

**A PROJECT REPORT ON**

**IMPLEMENTING**

**KUBERNETES CLUSTER(GKE)**

**WITH LOADBALANCER FOR**

**WORDPRESS BLOG HOSTING ON**

**GOOGLE CLOUD PLATFORM**



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# **ACKNOWLEDGEMENT**

I am profoundly grateful to the World Record Holder , TEDx speaker , Philanthropist , Senior IT consultant , Entrepreneur, Founder of Linux World Informatics Pvt. Ltd. & and Expert Corporate Trainer in almost all Latest & High-End Technologies Mr. VIMAL DAGA for his expert guidance and encouragement throughout to see that this project rights its target since its commencement to its completion.

I would like to express my gratitude again to such a huge personality Mr. VIMAL Sir who gave me this golden opportunity to do this wonderful project , which helped me in doing a lot of research and I learned so many new things.

Although this report has been prepared with utmost care and deep routed interest. Even then I would like to accept respondents and imperfections.

Thank You

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## ■ INTRODUCTION

Cloud Computing is the delivery of computing services such as servers, storage, databases, networking, software, analytics, intelligence, and more, over the Cloud (Internet). Cloud Computing provides an alternative to the on-premises datacentre. With an on-premises datacentre, we have to manage everything, such as purchasing and installing hardware, virtualization, installing the operating system, and any other required applications, setting up the network, configuring the firewall, and setting up storage for data. After doing all the set-up, we become responsible for maintaining it through its entire lifecycle.

There are many Cloud Service providers in the market : Amazon Web Services(AWS) ,Microsoft Azure ,Google Cloud Platform (GCP) etc . These Cloud Service Providers are providing Infrastructure As A Service , Platform As A Service and Software As A Service .

<b>Name of Company</b>	<b>IaaS</b>	<b>Paas</b>	<b>SaaS</b>
<b>AWS</b>	Amazon EC2	Amazon Web Services	Amazon Web Services
<b>Microsoft</b>	Microsoft Private Cloud	Microsoft Azure	Microsoft Office 365
<b>Google</b>	—	Google App Engine (Python, Java and many)	Google Applications
<b>IBM</b>	Smart Cloud Enterprise	Smart Cloud Application Services	SaaS Products

Google Cloud Platform, 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. Google Cloud Platform services are available in various locations across North America, South America, Europe, Asia, and Australia. These locations are divided into regions and zones. You can choose where to locate your applications to meet your latency, availability and durability requirements.

Google offers a wide range of Services such as Compute , Networking , Storage and Databases , Big Data , Machine Learning , Identity & Security , Management and Developer Tools .

## ■ **OBJECTIVE**

In this project I am going to host a WordPress Blog on the top of Google Cloud Platform (GCP) using its one of the managed services I.e Google Kubernetes Engine (GKE) . It provides a managed environment for deploying, managing, and scaling your containerized applications using Google infrastructure. The GKE environment consists of multiple machines (specifically, Compute Engine instances) grouped together to form a cluster.

The objective of this document is to provide information about the technology and technical aspects of a real industry use case. It covers the technology used for this project , its planning and implementation process , results & its future scope .

## ■ **PROJECT IDEATION**

In this project I am going to create a multi-tier infrastructure for WordPress blog hosting .

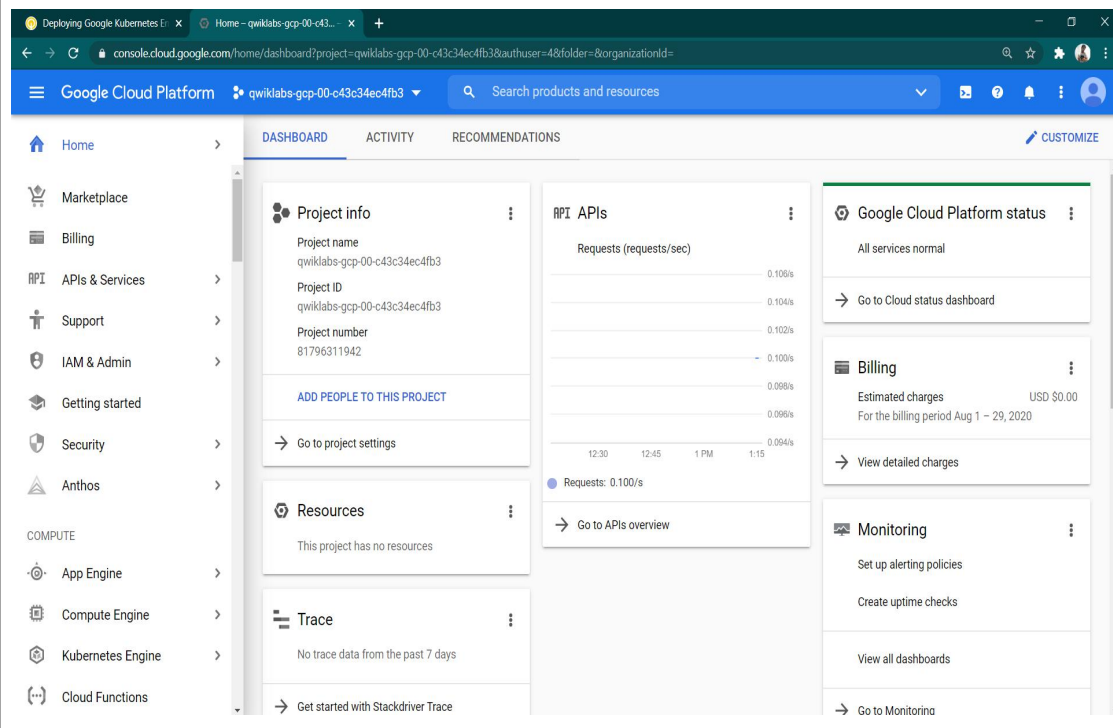
WordPress is a open-source content management system (CMS) written in PHP and paired with database. So initially I will be creating two different VPCs ; one for web server and another one for database server .Virtual Private Cloud (VPC) will provide networking functionality to Google Kubernetes Engine (GKE) clusters and MySQL instances .

