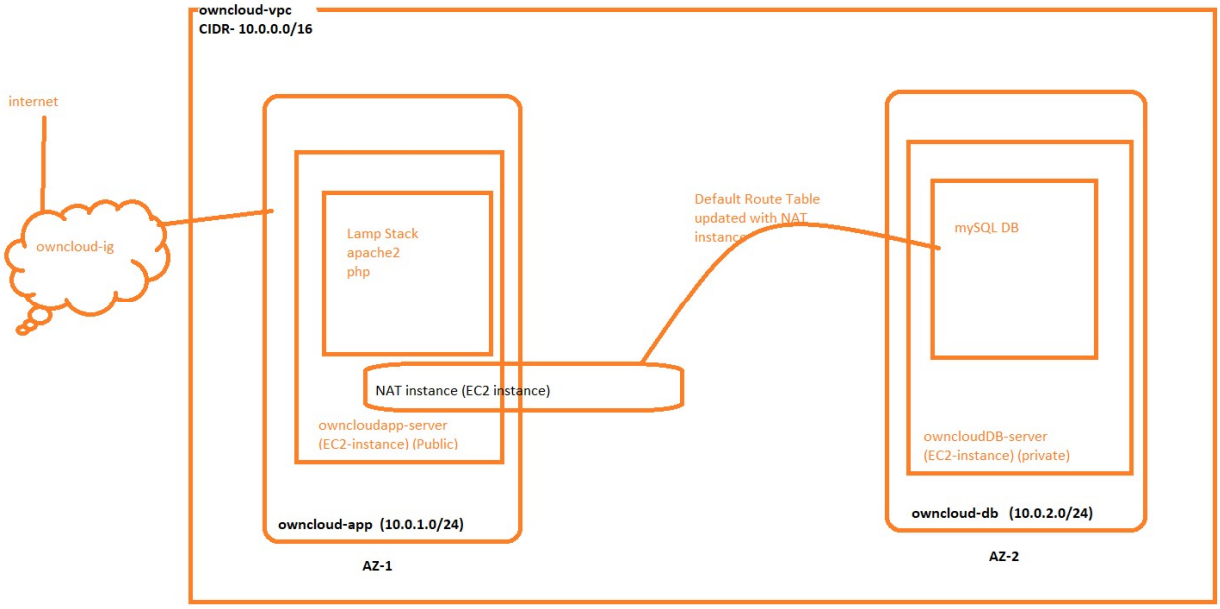
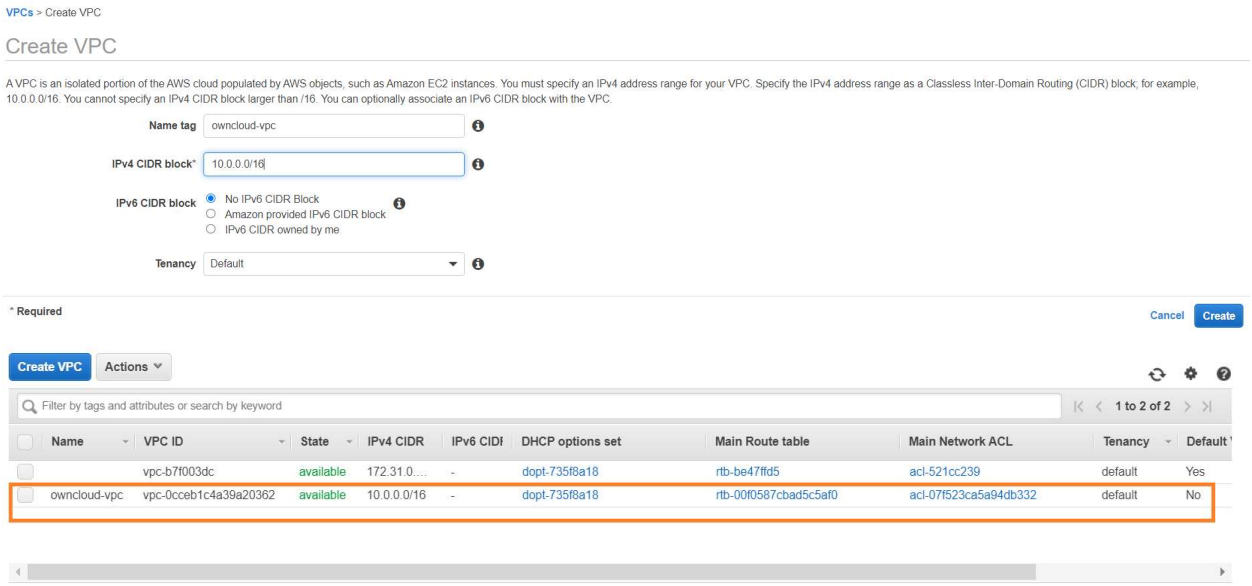
1. **Architecture**- Below is the architecture to create the scenario.



