



Mechanisms Critical Analysis and Response



CSCI5409: Advanced Cloud Computing

Group 40 (Team 3): Stormtroopers

Tanvi Pruthi – B00875949

Sidharth Mahant – B00899439

Mayank Sareen – B00899565

Table of Contents

Cloud Computing Mechanisms.....	2
Cloud Service Role for the Software Architecture.....	2
Cloud Service Alternatives.....	4
Cloud Services and Alternatives Trade-offs.....	5
Cloud Computing Mechanisms Cost Analysis	7
References.....	9

Cloud Computing Mechanisms

Below is the list of the AWS services planned for the delivery and deployment of the Krypton website on the AWS cloud.

- **Compute:** We'll use AWS EC2, Docker, and AWS Elastic Beanstalk for the computing operations and deployment.
- **Storage:** Our website will use AWS S3 and AWS DynamoDB to store and manage data.
- **Network:** AWS Virtual Private Cloud, AWS API Gateway will be used in the deployment of our application in a private network on the public cloud.
- **Security:** We will use Amazon Cognito and Secrets Manager primarily for the security of our application.
- **General:** We have selected AWS SNS, AWS Elastic load balancing, AWS Glue

Cloud Service Role for the Software Architecture

1. COMPUTE

a. AWS EC2

Amazon EC2 is at the forefront of virtual cloud providing services. Amazon's Elastic Compute Cloud enables Compute Instances to run cloud-based applications based on configurations defined with Amazon Machine Image (AMI), such as Windows, Linux, and others. It has dynamic billing that is based on consumption. Every instance is assigned a unique IP address. Our web application "Krypton" will be launched on EC2 to meet CPU, memory, and storage needs. Krypton must be run and hosted on a cloud server, and EC2 provides a secure, high-performance server that is not immutable and can be scaled to meet our requirements.

b. Docker & AWS Elastic Beanstalk

Docker is an open-source platform that uses the docker file to produce an image of the source code and then sends that image to the Docker Hub, a repository that stores the source code image in the cloud. Once our EC2 instance is up and running, we can use the docker-compose file to build and execute the docker image from the docker hub using AWS Elastic Beanstalk. Docker will take care of the infrastructure through docker images in this manner. We will execute the krypton application deployment on Elastic Beanstalk in EC2 for quick deployment and management of our application.

2. STORAGE

a. AWS S3

AWS Simple Storage Service is a NoSQL database that employs buckets as objects and stores data in them. It saves the data as a key-value pair. S3 allows for the generation of numerous versions of data, making restoration simple. The Krypton application will use Amazon's S3 to store log data, pictures, and other such information in buckets. The REST API will be used to create, delete, and update these buckets.

b. AWS DynamoDB

Amazon's DynamoDB, another NoSQL database service, is faster and more efficient than S3. It saves data in key-value pairs in documents, just as S3. Krypton will use DynamoDB to store all user-related data, such as cryptocurrency trade data, account balances, user portfolios, and so on. Because there are many transactions, DynamoDB will handle them efficiently and keep their details.

3. NETWORK

a. AWS Virtual Private cloud

The Krypton web application will be deployed in an EC2 instance that is linked to a virtual private network to assure resource placement, connectivity, and application security. A virtual private network (VPC) is a private network constructed in a specific location to isolate the network from public availability. Launch EC2 instances in a public or private subnet of this private network, and the network is connected to the internet via the internet gateway. Multiple VPCs can be built in a single area based on the needs of an application.

b. AWS API Gateway

API Gateway is necessary to link numerous third-party apps to AWS services. Krypton will use a private endpoint on the same Virtual Private Cloud network to connect to EC2 instances located in the same VPC network. This reduces latency while safely exposing the REST APIs to the same VPC network.

4. SECURITY

a. Amazon Cognito

Amazon Cognito will store user data from the Krypton website, which makes it very easy to log in or register using email, Facebook, and Gmail. To access the data for cryptocurrency transactions, DynamoDB will have additional linkages to the user credentials and data. Amazon Cognito is a user identification and data synchronization service that aids in the reduction of the back-end development to save data when a user logs in or registers. It aids in the integration of the user's identification with the user's numerous social networks and stores the data as key-value pairs.

b. AWS Secret Manager

The Secrets Manager securely saves the API keys, database credentials, or any predefined credentials, ensuring that the critical secret keys are not revealed to unknown developers or anybody else who has access to the code in the future, preserving privacy and security. The Secrets Manager stores any credentials or keys used in the creation of the Krypton website, and those credentials are retrieved anytime via the HTTPS channel.