Then a Kubernetes Cluster will be launched in Singapore region for Webserver and MySQL instance will be launched in South Carolina region for Database server . A LoadBalancer will be configured for reverse proxy and distribution of network traffic across servers with clusters . The IP address of LoadBalancer will be exposed to the outside world. So when clients will hit that particular IP requests will be equally distributed among servers .

## ■ PROJECT IMPLEMENTATION

### Step - 1 :

To use Google Cloud Platform first login or create an account , then visit <https://cloud.google.com/> this url . Go to console and attach your billing account so that you can use the services .



Here is the GCP console dashboard. All the services can be used inside a project only. A project organizes all your Google Cloud resources. Each project has unique name and id. They form the basis for creating, enabling and using all services such as managing APIs, billing, adding and removing collaborators and managing permissions for Google Cloud Resources.

### Step - 2 :

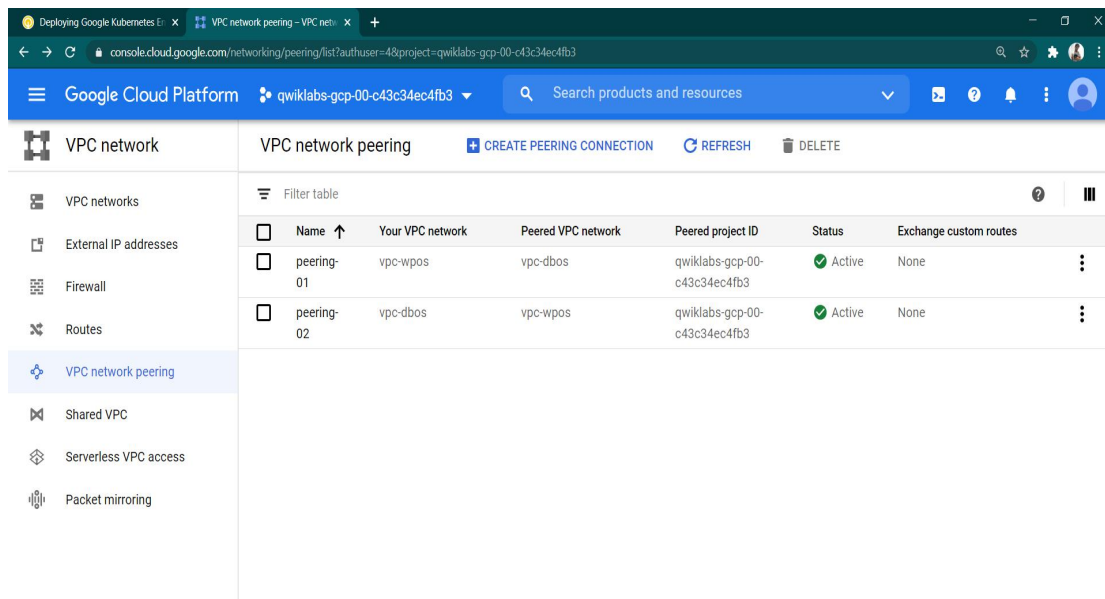
I have created two distinguished VPCs namely *vpc-dbos* and *vpc-wpos* for database and wordpress respectively. Also configured separate subnets in them. Also I have attached custom firewall rule for them.

The screenshot shows the Google Cloud Platform console for a project named 'qwiklabs-gcp-00-c43c34ec4fb3'. The left sidebar lists various network services: VPC networks, External IP addresses, Firewall, Routes, VPC network peering, Shared VPC, Serverless VPC access, and Packet mirroring. The main panel displays the 'VPC network details' for 'vpc-wpos'. The configuration includes: Subnet creation mode (Custom subnets), Dynamic routing mode (Regional), and DNS server policy (None). Below this, there are tabs for Subnets, Static internal IP addresses, Firewall rules, Routes, VPC Network Peering, and Private service connection. The 'Subnets' tab is active, showing a table with one subnet: 'subnet-wpos' in the 'asia-southeast1' region with IP address range '10.0.1.0/24', gateway '10.0.1.1', private Google access 'Off', and flow logs 'Off'. There is also a section for 'Reserved subnets for internal HTTP(S) load balancers' which shows 'No matching results'. At the bottom, it says 'Equivalent REST'.

The screenshot shows the Google Cloud Platform console for the same project. The left sidebar is identical to the previous screenshot. The main panel displays the 'VPC network details' for 'vpc-dbos'. The configuration includes: Subnet creation mode (Custom subnets), Dynamic routing mode (Regional), and DNS server policy (None). Below this, there are tabs for Subnets, Static internal IP addresses, Firewall rules, Routes, VPC Network Peering, and Private service connection. The 'Subnets' tab is active, showing a table with one subnet: 'subnet-dbos' in the 'us-east1' region with IP address range '10.0.5.0/24', gateway '10.0.5.1', private Google access 'Off', and flow logs 'Off'. There is also a section for 'Reserved subnets for internal HTTP(S) load balancers' which shows 'No matching results'. At the bottom, it says 'Equivalent REST'.

