ATAL BIHARI VAJPAYEE INDIAN INSTITUTE OF INFORMATION TECHNOLOGY AND MANAGEMENT GWALIOR - 474015

Cloud Computing

Case Study : Google Cloud

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Q.1. What is Google Compute Engine? Explain its significance and functionalities in Google Cloud.

Google Compute Engine (GCE) is the Infrastructure as a Service (IaaS) component of Google Cloud Platform which is built on the global infrastructure that runs Google's search engine, Gmail, YouTube and other services. Google Compute Engine enables users to launch virtual machines (VMs) on demand. VMs can be launched from the standard images or custom images created by users. GCE users must authenticate based on OAuth 2.0 before launching the VMs. Google Compute Engine can be accessed via the Developer Console, RESTful API or command-line interface (CLI).

Google Compute Engine delivers virtual machines running in Google's innovative data centers and worldwide fiber network. Compute Engine's tooling and workflow support enable scaling from single instances to global,load-balanced cloud computing. Compute Engine's VMs boot quickly, come with persistent disk storage, and deliver consistent performance. Our virtual servers are available in many configurations including predefined sizes or the option to create Custom Machine Types optimized for your specific needs. Flexible pricing and automatic sustained use discounts make Compute Engine the leader in price/performance.

Functionalities provided by Google Compute Engine :

- ❑ Custom Machine Types
- ❑ Persistent Disks
- ❑ Local SSD
- ❑ Transparent Maintenance
- ❑ Global Load Balancing
- ❑ Containers
- ❑ Compliance & Security
- ❑ Per-Second Billing
- ❑ Batch Processing
- ❑ Linux & Windows Support

Q.2. What types of services offered by Google Clouds? Brief about the major categories?

The complete list of services that form Google Cloud Platform is shown below. While Google offers many other services and APIs, only the services below are covered by the Google Cloud Platform terms of service, service level agreements (if applicable), and support offerings.

Google App Engine : Google App Engine enables you to build and host applications on the same systems that power Google applications. App Engine offers fast development and deployment; simple administration, with no need to worry about hardware, patches or backups; and effortless scalability.

Google BigQuery Service : Google BigQuery Service is a fully managed data analysis service that enables businesses to analyze Big Data. It features highly scalable data storage that accommodates up to hundreds of terabytes, the ability to perform ad hoc queries on multi-terabyte datasets, and the ability to share data insights via the web

Google Cloud Bigtable : Google Cloud Bigtable is a fast, fully managed, highly-scalable NoSQL database service. It is designed for the collection and retention of data from 1TB to hundreds of PB.

Google Cloud Build : Google Cloud Build is a service that executes your builds on Google Cloud Platform infrastructure. Google Cloud Build can import source code from Google Cloud Storage, Cloud Source Repositories, GitHub, or Bitbucket; execute a build to your specifications; and produce artifacts such as Docker containers or Java archives.

Google Cloud Dataflow : Google Cloud Dataflow is a fully managed service for strongly consistent, parallel data-processing pipelines. It provides an SDK for Java with composable primitives for building data-processing pipelines for batch or continuous processing. This service manages the life cycle of Google Compute Engine resources of the processing pipeline(s). It also provides a monitoring user interface for understanding pipeline health.

Google Cloud Datalab : Google Cloud Datalab is an interactive tool for exploration, transformation, analysis and visualization of your data on Google Cloud Platform. It runs in your cloud project and enables you to write code to use other Big Data and storage services using a rich set of Google- authored and third party libraries.

Google Cloud Dataproc : Google Cloud Dataproc is a fast, easy to use, managed Spark and Hadoop service for distributed data processing. It provides management, integration, and development tools for unlocking the power of rich open source data processing tools. With Cloud Dataproc, you can create Spark/Hadoop clusters sized for your workloads precisely when you need them.

Google Cloud Datastore : Google Cloud Datastore is a fully managed, schemaless, non-relational datastore. It provides a rich set of query capabilities, supports atomic transactions, and automatically scales up and down in response to load. It can scale to support an application with 1,000 users or 10 million users with no code changes.