5. GENERAL

a. AWS SNS

When a user logs in or registers on the Krypton website, an email will be sent to the user's registered email address. In addition, when the user buys or sells any cryptocurrency, the user will receive an email with the transaction details. These emails will be delivered via AWS' SNS services. Amazon Simple Notification Service is Amazon's messaging service that allows you to send messages via email, SMS, mobile push, and other methods.

b. AWS Glue

The Krypton website will receive live raw data from internet sources via API calls and store it in an S3 bucket. The stored raw data will be retrieved from the S3 bucket, processed as per the portfolio requirement, then loaded as transformed data in the S3 bucket via AWS Glue for a more tailored forecast of cryptocurrencies for users and improved data display on the Krypton website.

c. AWS Elastic Load Balancing

For improving response time, the Krypton website will use Elastic Load Balancing, in which numerous servers or resources will be added or deleted as needed to optimize performance and scalability. Elastic Load Balancing redirects and redistributes traffic from several sources, as well as multiple hits from those sources, at the same time. Because the response will come from multiple targets where the traffic redirects, the response time to those destinations becomes faster.

Cloud Service Alternatives

Table 1: List of services and their Alternatives

SERVICES	ALTERNATIVES
AWS EC2	DigitalOcean, Google Compute Engine
Docker & AWS Elastic Beanstalk	Google App Engine
AWS S3	Google Cloud Storage, Azure Blob Storage
AWS DynamoDB	MongoDB, Google Cloud Firebase
AWS Virtual Private Cloud	AWS CloudFront, Google Virtual Private Cloud
Amazon Cognito	Google Identity Platform

AWS SNS	Twilio SendGrid Email API
AWS Secret Manager	Microsoft Azure Active Directory
AWS Elastic Load Balancing	Azure application gateway
AWS Glue	Azure data factory, Talend, Apache NiFi

Cloud Services and Alternatives Trade-offs

1. COMPUTE

a. AWS EC2 v/s DigitalOcean

Although AWS EC2 and DigitalOcean provide scalable and affordable cloud solutions, we chose EC2 for the Krypton application deployment on the EC2 server. It gives us the flexibility of adjusting the storage as per the requirement. Also, it supports all the operating systems and manages and controls all the services on its own. DigitalOcean, on the other hand, supports only the predefined Linux installations and is limited to the infrastructure-as-a-Service platform.

b. AWS EC2 v/s Google Compute Engine

AWS is a considerable leader in providing services over the cloud infrastructure and computes platform and provides the flexibility of the availability of the servers in many regions. Also, it offers high computing power and capacity compared to the Google Computer Engine.

c. AWS Elastic Beanstalk v/s Google App Engine

Elastic Beanstalk is quite a compatible deployment platform to run and test the applications on the cloud servers. The combination of docker and Elastic Beanstalk will help us connect and manage the Krypton website easily along multiple regions. Elastic Beanstalk is a more scalable and easy-to-manage cloud service, whereas Google App Engine provides fewer options for the application run.

2. STORAGE

a. AWS S3 v/s Google Cloud Storage and Azure Blob Storage

The AWS S3 powerful API for uploading large pieces of data, object versioning, data durability and object-level tagging are the main reasons we selected the S3 storage system over Google Cloud Storage or Azure Bob Storage. Also, the high stability and performance were the key metrics to choose S3 because the Krypton application will retrieve a large amount of the live data for the cryptocurrencies.

b. AWS DynamoDB v/s MongoDB and Google Cloud Firebase

We have planned to use DynamoDB to store the user-related data, where security is the priority while storing and fetching the user's data. We chose DynamoDB over MongoDB and Google

Cloud Firebase to deliver an application with built-in security, data backup and restoration features.