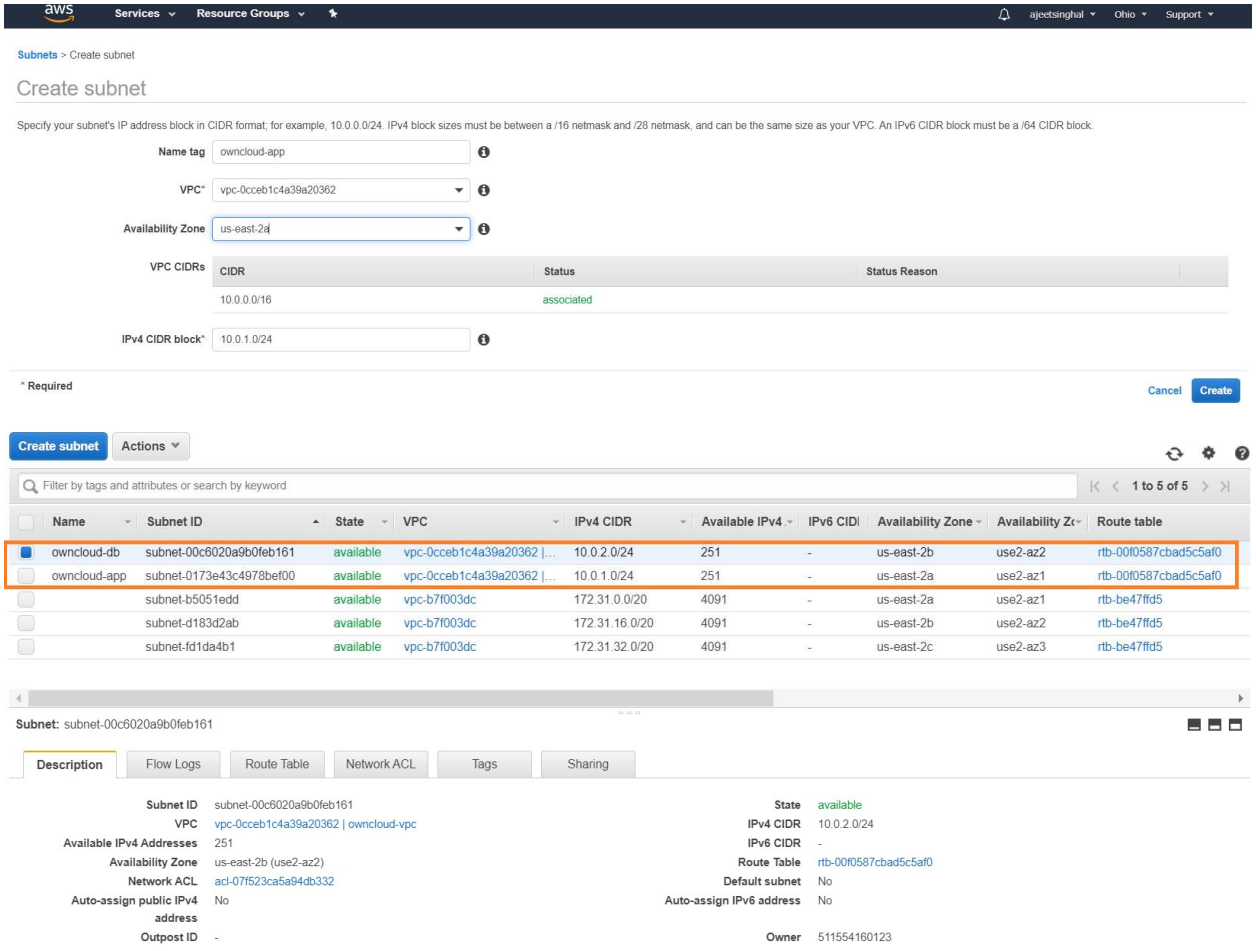
2. **Implementation Steps**: Below are the steps implementing it-

a- Create VPC and subnets

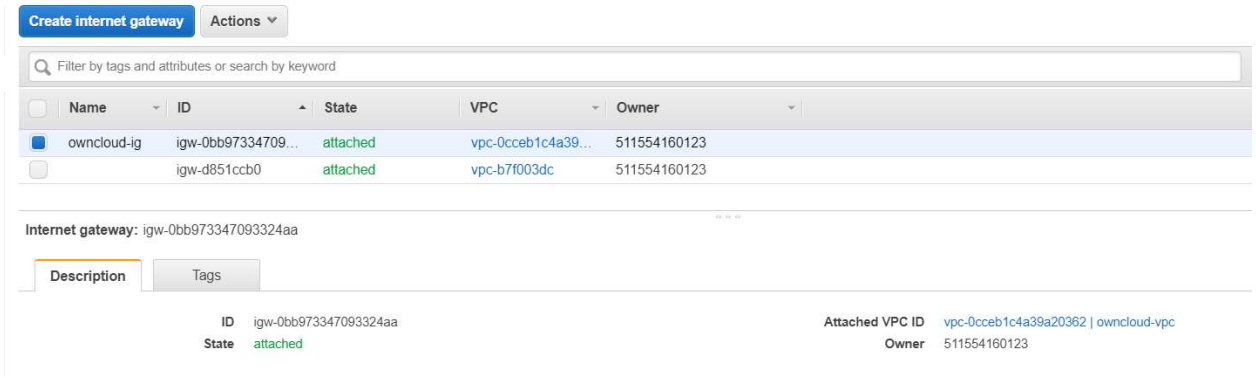
Creating owncloud-vpc with CIDR – 10.0.0.0/16