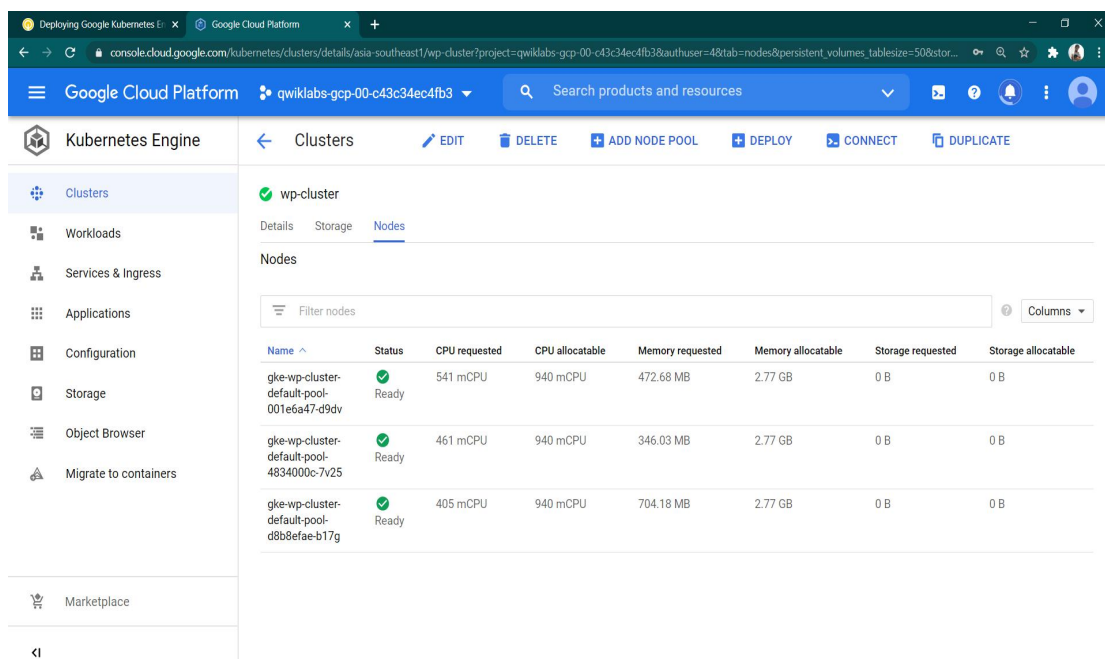
### Step - 3 :

Google Cloud VPC Network Peering allows internal IP address connectivity. It also provides some major advantages like low latency and more secure data transmission .So I have enabled VPC peering for both the VPCs created in previous step .



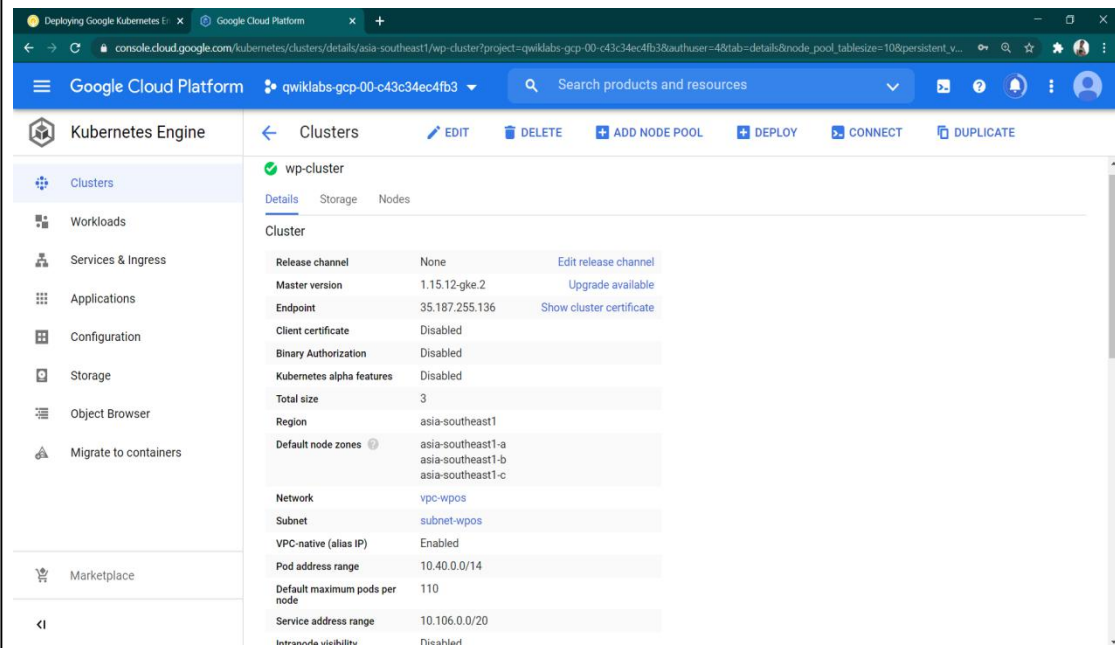
#### Step - 4 :

Google Kubernetes Engine (GKE) is a management and orchestration system for Docker container and container clusters that run within Google's public cloud services. Google Kubernetes Engine is based on Kubernetes, Google's open source container management system. Using this facility I have created a cluster for Web Server.



