Compute Engine

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Google Cloud Platform (GCP)

Introduction to GCP

Google Cloud Platform (GCP) is not yet a household name in the public cloud marketplace as is Amazon Web Services (AWS) or Microsoft Azure, but that's changing rapidly. While the GCP still lags behind AWS and Azure regarding market share, it is catching up fast.

Many notable organizations, including HSBC, Snapchat, Philips, and Sony Music are currently using GCP. Google has a strong value proposition in the public cloud marketplace because of its powerful Google Compute Engine (henceforth just called Compute Engine). Organizations can use the Compute Engine to run fault-tolerant, high-performance, scalable Virtual Machines (VMs), on-demand.

Google Cloud Platform (**GCP**), offered by Google, is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-

user products, such as Google Search, Gmail, file storage, and YouTube. Alongside a set of management tools, it provides a series of modular cloud services including computing, data storage, data analytics and machine learning. Registration requires a credit card or bank account details.
Google Cloud Platform provides infrastructure as a service, platform as a service, and serverless computing environments.
Google Cloud Platform is a part of **Google Cloud**, which includes the Google Cloud Platform public cloud infrastructure, as well as Google Workspace (formerly G Suite), enterprise versions of Android and Chrome OS, and application programming interfaces (APIs) for machine learning and enterprise mapping services.

What is GCE?

Google Compute Engine lets you create and run virtual machines on Google infrastructure. Compute Engine offers scale, performance, and value that allows you to easily launch large compute clusters on Google's infrastructure. There are no upfront investments and you can run thousands of virtual CPUs on a system that has been designed to be fast and to offer strong consistency of performance.

IaaS: Infrastructure as a Service

Cloud infrastructure services, known as Infrastructure as a Service (IaaS), are made of highly scalable and automated compute resources. IaaS is fully self-service for accessing and monitoring computers, networking, storage, and other services. IaaS allows businesses to purchase resources on-demand and as-needed instead of having to buy the hardware outright. Example — Digital Ocean, Linode, Rackspace, Amazon Web Services (AWS), Cisco Metapod, Microsoft Azure, Google Compute Engine (GCE)

Google Compute Engine as IAAS

Google Compute Engine (GCE) is an Infrastructure as a Service (IaaS) offering that allows clients to run workloads on Google's physical hardware.
Google Compute Engine provides a scalable number of virtual machines (VMs) to serve as large compute clusters for that purpose. GCE can be managed through a RESTful API, command-line interface (CLI) or Web console. Compute Engine is a pay-per-usage service with a 10-minute minimum. There are no up-front fees or time-period commitments. GCE competes with Amazon's Elastic Compute Cloud (EC2) and Microsoft Azure.

GCE's application program interface (API) provides administrators with virtual machine, DNS server and load balancing capabilities. VMs are available in a number of CPU and RAM configurations and Linux distributions, including Debian and CentOS. Customers may use their own system images for custom virtual machines. Data at rest is encrypted using the AEC-128-CBC algorithm.

GCE allows administrators to select the region and zone where certain data resources will be stored and used. Currently, GCE has three regions: the United States, Europe and Asia. Each region has two availability zones and each zone supports either Ivy Bridge or Sandy Bridge processors. GCE also offers a suite of tools for administrators to create advanced networks on the regional level.

What is a virtual machine (VM)?

A virtual machine is a virtual representation, or emulation, of a physical computer. They are referred to as a guest while the physical machine they run on is referred to as the host.

Virtualization helps to create multiple virtual machines, each with their own operating system (OS) and applications, on a single physical machine. A VM cannot interact directly with a physical computer. Instead, it needs a lightweight software layer called a hypervisor to coordinate between it and the underlying physical hardware. The hypervisor allocates physical computing resources — such as processors, memory, and storage — to each VM. It keeps each VM separate from others so they don't interfere with each other.

How virtualization works

When a hypervisor is used on a physical computer or server, it allows the physical computer to separate its operating system and applications from its hardware. Then, it can divide itself into several independent "virtual machines."

Each of these new virtual machines can then run their own operating systems and applications independently while still sharing the original resources from the bare metal server, which the hypervisor manages. Those resources include memory, RAM, storage, etc.

The hypervisor acts as a traffic cop of sorts, directing and allocating the bare metal's resources to each of the various new virtual machines, ensuring they don't disrupt each other.

There are two primary types of hypervisors.

Type 1 hypervisors run directly on the physical hardware (usually a server), taking the place of the OS. Typically, you use a separate software product to create and manipulate VMs on the hypervisor.

Type 2 hypervisors run as an application within a host OS and usually target single-user desktop or notebook platforms. With a Type 2 hypervisor, you manually create a VM and then install a guest OS in it.