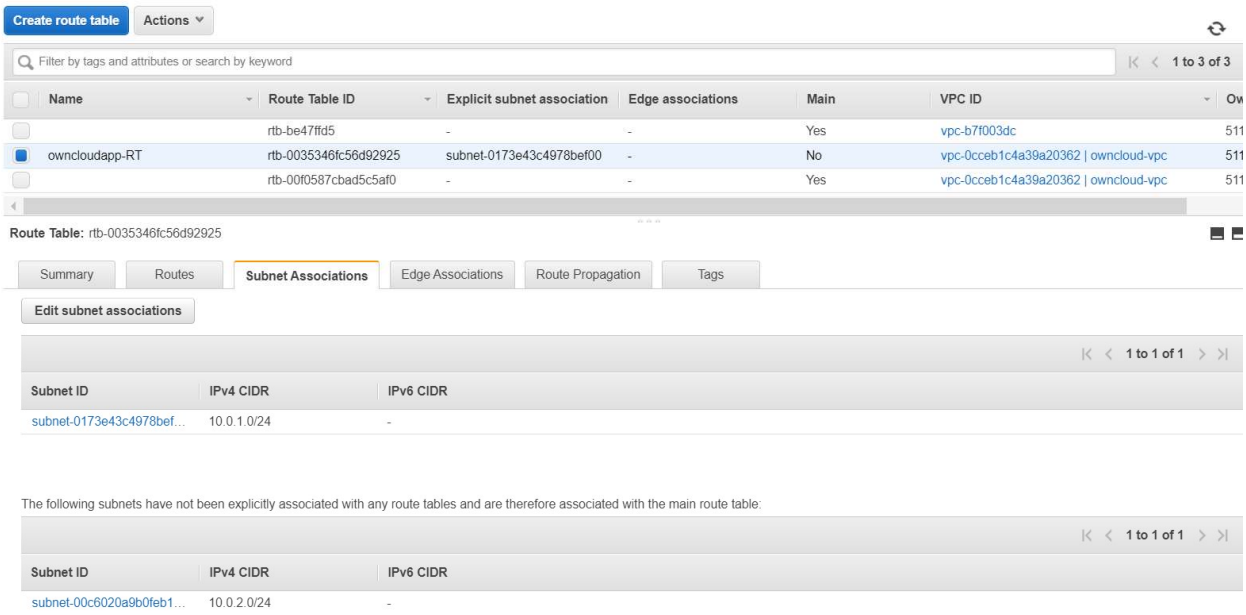
Creating two subnets- 1. owncloud-app CIDR: 10.0.1.0/24 and 2. Owncloud-db CIDR: 10.0.2.0/24



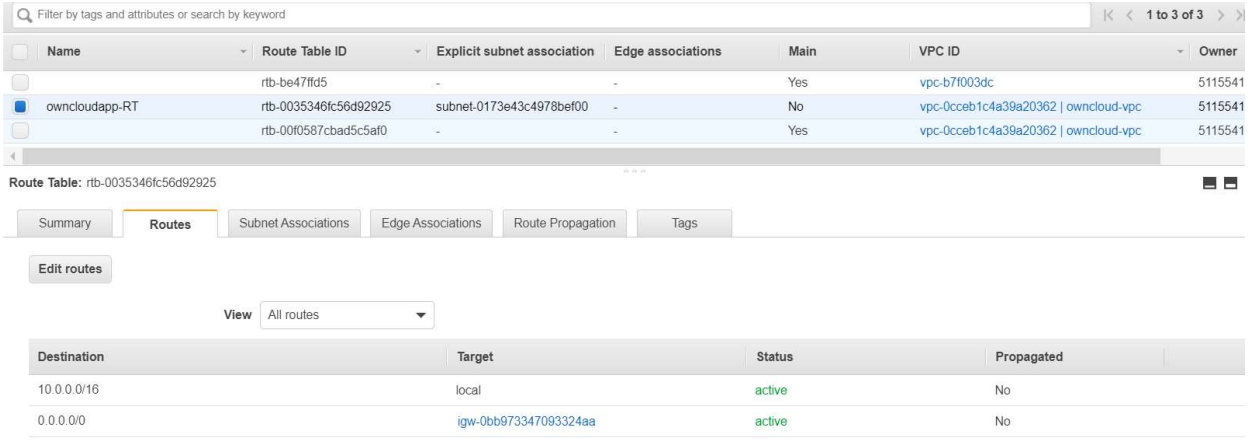
b- Creating IGW and update route table



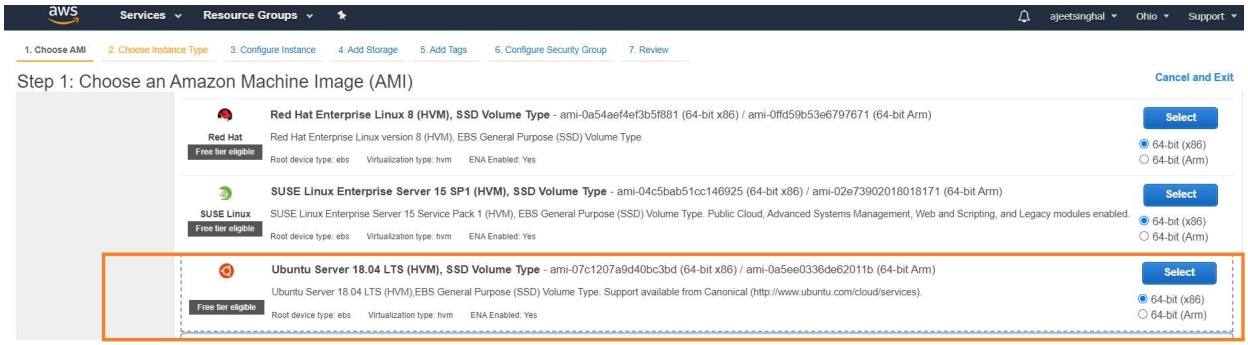
Creating route table for owncloud-app subnet



Updating route table with owncloud-ig for internet access



c- Creating EC2 instance – owncloudapp-server with ubuntu AMI having security group open for ssh, http and https and also associate it owncloud-app subnet



Step 2: Choose an Instance Type

Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are virtual servers that can run applications. They have varying combinations of CPU, memory, storage, and networking capacity, and give you the flexibility to choose the appropriate mix of resources for your applications. Learn more about instance types and how they can meet your computing needs.