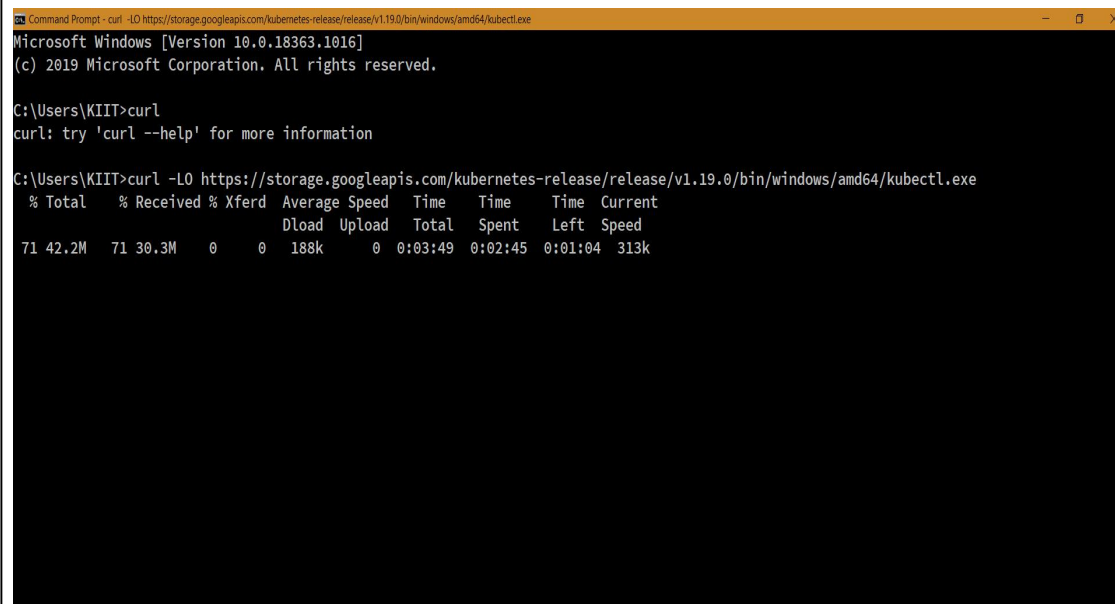
This cluster is configured in asia-southeast1 (Singapore) region under subnet-wpos of vpc-wpos. These configuration information is shown below.





## Step - 5 :

I will be configuring Kubernetes cluster further from my base machine I.e Windows 10 . So I need a client program for it I.e kubectl .



## Step - 6 :

To use kubectl for GKE I also need Google SDK . After installing SDK ,I can authenticate my account as well as Kubernetes client program from command prompt as following .

```
Microsoft Windows [Version 10.0.18363.1016]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\KIIT>gcloud auth login
Your browser has been opened to visit:

    https://accounts.google.com/o/oauth2/auth?client_id=32555940559.apps.googleusercontent.com&redirect_uri=http%3A%2F%2Flocalhost%3A8085%2F&scope=openid+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fuserinfo.email+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fcloud-platform+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fappengine.admin+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fcompute+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Faccounts.reauth&code_challenge=r_H0eG2tMem2yluu1TcirKltygDcDbsC-nshfZbxmu4&code_challenge_method=S256&access_type=offline&response_type=code&prompt=select_account

You are now logged in as [student-00-e91de4f26747@qwiklabs.net].
Your current project is [None]. You can change this setting by running:
$ gcloud config set project PROJECT_ID

C:\Users\KIIT>gcloud container clusters get-credentials wp-cluster --region asia-southeast1 --project qwiklabs-gcp-00-c43c34ec4fb3
Fetching cluster endpoint and auth data.
kubeconfig entry generated for wp-cluster.

C:\Users\KIIT>
C:\Users\KIIT>
C:\Users\KIIT>gcloud container clusters get-credentials wp-cluster --region asia-southeast1 --project qwiklabs-gcp-00-c43c34ec4fb3
Fetching cluster endpoint and auth data.
kubeconfig entry generated for wp-cluster.

C:\Users\KIIT>
```

