security of GKE clusters. These security features include immutable root file systems, verified boot, stateless configuration, security-hardened kernel, a firewall, instance access management, and CVE scanning.

In GCP Container-Optimized OS enables several security-hardening kernel features, including Integrity Measurement Architecture (IMA), Audit, Kernel Page Table Isolation (KPTI), and some Linux Security Modules (LSMs) from Chromium OS, features like seccomp and AppArmor that make it possible to enforce finer grained security policies.

## Security

The key differentiators in GCP in terms of security are:

* Enhanced Data Encryption: GCP takes encryption seriously, exceeding industry standards by encrypting data at rest and in transit by default. This includes customer-managed keys, adding an extra layer of protection against unauthorized access.
* Unparalleled Privacy with Confidential Computing: GCP's innovative Confidential VMs offer isolated execution environments, ensuring even Google itself can't access your data while it's being processed. This provides unmatched privacy and security, especially for sensitive workloads.
* Proactive Threat Defense: GCP goes beyond basic monitoring with advanced threat detection and prevention tools like Chronicle and Cloud Security Command Center. These services deliver comprehensive security insights and automated threat responses, actively safeguarding your cloud environment.

The Compliance and Certifications in GCP security:

* Broader Compliance Coverage: Unlike its competitors, GCP boasts a wider range of compliance certifications relevant to critical industries like healthcare, finance, and government. This makes it a trusted choice for organizations navigating strict compliance requirements.
* Privacy at the Forefront: GCP prioritizes data privacy, integrating stringent regulations like GDPR and CCPA into its compliance framework. This exceeds the current compliance offerings of AWS and Azure, demonstrating a commitment to data protection.

The additional advantages of GCP are as follows.

* Leveraging Security Expertise: Google's extensive cybersecurity knowledge informs GCP's security features and architecture. This translates to a potentially more secure environment compared to competitors.

Open Source Collaboration: GCP actively participates in open-source security projects, fostering continuous innovation and community-driven security enhancements. This benefits all users by ensuring the platform stays ahead of evolving threats.

## Access Controls

Granular Permissions: Unlike the user/group model of AWS and Azure, GCP's IAM grants specific permissions to individual users or groups for precise control over resource access and actions. This goes beyond basic read/write permissions and allows tailored access levels for each user's role.

Contextual Security: Leverage IAM's conditional  
access controls based on time, location, device, or user attributes. This adds an extra layer of security by restricting access based on predefined parameters, preventing unauthorized attempts even with valid credentials.

The GCP has special Unified Identity Management

* Centralized Control: GCP integrates IAM seamlessly with Google services like G Suite and Google Cloud Directory, offering a single point of control for access across your entire IT infrastructure. This eliminates the complexity of separate identity management solutions needed in AWS and Azure.
* External Identity Bridge: For hybrid environments, GCP readily integrates with external identity providers like Active Directory and LDAP. This allows smooth user onboarding and access management, bridging the gap between on-premises and cloud environments.

Enhanced Audit and Compliance in GCP:

* Detailed Activity Logs: Track and analyse access events in detail with GCP's comprehensive IAM audit logs. This transparency facilitates identifying suspicious activity and adhering to security regulations for enhanced compliance.
* Robust Certifications: Compared to AWS and Azure, GCP boasts a wider range of compliance certifications encompassing critical industries like healthcare, finance, and government. This makes it ideal for organizations with stringent access control compliance requirements.

GCP follows organizational level hierarchy, the additional benefits of GCP are:

* Hierarchical Inheritance: Simplify access control management by inheriting settings from parent resources in GCP's resource hierarchy. This reduces administrative overhead and minimizes the need for granular configuration for every child resource.
* Zero-Trust Approach: GCP's zero-trust security model assumes no inherent trust and requires explicit verification for every access attempt. This strengthens access control by adding an extra layer of security before granting permissions, even for authorized users.