Filter by: All instance types | Current generation | Show/Hide Columns

Currently selected: t2.micro (Variable ECUs, 1 vCPUs, 2.5 GHz, Intel Xeon Family, 1 GiB memory, EBS only)

	Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IPv6 Support
☐	General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
☑	General purpose	t2.micro Free tier eligible	1	1	EBS only	-	Low to Moderate	Yes

1. Choose AMI | 2. Choose Instance Type | **3. Configure Instance** | 4. Add Storage | 5. Add Tags | 6. Configure Security Group | 7. Review

Step 3: Configure Instance Details

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of instances 1 Launch into Auto Scaling Group

Purchasing option ☐ Request Spot instances

Network vpc-0cceb1c4a39a20362 | owncloud-vpc Create new VPC

Subnet subnet-0173e43c4978bef00 | owncloud-app | us-ea Create new subnet
251 IP Addresses available

Auto-assign Public IP Use subnet setting (Enable)

Placement group ☐ Add instance to placement group

Capacity Reservation Open Create new Capacity Reservation

IAM role None Create new IAM role

Shutdown behavior Stop

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. Learn more about storage options in Amazon EC2.

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encryption
Root	/dev/sda1	snap-0d2a2e7855e80a405	8	General Purpose SSD (gp2)	100 / 3000	N/A	☑	Not Encrypted

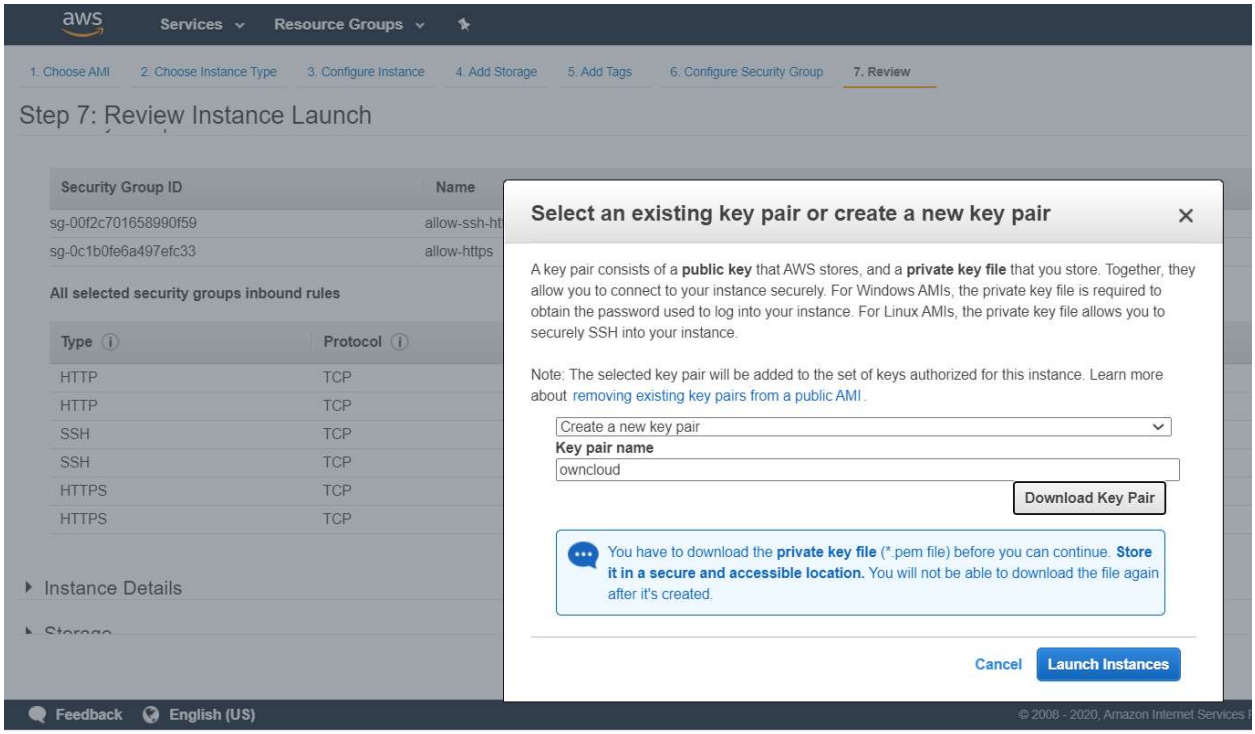
Add New Volume

Step 6: Configure Security Group

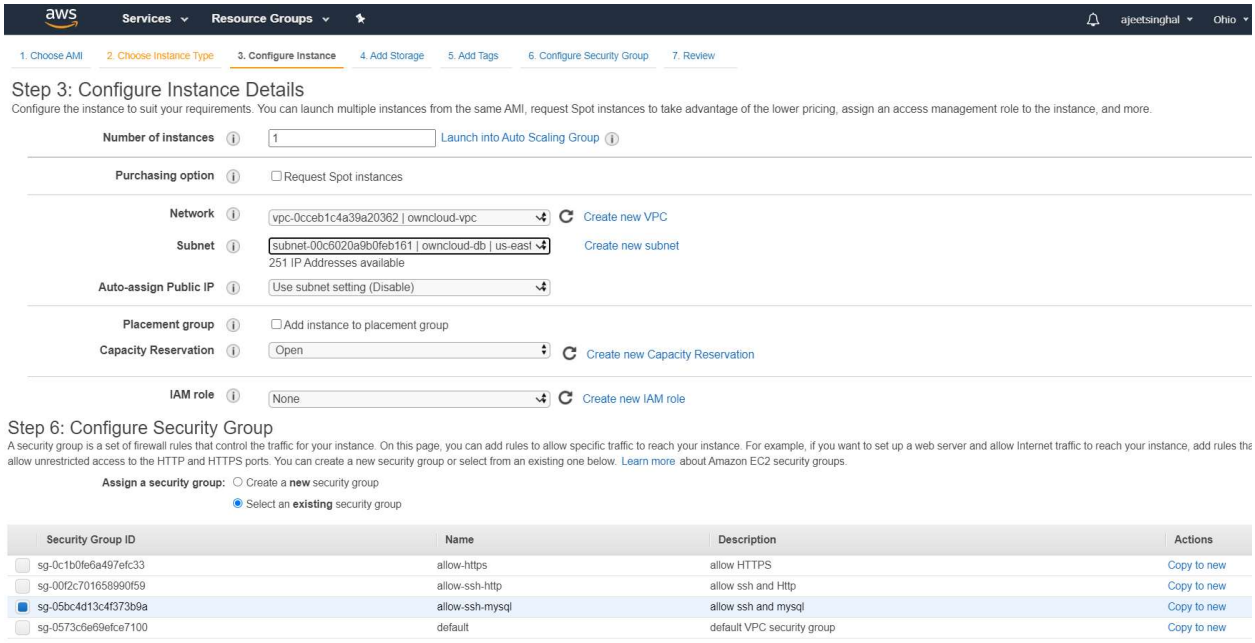
A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow Interr that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. Learn more about Amazon EC2 security groups.