Google Cloud Endpoints : Google Cloud Endpoints is a tool that helps you to develop, deploy, secure and monitor your APIs running on Google Cloud Platform.

Cloud Firestore : Cloud Firestore is a NoSQL document database for storing, syncing, and querying data for mobile and web apps. Its client libraries provide live synchronization and offline support, while its security features and integrations with Firebase and Google Cloud Platform accelerate building serverless apps.

Google Cloud Functions : Google Cloud Functions is a lightweight, event-based, asynchronous compute solution that allows you to create small, single-purpose functions that respond to cloud events without the need to manage a server or a runtime environment.

Google Cloud IoT Core : Google Cloud IoT Core is a fully managed service that allows you to easily and securely connect, manage, and ingest data from internet connected devices. It permits utilization of other Google Cloud services for collecting, processing, analyzing, and visualizing IoT data in real time.

Cloud Talent Solution : Cloud Talent Solution offers access to Google's machine learning, enabling company career sites, job boards, ATS, staffing agencies, and other recruitment technology platforms to improve the talent acquisition experience.

Q.3. Discuss the concept of IoT core and its pricing in Google Cloud.

Cloud IoT Core is a fully managed service that allows you to easily and securely connect, manage, and ingest data from millions of globally dispersed devices. Cloud IoT Core, in combination with other services on Cloud IoT platform, provides a complete solution for collecting, processing, analyzing, and visualizing IoT data in real time to support improved operational efficiency.

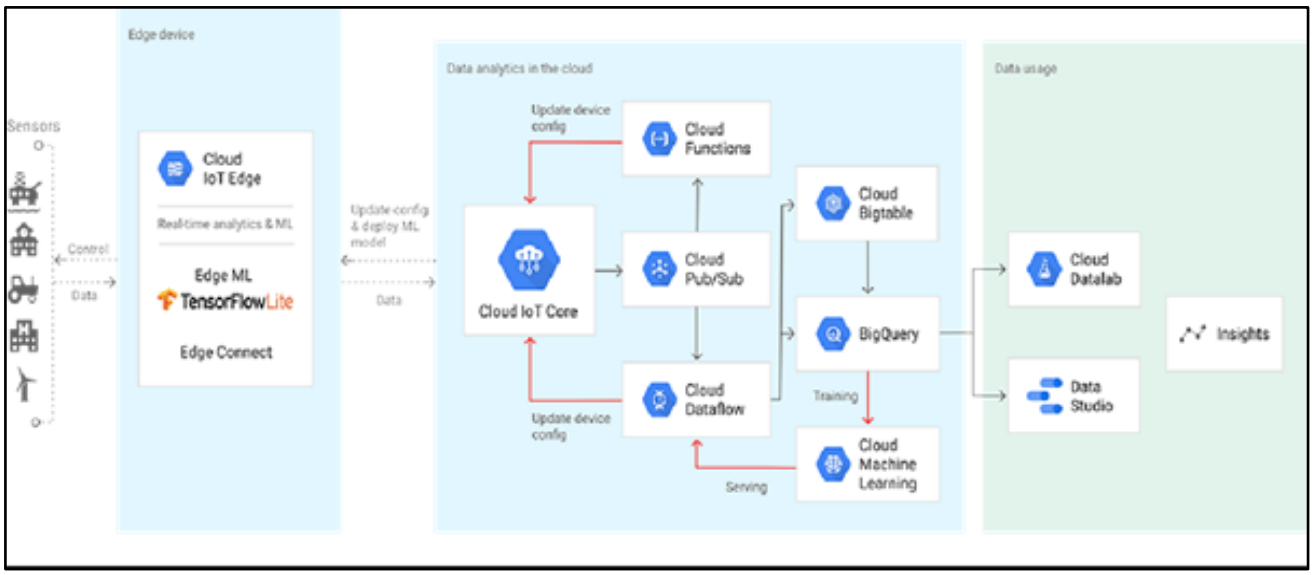
Cloud IoT Core has two main components : a device manager and a protocol bridge.

Device manager :

The device manager allows individual devices to be configured and managed securely in a coarse-grained way; management can be done through a console or programmatically. The device manager establishes the identity of a device, and provides the mechanism for authenticating a device when connecting. It also maintains a logical configuration of each device and can be used to remotely control the device from the cloud.