3. NETWORK

a. AWS Virtual Private Cloud v/s AWS CloudFront

AWS Virtual Private Cloud is easy to set up and administer compared to AWS CloudFront. As we will deploy the website on the EC2 server, VPC will serve as a flexible and secure private network, where we will have the leverage to select our IP address range and network gateways.

b. AWS Virtual Private Cloud v/s Google Virtual Private Cloud

We chose AWS Virtual Private Cloud over Google Virtual Private Cloud to have network control at region, subnet and zone levels. Also, AWS provides an extra layer of privacy and security, where permits are required to access any other account.

4. SECURITY

a. Amazon Cognito v/s Google Identity Platform

We chose Amazon Cognito over Google Cloud Platform because it helps to log in or sign up easily and stores the information securely. Also, the integration of Cognito with the other Amazon services selected will help to manage and control the flow of users' identities and data.

b. AWS Secrets Manager v/s Microsoft Azure Active Directory

Since we will use DynamoDB and S3 to store users' and live cryptocurrencies data through API calls, AWS secrets manager is a better choice to cache the necessary information and credentials securely.

5. GENERAL

a. AWS SNS v/s Twilio SendGrid Email API

The Krypton application will let users register, log in, buy and sell cryptocurrencies. Users will receive an email for every user's activity to ensure that the request is initiated and completed by that user only. Twilio SendGrid Email API has a limit of 100 emails per day, and the other plans are more expensive than AWS SNS.

b. AWS Glue v/s Azure data factory, Talend, Apache NiFi

We can use many data processing services, such as Azure data factory, Talend, Apache NiFi, etc. transform the cryptocurrencies' live data for a personalized prediction model. But we have chosen AWS glue because it is a better and more robust ETL tool. Also, the tool's integration with the AWS S3 storage service will help in fetching, transforming, and loading the data with ease.

Cloud Computing Mechanisms Cost Analysis

1. COMPUTE

a. AWS EC2

The t3.micro instance of the Linux operating System of the US East (Ohio) region. With 2 CPUs and 1Gib memory and a network performance of up to 5 Gigabit and a 20 GB general purpose SSD added on, our total monthly cost estimates to 6.75USD. We explored that AWS also provides 750 hours every month free up to 12 months under the micro instance. Since we believe the krypton website would be able to run on a micro instance judging by the traffic and the users on the website, we will attempt to use the free tier service.

b. Docker

Free Open Source

c. AWS Elastic Beanstalk

There is no additional charge for using AWS Elastic beanstalk since the cost is included with the EC2 instance and for the S3 buckets.

We have considered the options which suited the best for krypton website and did not consider pricing as a factor while selecting these services from the compute category.

2. STORAGE

a. AWS S3

We are planning to use the S3 standard which is used for any type of data and is, where the first 50TB/month costs around 0.023USD per GB.[9]

b. AWS DynamoDB

For the pricing estimate, we'll use DynamoDB with on-demand capacity since we feel it'll be more cost-effective and easier than using already provisioned capacity because we won't have to manually set it up and would pay only based on the usage. Based on the number of reads, writes and storage, the estimate costing in range of 5 -10 GB data storage, 30000-50000 reads and writes, krypton storage would approximately range from 1.29 USD to 2.57 USD [10]

For the storage section we have planned to use S3 to store data like logs, images, etc. and dynamo db will store all the currency related information, user wallet details, transactions details etc. Prices did not concern us while selecting these services and anyway the prices we see above are quite economical when we compare the benefits, we are getting from the service features.

2. NETWORK

a. AWS Virtual Private Cloud

There are no additional charges for creating and using this service.[11]

b. AWS API Gateway

There is also a free tier which includes one million API calls for REST APIs, HTTP APIs, messages, etc. for a year. Additionally, 300+ million requests cost around 0.90 USD. The charges are based only if the usage exceeds these numbers and failed requests are not charged. [12]

Looking at the features by the two services, we did not let prices affect our choices.

4. SECURITY

a. Amazon Cognito

The charges are based on the user pools that Cognito creates. The identity pools do not incur any additional costs. Assuming the application would have around 100 active users in the pool. We would be charged with approximately around 5.00 USD. [13]

b. AWS Secret Manager: Secret manager has a free trial of 30 days after which we would need to pay based on our usage. The monthly price of a single secret is 0.40 USD. [14]

Amazon Cognito will manage the entire user login and credential management of the Krypton website and is a very good feature to have. AWS Secret Manager would help storing the secure credentials for accessing different endpoints and thus would secure the application. Security being very essential in any application, we did not consider prices while selecting the services.