Assign a security group: ○ Create a **new** security group
● Select an **existing** security group

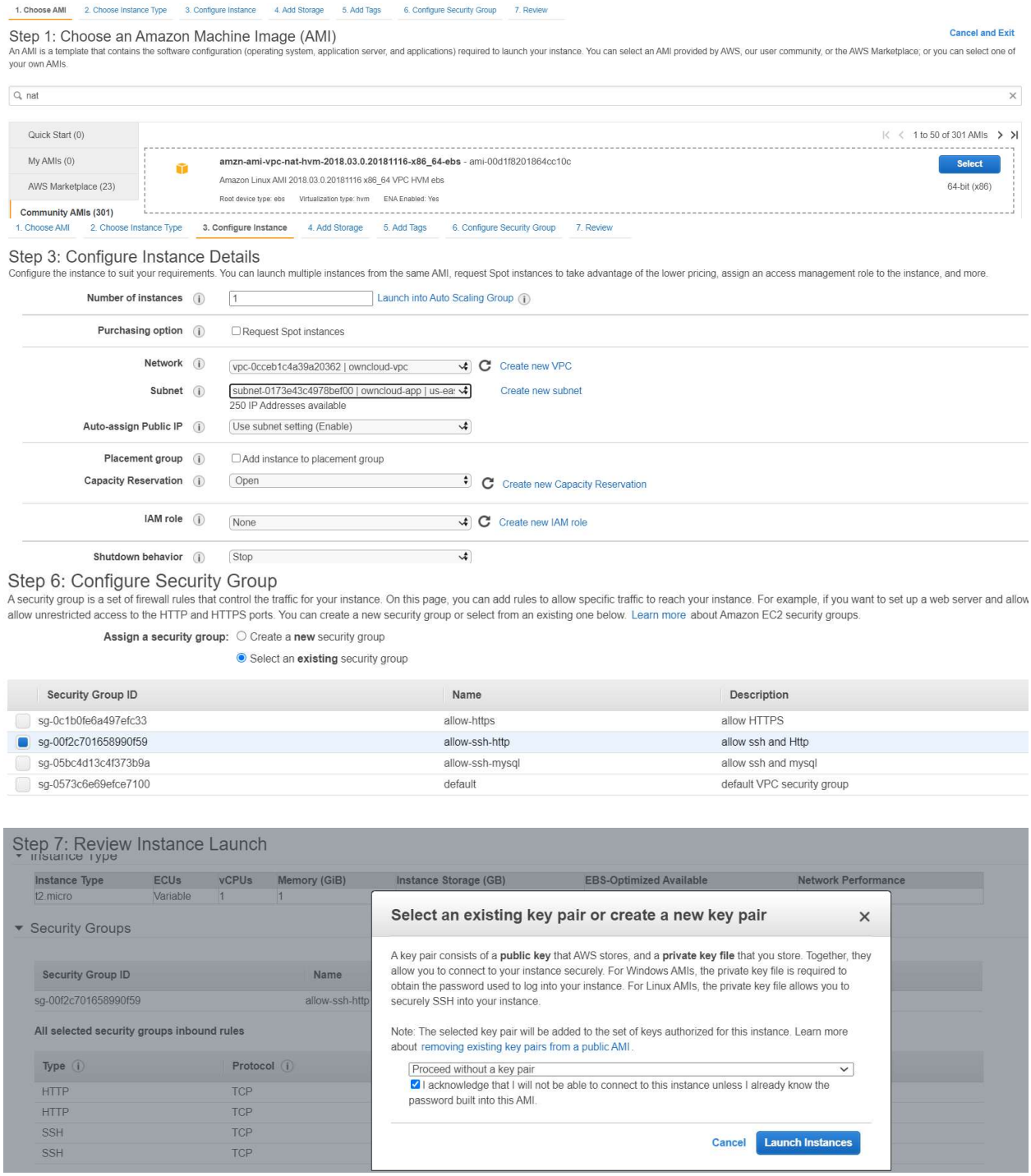
	Security Group ID	Name	Description
☑	sg-0c1b0fe6a497efc33	allow-https	allow HTTPS
☑	sg-00f2c701658990f59	allow-ssh-http	allow ssh and Http
☐	sg-05bc4d13c4f373b9a	allow-ssh-mysql	allow ssh and mysql
☐	sg-0573c6e69efce7100	default	default VPC security group