# ANALYSIS OF THE COMPARISON

This paper concentrates on analyzing and comparing the major cloud service providing platforms i.e. Amazon web service, Google Cloud Platform & Microsoft Azure. The paper begins with a brief description of GCP special features and unique features which will make it a emerging cloud provider The analysis of the above comparisons show the following results which are categorized below:-

GCP has almost all similar features if we compare it on basis of Virtual Machines, they has 39 Regions and 118 zones and 187 edge locations and their own private network cable which is spread over all network which has capabilities to provide low latency between VMs, which provides a competitive advantage to GCP than its peers in terms of Virtual Machines.

In terms of Serverless Services GCP has there is a default timeout of 60 seconds which can be increased to up to 3600 seconds which equals 60 minutes for HTTP-triggered functions and 540 seconds which equals 9 minutes for event-triggered functions. Additionally, they have default autoscaling limit which gives GCP a advantage over its peers.

In terms of container orchestration and Kubernetes GCP is the best option to go for due to its foundation and open-source community. GCP provides simultaneous multithreading that is automatically deactivated for vulnerable CPUs, provides unmutable root file system, verified boot and stateless configuration. GCP places first for Container security and Serverless Computing Security

For other CSPM and access control GCP has almost similar kind of features but with good functional support.

# Conclusion

With the unicorns of new start-ups everyday & the high uses of data by the users on a daily basis, the need for high speed data processing & large-scale storage solutions are very necessary. Many solution for these issues is provided by the cloud provider platforms through virtualization i.e. creating many VMs (virtual machines) on a single node/physical machine. This reflects in high processor efficiency & low idle wait time for the processor. The three cloud platforms compared above have their own merits which makes them good in their own respective ways. While the Amazon Web Service is the oldest & has the support for maximum number of pre-configured operating systems, it lacks in its reach &support availability. However, Google Cloud Platform supports the maximum number of databases & has a great repository of in-built libraries, it lacks SDK support & has a pay to-help model which modify the support delay as per the tier of service used and availed. Google cloud offer many in terms of revolution and Google has their hands in so many small project transformations, which means limited opportunities for big companies. Hence, we conclude that the selection of the cloud platform is highly dependent on the requirements of the user which change user to user, and GCP has almost all the requirements which a user can use which will make GCP a cloud leader in future.

# References

1. Google Cloud Platform. Confidential Space components. https://cloud.google.com/static/docs/security/images/confidential-space-components.svg.
2. Kubernetes. Overview. https://kubernetes.io/docs/concepts/overview/
3. Comparison of the Cloud Computing Platforms Provided by Amazon and Google -2017by Lindita Nebiu Hyseni, Afërdita Ibrahimi.
4. Amazon Web Services. Shared Responsibility Model. https://aws.amazon.com/ compliance/shared-responsibility-model/
5. A. Mazrekaj and I. Shabani, “Pricing Schemes in Cloud Computing : An Overview,” vol. 7, no. 2, pp. 80–86, 2016.
6. A Comparison between Google Cloud Service and iCloud-2019 IEEE by Hera Arif , Hassan Hajjdiab, Fatima Al Harbi2, Mohammed Ghazal
7. A Precise Model for Google Cloud Platform - 2018 IEEE by Stephanie Challita, Faiez Zalila, Christophe Gourdin, and Philippe Merle
8. Comparative study of Amazon EC2 and Microsoft Azure cloud architecture- September 2018 by Prof Vaibhav A Gandhi, Dr C K Kumbharana
9. Google cloud Documentation Standard Environments <https://cloud.google.com/appengine/docs/standard>
10. Google Cloud Documentation -https://cloud.google.com/products/calculator
11. Google cloud Documentation Supported OS -https://cloud.google.com/compute/docs/instances/view-os-details
12. Amazon Documentation -https://aws.amazon.com/ec2/pricing/
13. Microsoft Azure Documentation -https://azure.microsoft.com/en-in/pricing/
14. A Comparative Review of High-Performance Computing Major Cloud Service Providers -2018 IEEE by Rawan Aljamal, Ali El-Mousa, Fahed Jubair