How does cloud computing use virtual machines?
Virtualization is the backbone of Cloud Computing; Cloud Computing brings efficient benefits as well as makes it more convenient with the help of Virtualization, not only this, it also provides solutions for great challenges in the field of data security and privacy protection. Efficient use of resources, increased security, portability, problem-free testing, easier manageability, increased flexibility, fault isolation, rapid deployment are the benefits of virtualization. Several cloud providers offer virtual machines to their customers. These virtual machines typically live on powerful servers that can act as a host to multiple VMs and can be used for a variety of reasons that wouldn't be practical with a locally-hosted VM. These include:

1. Running SaaS applications — Software-as-a-Service, or SaaS for short, is a cloud-based method of providing software to users. SaaS users subscribe to an application rather than purchasing it once and installing it. These applications are generally served to the user over the Internet. Often, it is virtual machines in the cloud that are doing the computation for SaaS applications as well as delivering them to users. If the cloud provider has a geographically distributed network edge, then the application will run closer to the user, resulting in faster performance.

2. Backing up data — Cloud-based VM services are very popular for backing up data because the data can be accessed from anywhere. Plus, cloud VMs provide better redundancy, require less maintenance, and generally scale better than physical data centres. (For example, it's generally fairly easy to buy an extra

gigabyte of storage space from a cloud VM provider, but much more difficult to build a new local data server for that extra gigabyte of data.)

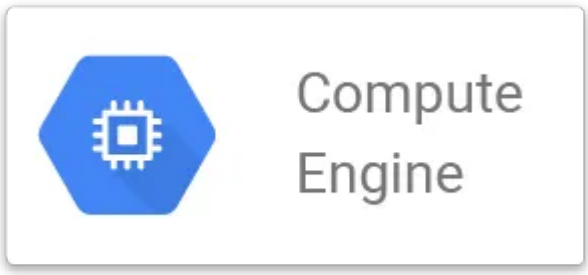
3. Hosting services like email and access management — Hosting these services on cloud VMs is generally faster and more cost-effective, and helps minimize maintenance and offload security concerns as well.

Pricing models for virtual machines

The most common pricing models for virtual machines in the cloud are pay-as-you-go (by the hour or second), transient/spot instances, reserved instances and dedicated hosts.

- Pay-as-you-go: In the pay-as-you-go model, there are no upfront costs for the virtual machine and users simply pay for what they use, typically billed by the hour or second depending on the provider and instance type.
- Transient/spot instances: The lowest cost model of VMs, transient and spot instances are taking advantage of a provider's excess capacity but can be reclaimed by the provider at any time. They are typically useful for applications that don't need to be always on or that are prohibitively expensive in any other model.
- Reserved instances: Unlike pay-as-you-go models, reserved instances come with an explicit term commitment, usually of between one and three years, but are also coupled with steep discounts.

Dedicated hosts: In the case of dedicated hosts, a user typically takes on the cost of the total physical server and is billed in whatever increments the provider offers dedicated servers, typically hourly or monthly.



Google Compute Engine

FEATURES OF COMPUTE ENGINE

- **IMAGES :**
  Google provides public and custom images; public images contain both open-source and proprietary options. While custom images are mainly used for customised solutions like production-ready environments. Public images are great at starting level but they may not offer customized needs. At starting level in GCP we can use the open-source CentOS and Debian images that Google provides as standard images, also we can use the proprietary images such as RHEL(Red Hat Enterprise Linux) or Microsoft Windows Server, which are not free of cost but provide more cloud options.

- **STORAGE :**
  Compute engine offers several types of storage options with unique prize and performance characteristics:
  - Zonal persistent disk: Efficient, reliable block storage.
  - Regional persistent disk: Regional block storage replicated in two zones.
  - Local SSD: High performance, transient, local block storage.
  - Cloud Storage buckets: Affordable object storage that one can mount onto a VMs' file system.
  - Filestore: High-performance file storage for Google Cloud users. Used for implementing a system with multiple parallel services, to access the files from the same disk over the network.

The most common solution at the beginning level is to add a persistent disk to user's instance. However, unlike persistent disks which are file-based and can serve as a root drive for the VM, cloud storage is object-based and cannot serve as a root in the file system.

GCE Advantages

1. **Throughput**
   Compute Engine's network Input/output across regions is much faster than AWS's. Google's global network infrastructure — the backbone of the Compute Engine — is superior to AWS, which uses the public internet. As of Q1 2020, Google has 22 regions and 61 zones for its Compute Engine infrastructure. Also, Google is investing billions of US dollars to cement its footprint in cloud computing.
   This provides 100% uptime via transparent maintenance when compared to AWS and Azure. As such, you can set up multiple cloud scenarios, including synchronous database replication between the regions.