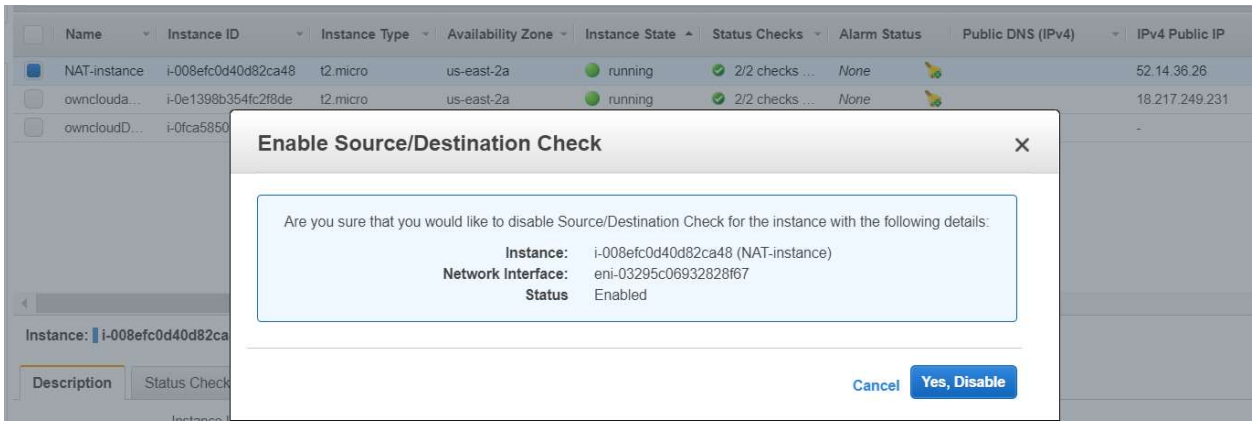
d- Creating owncloudDB-server EC2 instance-



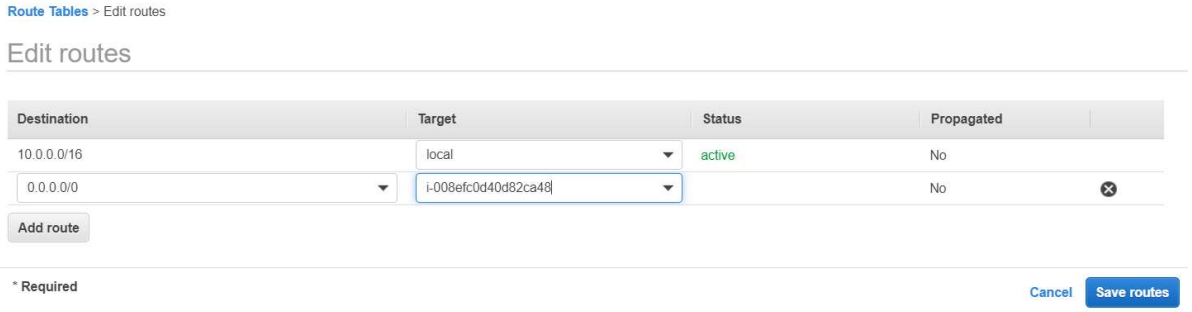
e- Creating NAT-instance (EC2 instance)

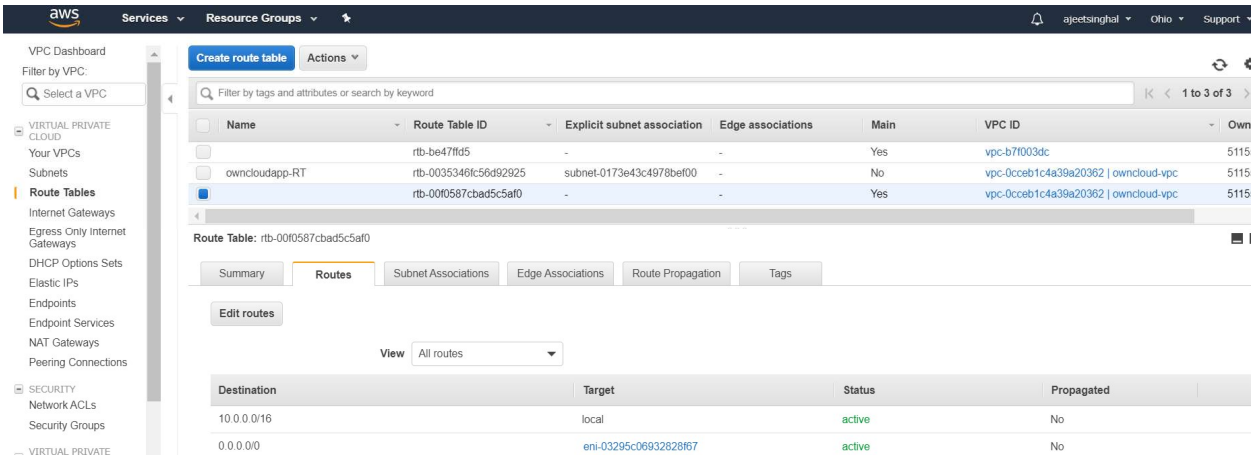


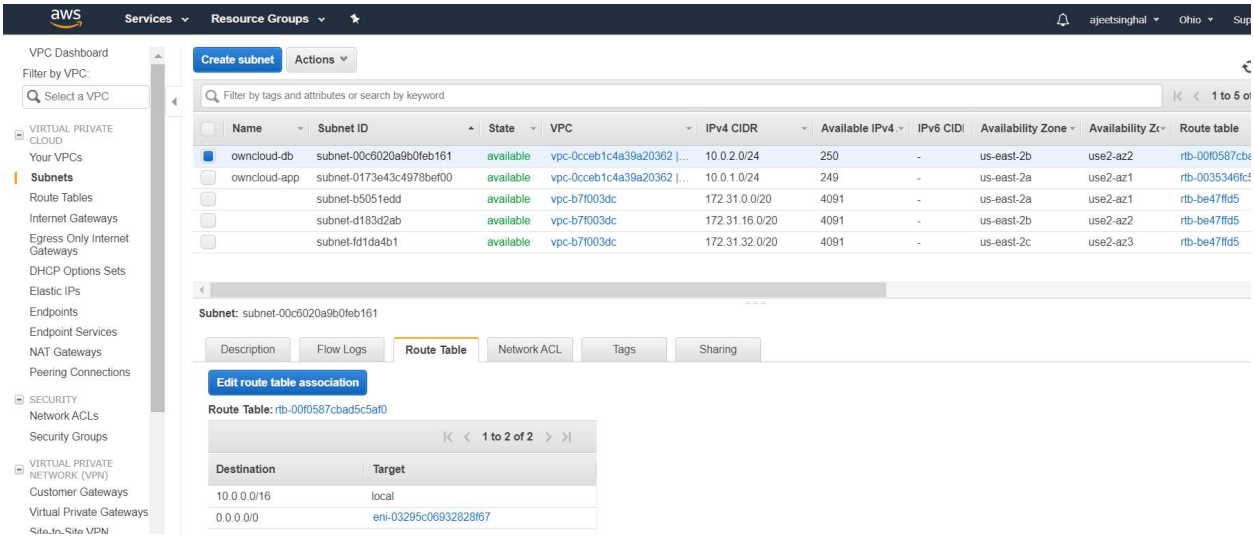
Disabling source/destination check for NAT-instance