## Step - 7 :

Let us check the kubernetes cluster details from command prompt using kubectl.

```
C:\Users\KIIT>
C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get nodes
NAME                                STATUS    ROLES    AGE     VERSION
gke-wp-cluster-default-pool-001e6a47-d9dv    Ready    <none>    7m42s   v1.15.12-gke.2
gke-wp-cluster-default-pool-4834000c-7v25    Ready    <none>    7m36s   v1.15.12-gke.2
gke-wp-cluster-default-pool-d8b8efae-b17g    Ready    <none>    7m37s   v1.15.12-gke.2

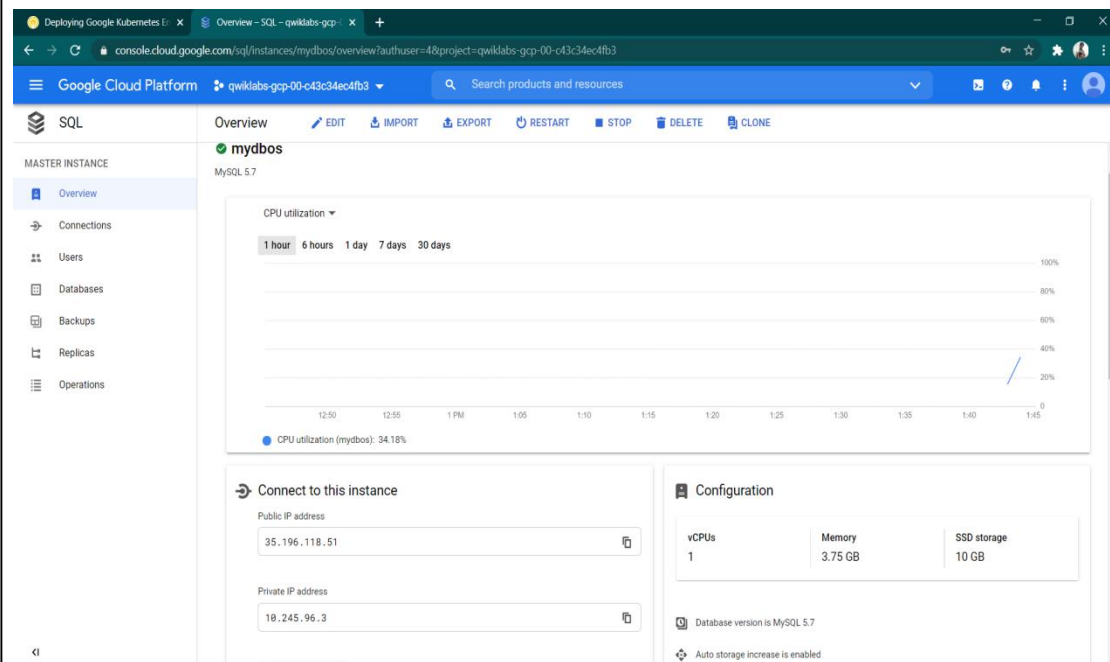
C:\Users\KIIT>kubectl.exe get podes
error: the server doesn't have a resource type "podes"

C:\Users\KIIT>
C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get nodes -o wide
NAME                                STATUS    ROLES    AGE     VERSION    INTERNAL-IP    EXTERNAL-IP    OS-IMAGE
KERNEL-VERSION    CONTAINER-RUNTIME
gke-wp-cluster-default-pool-001e6a47-d9dv    Ready    <none>    8m30s   v1.15.12-gke.2    10.0.1.4        35.247.187.135    Container-Optimiz
ed OS from Google 4.19.112+        docker://19.3.1
gke-wp-cluster-default-pool-4834000c-7v25    Ready    <none>    8m24s   v1.15.12-gke.2    10.0.1.2        35.240.131.144    Container-Optimiz
ed OS from Google 4.19.112+        docker://19.3.1
gke-wp-cluster-default-pool-d8b8efae-b17g    Ready    <none>    8m25s   v1.15.12-gke.2    10.0.1.3        35.247.187.134    Container-Optimiz
ed OS from Google 4.19.112+        docker://19.3.1

C:\Users\KIIT>
```

## Step - 8 :

Now let us go to GCP console and create an instance for MySQL database server .



It has been launched inside vpc-dbos . Now I've set rules under the 'connections' section to allow from all IPs I.e 0.0.0.0/0 . There I have selected the private IP checkbox so that I can connect to it using Google's private network according to my subnet . After that I have created a database named as wordpressdb as shown following .

The screenshot shows the Google Cloud Platform console for the 'mydbos' instance, specifically the 'Databases' section. It lists the databases created on the instance:

Name	Collation	Character set	Type
information_schema	utf8_general_ci	utf8	System
mysql	utf8_general_ci	utf8	System
performance_schema	utf8_general_ci	utf8	System
sys	utf8_general_ci	utf8	User
wordpressdb	utf8_general_ci	utf8	User

## Step - 9 :

Now I will be creating a pod named mywordpress using wordpress image available [hub.docker.io](https://hub.docker.io) from CLI .

```

C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get pods
No resources found in default namespace.

C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe create deployment mywordpress --image=wordpress
deployment.apps/mywordpress created

C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get pods
NAME                                READY   STATUS             RESTARTS   AGE
mywordpress-5b9cddd4f8-2jqjd        0/1     ContainerCreating   0           8s

C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get pods -o wode
error: unable to match a printer suitable for the output format "wode", allowed formats are: custom-columns,custom-columns-file,go-template,go-template-file,json,jsonpath,jsonpath-as-json,jsonpath-file,name,template,templatefile,wide,yaml

C:\Users\KIIT>kubectl.exe get pods -o wide
NAME                                READY   STATUS             RESTARTS   AGE   IP           NODE                                NOMINATED NODE
mywordpress-5b9cddd4f8-2jqjd        1/1     Running            0           29s   10.40.1.5    gke-wp-cluster-default-pool-d8b8efae-b17g   <none>

C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get pods
NAME                                READY   STATUS             RESTARTS   AGE
mywordpress-5b9cddd4f8-2jqjd        1/1     Running            0           83s

C:\Users\KIIT>