5. GENERAL

a. AWS SNS

The first 1 million Amazon SNS requests each month are free, and each additional 1 million requests costs 0.50 USD [15]

b. AWS Glue

We are planning to use ETL jobs and development endpoints which has the estimates of 0.44 USD per DPU-Hour, billed per second, with a 10-minute minimum for each provisioned development endpoint [16]

c. AWS Elastic Load Balancing

Each hour or partial hour that an Application Load Balancer is running, as well as the number of Load Balancer Capacity Units (LCU) consumed each hour, are charged. The elastic load balancing charges excluding the price of the LCU is 16.43 USD. The LCU charges are 0.008 USD per LCU-hour. [17]

The cost of these features is not affecting our choice of these services looking at their features.

References

- [1] "DigitalOcean vs AWS: 10 Most Important Differences You Must Know!," *Guru99* [Online]. Available: <https://www.guru99.com/digitalocean-vs-aws.html> [Accessed: February 25, 2022].
- [2] "DigitalOcean vs AWS EC2: 8 Factors to Decide Who's the Winner?," *Serverguy* [Online]. Available : <https://serverguy.com/comparison/digitalocean-vs-aws-ec2/>. [Accessed: February 25, 2022].
- [3] "EC2 vs Google Compute Engine: Comparing the Big Players in IaaS?," *Cloud Academy* [Online]. Available : <https://cloudacademy.com/blog/ec2-vs-google-compute-engine/>. [Accessed: February 25, 2022].
- [4] "Amazon EC2 vs Google App Engine," *Stackshare* [Online]. Available : <https://stackshare.io/stackups/amazon-ec2-vs-google-app-engine>. [Accessed: February 25, 2022].
- [5] "Four differences between google and amazon s3," *Zenko* [Online]. Available : <https://www.zenko.io/blog/four-differences-google-amazon-s3-api/>. [Accessed: February 25, 2022].
- [6] "dynamodb versus mongodb differences," *integrate io* [Online]. Available : <https://www.integrate.io/blog/dynamodb-vs-mongodb-differences/>. [Accessed: February 25, 2022].
- [7] "amazon-cloudfront-vs-amazon-virtual-private-cloud-amazon-vpc," *g2* [Online]. Available : <https://www.g2.com/compare/amazon-cloudfront-vs-amazon-virtual-private-cloud-amazon-vpc>. [Accessed: February 25, 2022].
- [8] "Twilio Pricing," *twilio* [Online]. Available : <https://www.twilio.com/pricing> [Accessed: February 25, 2022].
- [9] "AWS S3 pricing," AWS [Online]. Available: <https://aws.amazon.com/s3/pricing/>. [Accessed: February 25, 2022].
- [10] "Configure Amazon DynamoDB," AWS [Online]. Available: <https://calculator.aws/#/createCalculator/DynamoDB>. [Accessed: February 26, 2022].
- [11] "AWS VPN pricing," AWS [Online]. Available: <https://www.amazonaws.cn/en/vpc/pricing/>. [Accessed: February 26, 2022].
- [12] "AWS API-Gateway pricing," AWS [Online]. Available: <https://aws.amazon.com/api-gateway/pricing/>. [Accessed: February 25, 2022].
- [13] "AWS Cognito pricing," AWS [Online]. Available: <https://aws.amazon.com/cognito/pricing/>. [Accessed: February 27, 2022].
- [14] "AWS Secret-manager pricing," AWS [Online]. Available: <https://aws.amazon.com/secrets-manager/pricing/>. [Accessed: February 25, 2022].
- [15] "AWS SNS pricing," AWS [Online]. Available: <https://aws.amazon.com/sns/pricing/>. [Accessed: February 26, 2022].
- [16] "AWS Glue pricing," AWS [Online]. Available: <https://aws.amazon.com/glue/pricing/>. [Accessed: February 27, 2022].

[17] "AWS Elastic Load Balancing pricing," AWS [Online]. Available:
<https://aws.amazon.com/elasticloadbalancing/pricing/?nc=sn&loc=3>. [Accessed: February 25, 2022].