Protocol bridge :

The protocol bridge provides connection endpoints for protocols with automatic load balancing for all device connections. The protocol bridge has native support for secure connection over industry standard protocols such as MQTT and HTTP. The protocol bridge publishes all device telemetry to Cloud Pub/Sub, which can then be consumed by downstream analytic systems.



Pricing in Google Cloud :

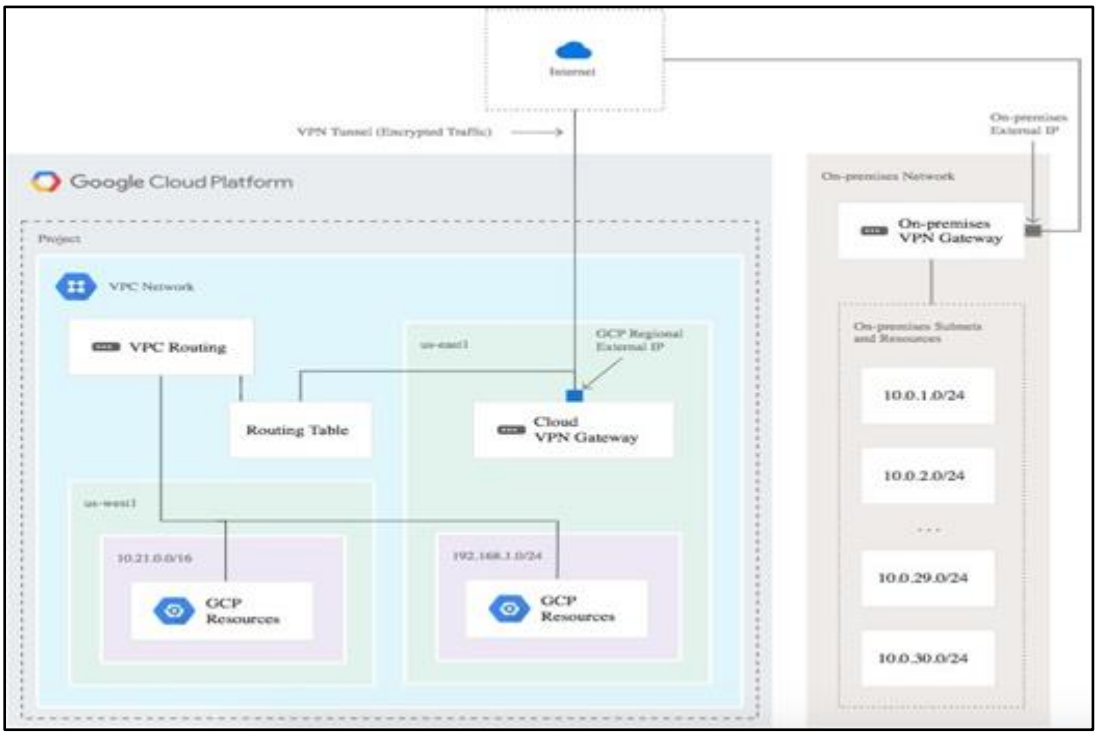
Monthly data volume	Price per MB	Registered devices	Minimum charge*
Up to 250 MB	$0.00	Unlimited, within QPS maximums	1024 bytes
250 MB to 250 GB	$0.0045	Unlimited, within QPS maximums	1024 bytes
250 GB to 5 TB	$0.0020	Unlimited, within QPS maximums	1024 bytes
5 TB and above	$0.00045	Unlimited, within QPS maximums	1024 bytes

Q.4. Explain the concept of Virtual Private Network (VPN) in networking resource management for Google Cloud.