```

## Step - 10 :

I am scaling up the number of pods to 5 it means now I have 5 servers running in Singapore region .

```

C:\Users\KIIT>
C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe scale deployment mywordpress --replicas=5
deployment.extensions/mywordpress scaled

C:\Users\KIIT>
C:\Users\KIIT>kubectl.exe get pods
NAME                                READY   STATUS             RESTARTS   AGE
mywordpress-5b9cddd4f8-2jqjd        1/1     Running            0           3m31s
mywordpress-5b9cddd4f8-7f8mf        0/1     ContainerCreating   0           9s
mywordpress-5b9cddd4f8-j2wlb        1/1     Running            0           9s
mywordpress-5b9cddd4f8-qjvj5        0/1     ContainerCreating   0           9s
mywordpress-5b9cddd4f8-wctwj        0/1     ContainerCreating   0           9s

C:\Users\KIIT>kubectl.exe get pods -o wide
NAME                                READY   STATUS             RESTARTS   AGE   IP           NODE                                N
mywordpress-5b9cddd4f8-2jqjd        1/1     Running            0           3m45s   10.40.1.5    gke-wp-cluster-default-pool-d8b8efae-b17g   <
mywordpress-5b9cddd4f8-7f8mf        0/1     ContainerCreating   0           23s     <none>       gke-wp-cluster-default-pool-4834000c-7v25   <
mywordpress-5b9cddd4f8-j2wlb        1/1     Running            0           23s     10.40.1.6    gke-wp-cluster-default-pool-d8b8efae-b17g   <
mywordpress-5b9cddd4f8-qjvj5        0/1     ContainerCreating   0           23s     <none>       gke-wp-cluster-default-pool-001e6a47-d9dv   <
mywordpress-5b9cddd4f8-wctwj        0/1     ContainerCreating   0           23s     <none>       gke-wp-cluster-default-pool-4834000c-7v25   <

C:\Users\KIIT>

```

## Step - 11 :

Now a LoadBalancer will be configured for them . After that port number 80 will be exposed so that anyone can access the site.

```

C:\Users\KIIT>
C:\Users\KIIT>
C:\Users\KIIT>kubectl get deploy
NAME          READY  UP-TO-DATE  AVAILABLE  AGE
mywordpress   5/5    5           5          5m15s

C:\Users\KIIT>
C:\Users\KIIT>kubectl expose deploy mywordpress --type=LoadBalancer --port=80
service/mywordpress exposed

C:\Users\KIIT>
C:\Users\KIIT>kubectl get services
NAME          TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)        AGE
kubernetes    ClusterIP     10.106.0.1    <none>         443/TCP        27m
mywordpress   LoadBalancer 10.106.12.109 <pending>      80:32415/TCP   16s

C:\Users\KIIT>
C:\Users\KIIT>kubectl get services
NAME          TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)        AGE
kubernetes    ClusterIP     10.106.0.1    <none>         443/TCP        29m
mywordpress   LoadBalancer 10.106.12.109 34.126.73.206 80:32415/TCP   99s

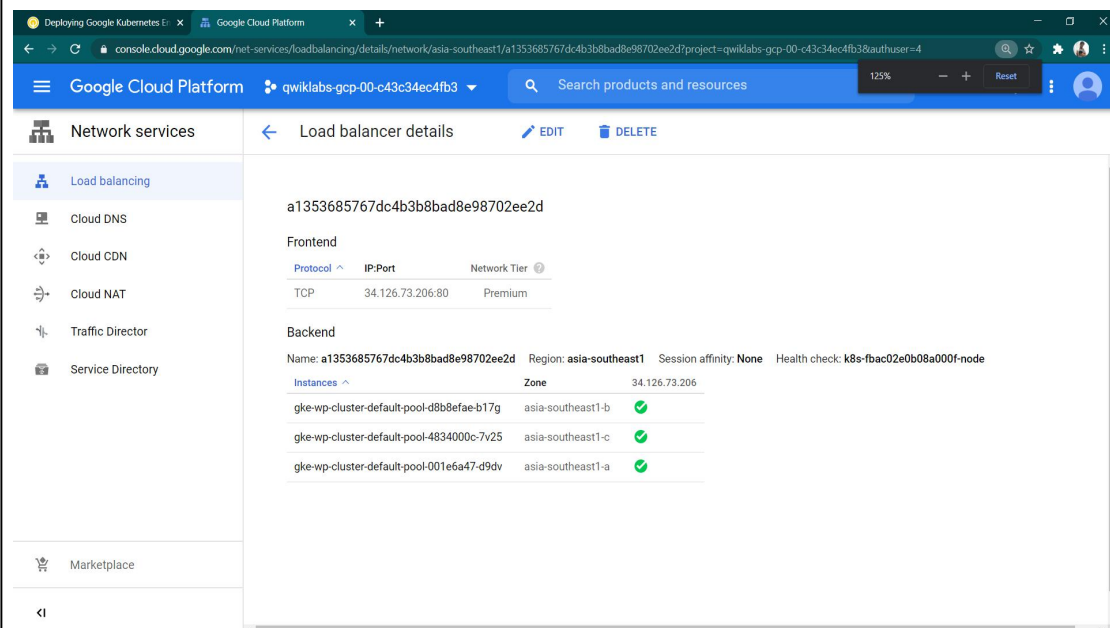
C:\Users\KIIT>ping 34.126.73.206

Pinging 34.126.73.206 with 32 bytes of data:
Reply from 34.126.73.206: bytes=32 time=380ms TTL=105
Reply from 34.126.73.206: bytes=32 time=590ms TTL=105
Reply from 34.126.73.206: bytes=32 time=194ms TTL=105

Ping statistics for 34.126.73.206:
    Packets: Sent = 3, Received = 3, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:

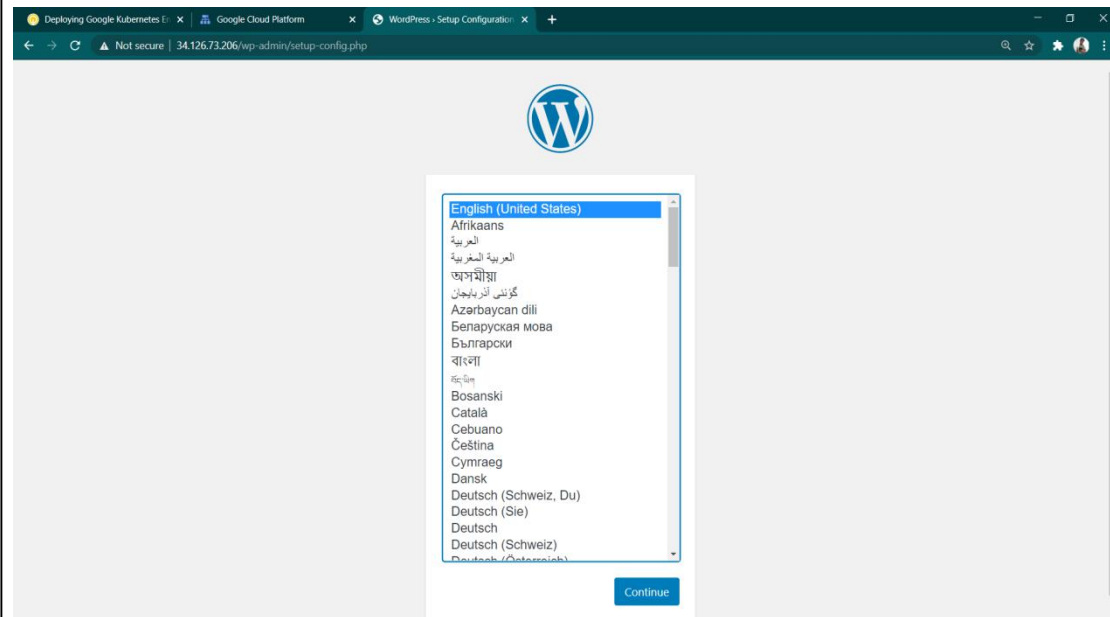
```