2. **Efficient Block Storage**
   Compute Engine's persistent disks can support up to 257 TB of storage. This is more than 10 times higher than what Amazon Elastic Block Storage (EBS) can accommodate (currently, the maximum is 16 TB). As such, Compute Engine is best suited for those organizations that want more scalable storage options.

3. **Stability**
   Compared to AWS, the Compute Engine offers more stable services because of its ability to provide live migration of VMs between the hosts. This means organizations can run 24 hours a day, 7 days a week and 365 days a year without downtime or any other performance hindrance.

4. **Pricing**
   Within the GCP ecosystem, you pay only for the computing time that you have consumed. The Compute Engine uses the per-second billing plan, as opposed to AWS that is per-hour based. You are also entitled to attractive discounts for long-running workloads on the Compute Engine. While Azure also provides discounted rates, you get only a 5% discount for a whole year's pre-payment, as opposed to Compute Engine's 30% discount for a month's pre-payment.

5. **Backups**
   GCP has a robust, inbuilt, redundant backup system. The Compute Engine uses this system for its flagship products, such as the Search Engine and Gmail.

6. **Security**
   It has been more than 20 years since Google launched. When you choose GCP, you get the security benefits that Google has developed over the years to secure its robust products such as the Search Engine and Gmail.

GCE Disadvantages

Since GCP is built on the Google infrastructure, there are a few facilitations and challenges that follow.
Other than issues with data security raised by concerned audiences, the most significant disadvantage of Google Cloud Platform from the developer's perspective would be the lack of elastic search in GCP.

Applications

Twitter

Every day, people come to Twitter to find out what's happening in the world and talk about it. With hundreds of millions of Tweets sent every day, it is critical that the infrastructure and data platforms are able to scale. So twitter worked with Google Cloud to move cold data storage and flexible compute Hadoop clusters which are the core of the data platform to Google Cloud Platform. Their Hadoop file systems host more than 300PB of data across tens of thousands of servers. This enabled them to enhance the experience and productivity of engineering teams working with the data platform and keep up with the growing needs of their service. This enabled them to enhance the experience and productivity of our engineering teams working with our data platform.

Benefits of the migration:

- Faster capacity provisioning
- Increased flexibility
- Access to a broader ecosystem of tools and services
- Security improvements
- Enhanced disaster recovery capabilities

PayPal

- PayPal separated from eBay in 2015 with a vision of managing risk, fighting fraud, and developing new financial products for everybody, everywhere.
- Migrating to Google Cloud, 5,000 PayPal developers are transforming the way they work.it has 300 million active accounts, 200 markets,100 currencies.
- It is authorizing new markets with a purpose: helping people everywhere join the global economy with financial services that are manageable, convenient and secure.
- It is designing economic opportunities that are personal, flexible, and that supports compliance with regulations.
- It is moving rapidly, with security and confidence.

The Home Depot

- The Home Depot helps people solve problems of contracting, home repair, or hobbies,

- Online or in-store, it gives them what they have, with great service, practical knowledge, and therefore the right tools.
- Running quite 600 projects in Google Cloud keeps it at its best.
- It is a 60x faster network,15 petabytes data examined in BigQuery, 40,000 stock keeping units, per store.
- Customer-first service means shipping directly, having the right tool in-store, teaching new skills, and anticipating customer needs, everywhere.
- It has 400,000 associates, 2,300 locations, and 40,000 different products bringing over $100 billion in sales annually and high customer satisfaction.
- When home depot connects need to locate goods they turn to their mobile apps for in-store navigation.

SPOTIFY

A Google Cloud customer since 2016, Spotify is the most popular global audio streaming subscription service with 248m users, including 113m subscribers, across 79 markets. Spotify is the largest driver of revenue to the music business today. In the past 15 years, AWS 'business has surpassed major competitors and captured a large market share. But on February 23 of 2016, streaming music service Spotify announced plans to migrate backend services from AWS to Google Cloud Platform moving 1200 online services and data processing DAGs (directed acyclic graphs) as well as 20,000 daily job executions, affecting more than 100 Spotify teams, from Spotify's data centres to the cloud. Robust building blocks that exist on top of core data storage, computing, and network services help take away much of the backend hassle on the way to new product creation.

Benefits of migration to the developers:

- Developer friendly services
- Focus better on core business
- Removed operational complexity from the ecosystem
- Iterate quicker on key needs, like data insights and machine learning
- Concentrate on what's important to the users and give them the experiences they know and love about Spotify.

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