Google Cloud VPN securely connects your on-premises network to your Google Cloud Platform (GCP) Virtual Private Cloud (VPC) network through an IPsec VPN connection. Traffic traveling between the two networks is encrypted by one VPN gateway, then decrypted by the other VPN gateway. This protects your data as it travels over the Internet. It has the following features :

- ❏ **Provides an SLA of 99.9% service availability**.
- ❏ **Supports site-to-site VPN** as a simple topology or with redundancy.
- ❏ **Supports both dynamic routes** that use Cloud Router , and static routes, to manage traffic between your Compute Engine Virtual Machine (VM) instances and your existing infrastructure.
- ❏ **Supports both IKEv1 and IKEv2** using a shared secret (IKE pre-shared key).Supports these IKE ciphers.

- **Uses ESP in Tunnel mode with authentication.** Cloud VPN does not support AHor ESP in Transport mode. Note that Cloud VPN does not perform policy-related filtering on incoming authentication packets. Outgoing packets are filtered based on the IP range configured on the Cloud VPN gateway.
- This diagram shows a simple VPN connection between your Cloud VPN gateway and your on-premises VPN gateway.With Cloud VPN, your on-premises hosts communicate through one or more IPsec VPN tunnels to Compute Engine Virtual Machine (VM) instances in your project's VPC networks



Q.5. What are the Cloud AI and Big Data facilities available at Google Cloud. Prepare the list for both and briefly discuss it in your own words.

The Cloud AI facilities available at the Google Cloud are as follows :

- **Cloud AutoML :** Service to train and deploy custom machine learning models.
- **Cloud TPU :** Accelerators used by Google to train machine learning models.
- **Cloud Machine Learning Engine :** Managed service for training and building machine learning models based on mainstream frameworks.
- **Cloud Job Discovery :** Service based on Google's search and machine learning capabilities for recruiting ecosystem.

- ❑ **Dialog Flow Enterprise :** Development environment based on Google's machine learning for building conversational interfaces.
- ❑ **Cloud Natural Language :** Text analysis service based on Google Deep Learning models.
- ❑ **Cloud Speech-to-Text :** Speech to text conversion service based on machine learning.
- ❑ **Cloud Text-to-Speech :** Text to speech conversion service based on machine learning.
- ❑ **Cloud Translation API :** Service to dynamically translate between thousands of available language pairs.
- ❑ **Cloud Vision API :** Image analysis service based on machine learning.

The Big Data facilities available at the Google Cloud are as follows :

- ❑ **BigQuery :** Scalable, managed enterprise data warehouse for analytics.
- ❑ **Cloud Dataflow :** Managed service based on Apache Beam for stream and batch data processing.
- ❑ **Cloud Dataproc :** Big data platform for running Apache Hadoop and Apache Spark jobs.
- ❑ **Cloud Composer :** Managed workflow orchestration service built on Apache Airflow.
- ❑ **Cloud Datalab :** Tool for data exploration, analysis, visualization and machine learning. This is a fully managed Jupyter Notebook service.
- ❑ **Cloud Dataprep :** Data service based on Trifacta to visually explore, clean, and prepare data for analysis.
- ❑ **Cloud Pub/Sub :** Scalable event ingestion service based on message queues.

Q.6. Prepare a list of all major customers and partners of the Google Cloud.