Details of LoadBalancer we can see from the console.



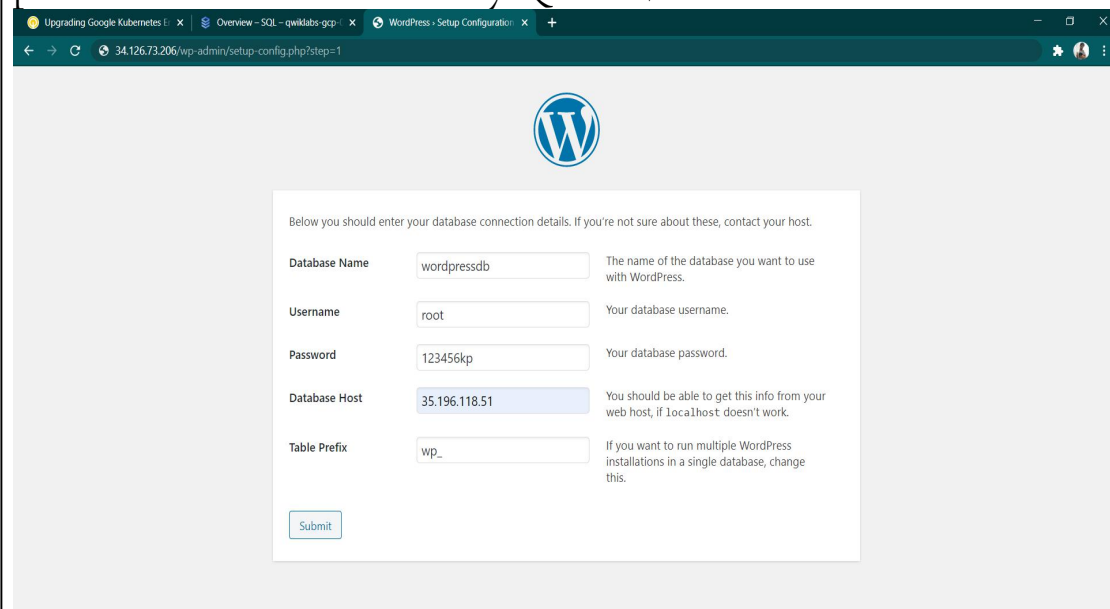
Step - 12 :

Now we can request our webpage on the external IP provided by LoadBalancer . We can see the first page of configuring WordPress has come up.