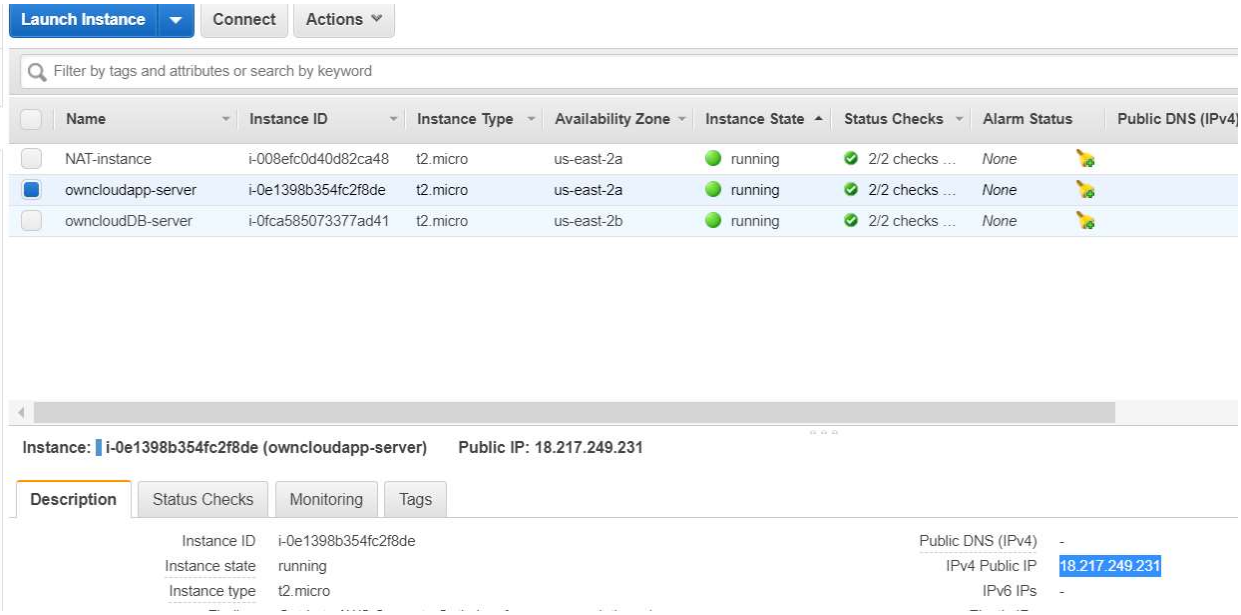
f- Attaching NAT instance to default route table







g- Accessing Private instance (owncloudDB-server) via public instance (owncloudapp-server)