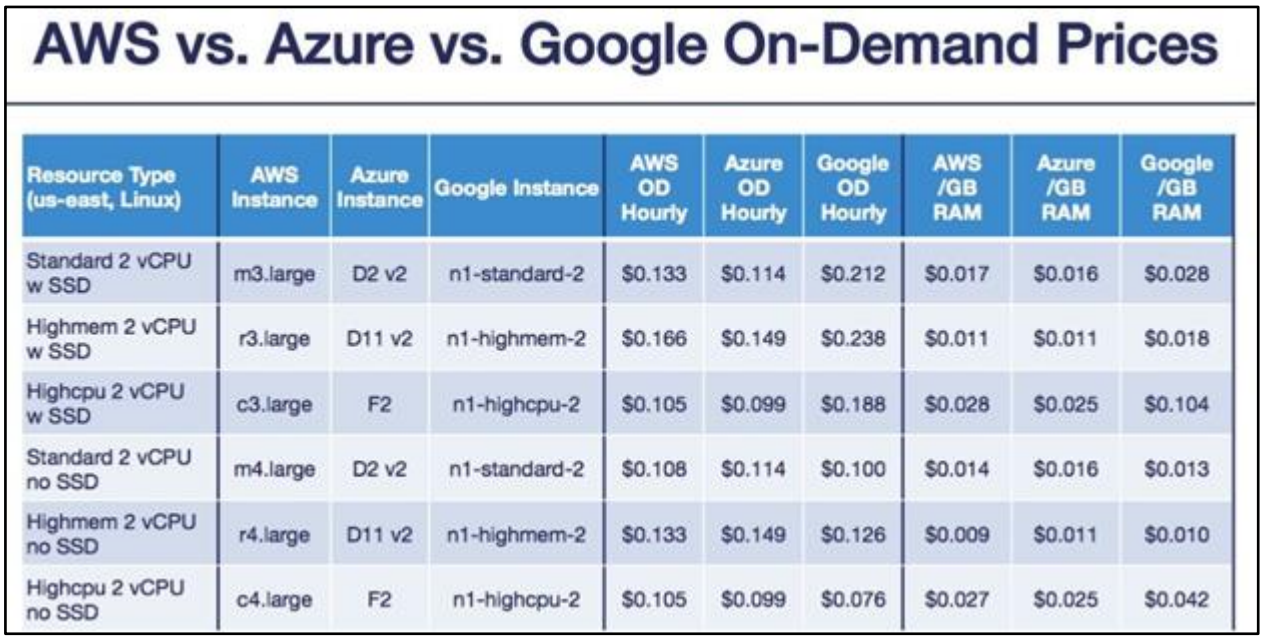
There are many customers of google cloud that use the google cloud for several purposes and many partners for google cloud.

Major Customers	Major Partners
Target	Accenture
20th Century Fox	SAP
Twitter	Pivotal

eBay	Intel
Paypal	Sales Force
Bloomberg	Cisco
Chevron	Deloitte
GO-JEK	Vmware
KeyBank	Dell
Lahey	NetApp

Q.7. Prepare a comparative list of pricing schemes of computing resources for Google Cloud, EC2 and Azure.

Comparative list of pricing schemes of computing resources for Google Cloud, EC2 and Azure is as follows:



AWS vs. Azure vs. Google On-Demand Prices

Resource Type (us-east, Linux)	AWS Instance	Azure Instance	Google Instance	AWS OD Hourly	Azure OD Hourly	Google OD Hourly	AWS /GB RAM	Azure /GB RAM	Google /GB RAM
Standard 2 vCPU w SSD	m3.large	D2 v2	n1-standard-2	$0.133	$0.114	$0.212	$0.017	$0.016	$0.028
Highmem 2 vCPU w SSD	r3.large	D11 v2	n1-highmem-2	$0.166	$0.149	$0.238	$0.011	$0.011	$0.018
Highcpu 2 vCPU w SSD	c3.large	F2	n1-highcpu-2	$0.105	$0.099	$0.188	$0.028	$0.025	$0.104
Standard 2 vCPU no SSD	m4.large	D2 v2	n1-standard-2	$0.108	$0.114	$0.100	$0.014	$0.016	$0.013
Highmem 2 vCPU no SSD	r4.large	D11 v2	n1-highmem-2	$0.133	$0.149	$0.126	$0.009	$0.011	$0.010
Highcpu 2 vCPU no SSD	c4.large	F2	n1-highcpu-2	$0.105	$0.099	$0.076	$0.027	$0.025	$0.042

A summary of the results:

- ❑ Google Cloud is the lowest price for 3 scenarios; highest price for 7.
- ❑ Google Cloud tends to be the lowest price when no SSD is needed and the highest when SSD is required due to the price of adding on a 375 GB local SSD.
- ❑ Google Cloud is higher priced on the "per GB RAM" cost for high cpu due to the fact that it includes less than half the memory of AWS and Azure.
- ❑ Azure is lowest price for 6 scenarios; highest price for 4.
- ❑ With the AWS price changes on December 1, 2016, Azure matches or is lower than AWS for only 7 of the 12 scenarios.
- ❑ AWS is the lowest price for 3 scenarios; highest price for 1.
- ❑ AWS is most often the middle-priced option if the 3.
- ❑ All of these results will depend on the level of Microsoft EA discount for Azure and on what type of RIs, if any, are purchased for AWS.