### Step - 13 :

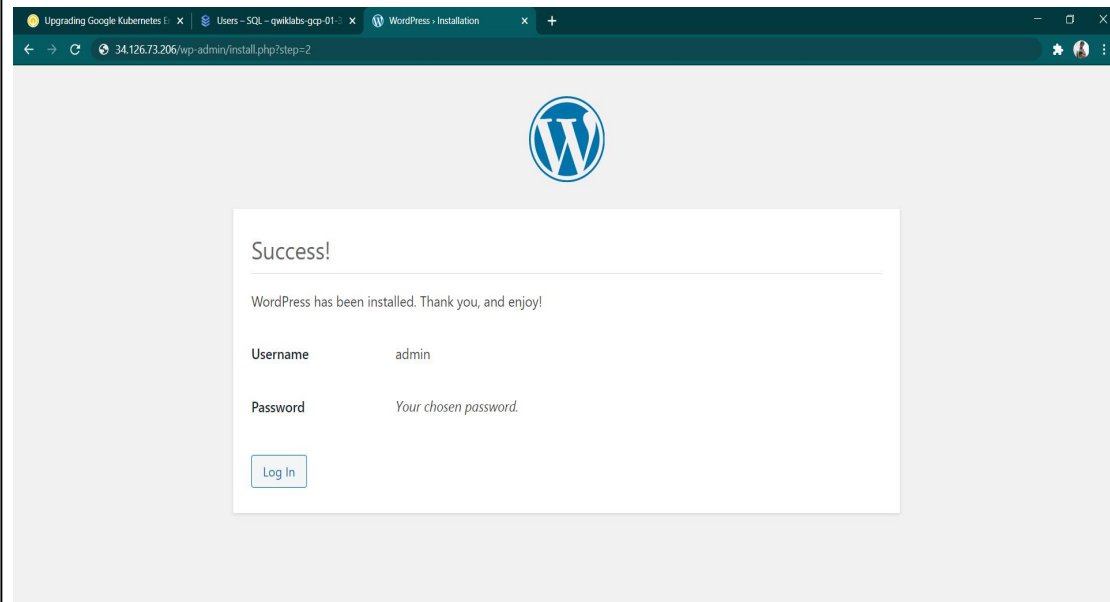
Then we have to provide some information such as database name , username , password and in place of database host name we have to provide the IP address of our MySQL database server.



### Step - 14 :

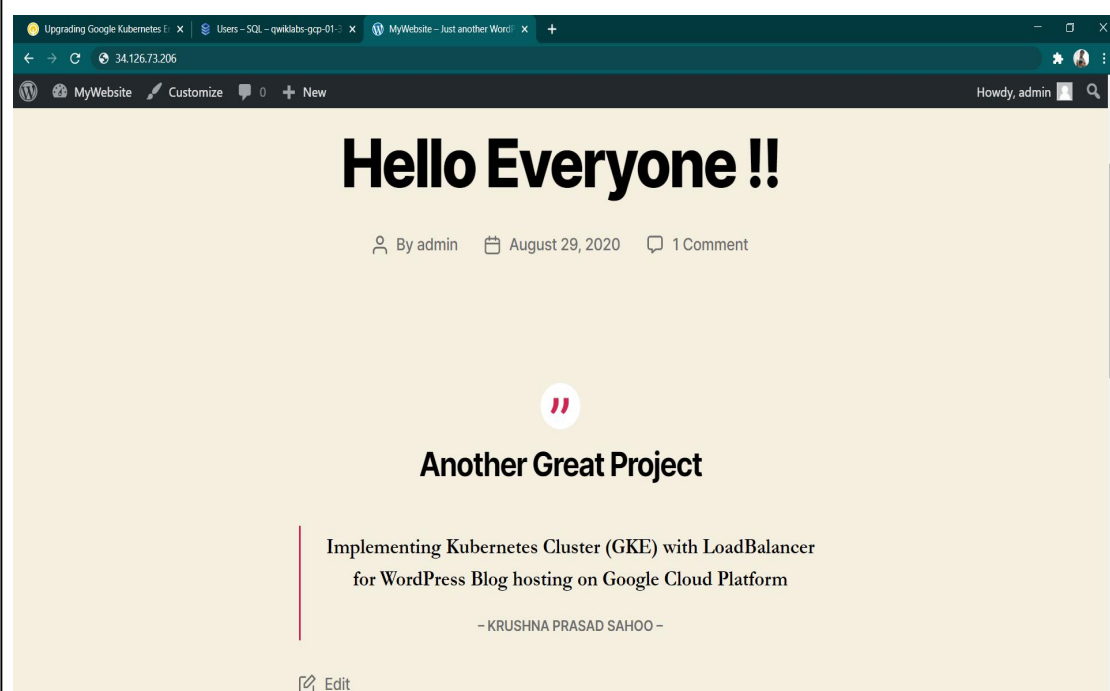
After going to the next page we can install WordPress latest version. Finally we have successfully done till that .





## ■ RESULTS & DISCUSSIONS

So finally after following these much steps we have our infrastructure ready . We can login to the WordPress dashboard and then create accordingly . I have created a simple blog post as following .



So this project really helped me to learn some more new concepts namely Google Cloud Platform and its implementation for various use cases .

## ■ **FUTURE SCOPE**

WordPress is a powerful CMS tool. I have implemented it using Kubernetes cluster on GCP in a small scale in this project. This idea can be implemented on a large scale for real industrial Web Application. More security policies and many more features can also be implemented for that . For this GCP provides a full fledged cloud solution.

## ■ **CONCLUSION**

Cloud Computing is one of the most demanding technology in today's world . And We can see the future of Cloud computing as a combination of cloud-based software products and on-premises compute which will help to create hybrid IT solutions.

At the end I would like to say that Technology is no longer just a tool we use to achieve something , the merging of machine capability and human consciousness is already happening. So a continually co-evolving well dynamic relationship should exist between Technology and Human Culture .Technological developments should be done for a good cause of our country & our world .