Q.8. Prepare a list of strengths of Google Cloud and separate a list of features which makes Google Cloud unique out of other Cloud platforms.

Strengths of Google Cloud :

- ❑ **Quick Collaboration:** Google cloud allows quick collaboration. Users can work on projects collaboratively at the same time as data is stored on the cloud instead of their computers.
- ❑ **Security:** Google mainly focuses on security and privacy of customers' data. Customers are benefited by security investments made by Google.
- ❑ **Higher Uptime and Reliability:** Customers are provided services with higher up-time and reliability. Switching of data centers is also provided in case of any failure.
- ❑ **Better Pricing Plans Availability:** Google cloud provides cheaper pricing plans as compared to microsoft azure and aws. No upfront cost is required for subscription.
- ❑ **Enhanced Execution:** At enterprise level, Google has enhanced the performance of google cloud. An individual can access the data from any location via remote. It has a big infrastructure so it allows executing various complex operations easily at its network.
- ❑ **Live Migration:** One of the top advantages of Google Cloud is "Live Migration" over aws and microsoft azure. It merely consists of migration of Virtual Machines. By having such a large network, Google Cloud allows users to migrate their machines.
- ❑ **Private Network:** Google provides its own private network to every customer so that they have more control and scalability over the network. It is the backbone of Google Cloud Hosting services.

Features of Google Cloud :

- ❑ **Google-grade Security :** Google provides an end-to-end security model to keep customers safe on google applications like gmail and google apps.
- ❑ **Billing by the second :** Compute Engine instances are charged in one-second increments with a one-minute minimum, so users are not needed to pay for compute minutes that they don't use.
- ❑ **Big data :** Google's big data technology innovations like Bigtable, BigQuery, MapReduce, Dremel and next generation breakthrough services help users in transforming their business and provide acceleration in service execution.
- ❑ **Global network :** Google's backbone network uses advanced software-defined networking and edge caching services to deliver fast, consistent, and scalable performance.
- ❑ **Environmentally friendly :** GCP data centers run on half the energy of a typical data center, and run on 100% renewable energy where available.

Q.9. Write 200 words overall impressive summary of Google cloud learning.

Google Cloud Platform 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 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. Google Cloud Platform provides Infrastructure as a service(Compute Engine), Platform as a service(App Engine), 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 G Suite, enterprise versions of Android and Chrome OS, and application programming interfaces (APIs) for machine learning and enterprise mapping services. Google offers many other services and APIs, only the services below are covered by the Google Cloud Platform terms of service, service level agreements and support offerings.

Google cloud provides many services such as :

- ❑ **<u>Compute</u> :**
  - ❖ **AppEngine -** Platform-as-a-Service(PaaS) to deploy PHP, Node.js, Java, Python, Ruby and Go applications.

- **Compute Engine -** Infrastructure-as-a-Service(IaaS) to run microsoft windows and linux virtual machines
- **Kubernetes Engine -** Containers as a Service based on kubernetes.
- **Cloud Functions -** Functions as a Service to run event-driven code written in Node.js and Python.

❑ Networking :

- **VPC -** Virtual private cloud for managing the software defined network of cloud resources.
- **Cloud Load Balancing -** Software-defined, managed service for load balancing the traffic.
- **Cloud CDN -** Content Delivery Network based on Google's globally distributed edge points of presence.
- **Cloud DNS** - Managed, authoritative DNS service running on the same infrastructure as Google.

❑ Storage & Databases :

- **Cloud Storage** - Object storage with integrated edge caching to store unstructured data.
- **Cloud BigTable -** Managed NoSQL database service.
- **Cloud Datastore -** NoSQL database for web and mobile applications
- **Cloud MemoryStore -** Managed in-memory data store based on Redis.

❑ Cloud AI :

- **Cloud AutoML -** Service to train and deploy custom machine learning models.
- **Cloud TPU -** Accelerators used by Google to train machine learning models.
- **Cloud Machine Learning Engine -** Managed service for training and building machine learning models based on mainstream frameworks.
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