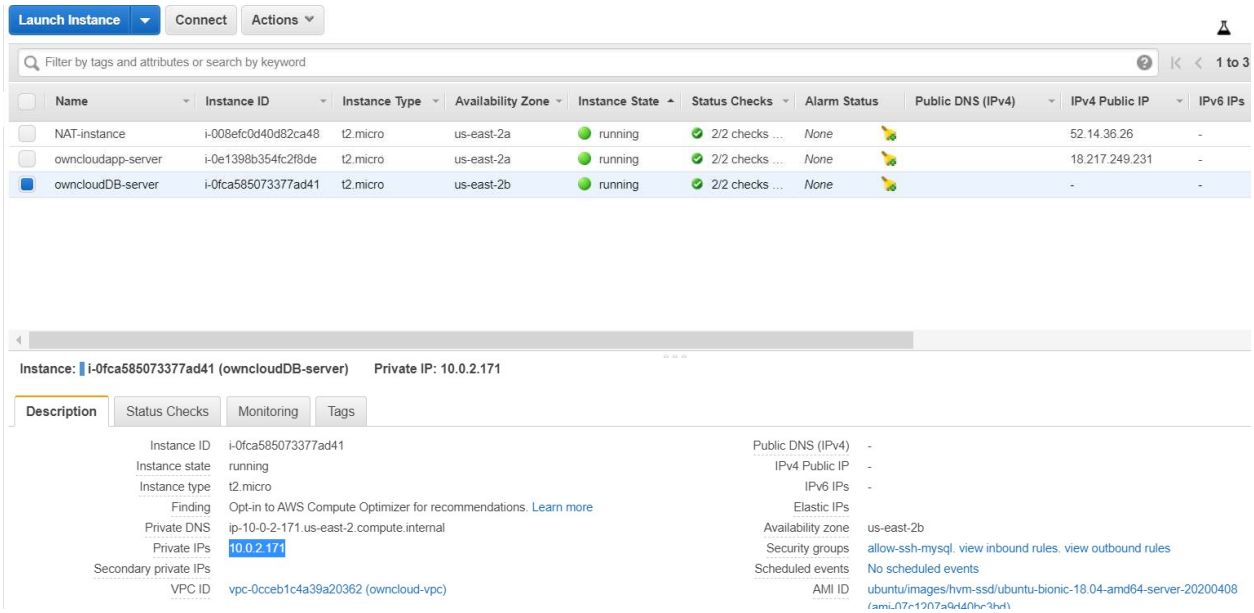


```
29/04/2020  12:36.38  /home/mobaxterm/MyDocuments  chmod 400 owncloud.pem

29/04/2020  12:36.54  /home/mobaxterm/MyDocuments  ssh -i owncloud.pem ubuntu@18.217.249.231
Warning: Permanently added '18.217.249.231' (RSA) to the list of known hosts.
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 4.15.0-1065-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Wed Apr 29 07:07:38 UTC 2020

  System load:  0.0               Processes:           86
  Usage of /:   13.7% of 7.69GB   Users logged in:     0
  Memory usage: 15%               IP address for eth0: 10.0.1.139
  Swap usage:   0%

0 packages can be updated.
0 updates are security updates.



The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

/usr/bin/xauth:  file /home/ubuntu/.Xauthority does not exist
To run a command as administrator (user "root"), use "sudo <command>".
```



```
ubuntu@ip-10-0-1-139:~$ cd /opt/
ubuntu@ip-10-0-1-139:/opt$ ls -al
total 8
drwxr-xr-x  2 root root 4096 Apr  8 17:35 .
drwxr-xr-x 23 root root 4096 Apr 29 06:28 ..
ubuntu@ip-10-0-1-139:/opt$ sudo chown ubuntu:ubuntu -R /opt
ubuntu@ip-10-0-1-139:/opt$ ls -al
total 8
drwxr-xr-x  2 ubuntu ubuntu 4096 Apr  8 17:35 .
drwxr-xr-x 23 root   root   4096 Apr 29 06:28 ..
ubuntu@ip-10-0-1-139:/opt$ ls -lh
total 0
ubuntu@ip-10-0-1-139:/opt$ ls -alh
total 8.0K
drwxr-xr-x  2 ubuntu ubuntu 4.0K Apr  8 17:35 .
drwxr-xr-x 23 root   root   4.0K Apr 29 06:28 ..
ubuntu@ip-10-0-1-139:/opt$ exit
logout
Connection to 18.217.249.231 closed.

29/04/2020  12:40.31  /home/mobaxterm/MyDocuments
```

```
29/04/2020 12:40.31 /home/mobaxterm/MyDocuments scp -i owncloud.pem ./owncloud.pem ubuntu@18.217.249.231:/opt
owncloud.pem                                                                  100% 1696     1.6KB/s   00:01

29/04/2020 12:42.00 /home/mobaxterm/MyDocuments ssh -i owncloud.pem ubuntu@18.217.249.231
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 4.15.0-1065-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Wed Apr 29 07:12:21 UTC 2020

  System load:  0.0               Processes:           87
  Usage of /:   13.9% of 7.69GB   Users logged in:     0
  Memory usage: 15%               IP address for eth0: 10.0.1.139
  Swap usage:   0%


0 packages can be updated.
0 updates are security updates.


Last login: Wed Apr 29 07:07:43 2020 from 196.207.102.129
ubuntu@ip-10-0-1-139:~$
```



```
ubuntu@ip-10-0-1-139:~$ cd /opt/
ubuntu@ip-10-0-1-139:/opt$ ls -al
total 12
drwxr-xr-x  2 ubuntu ubuntu 4096 Apr 29 07:11 .
drwxr-xr-x 23 root   root   4096 Apr 29 06:28 ..
-rw-------  1 ubuntu ubuntu 1696 Apr 29 07:11 owncloud.pem
ubuntu@ip-10-0-1-139:/opt$ ssh -i owncloud.pem ubuntu@10.0.2.171
The authenticity of host '10.0.2.171 (10.0.2.171)' can't be established.
ECDSA key fingerprint is SHA256:UrV4lfGv+MxugkSS+tFfYSmw5wSjlyn0kZNaAYq+MAE.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '10.0.2.171' (ECDSA) to the list of known hosts.
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 4.15.0-1065-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Wed Apr 29 07:13:58 UTC 2020

  System load:  0.0               Processes:           86
  Usage of /:   13.7% of 7.69GB   Users logged in:     0
  Memory usage: 15%               IP address for eth0: 10.0.2.171
  Swap usage:   0%

0 packages can be updated.
0 updates are security updates.



The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
```

#Below command executed in owncloudDB-server

sudo apt-get update

sudo apt install mysql-server -y

sudo mysql_secure_installation

sudo mysql

CREATE DATABASE Employee;

use Employee;

create table Info (EmpId INT, First_Name VARCHAR(20),Last_Name VARCHAR(20),Address VARCHAR(20),City VARCHAR(15), Department VARCHAR(10),Salary INT);

insert into Info values ("786" , "Ajeet" , "Parker" , "WestStreet" , "Las Vegas" , "Accounts" , 1000);

CREATE USER 'Harry'@'localhost' IDENTIFIED BY 'Test$123';

GRANT ALL PRIVILEGES ON * . * TO 'Harry'@'localhost';

FLUSH PRIVILEGES;

exit

sudo service mysql status

```
mysql> use Employee;
Database changed
mysql> create table Info (EmpId INT, First_Name VARCHAR(20),Last_Name VARCHAR(20),Address VARCHAR(20),City VARCHAR(15), Depart
ment VARCHAR(10),Salary INT);
Query OK, 0 rows affected (0.06 sec)

mysql> insert into Info values ( "786" , "Ajeet" , "Parker" , "WestStreet" , "Las Vegas" , "Accounts" , 1000 );
Query OK, 1 row affected (0.01 sec)

mysql> CREATE USER 'Harry'@'localhost' IDENTIFIED BY 'Test$123';
Query OK, 0 rows affected (0.00 sec)

mysql> GRANT ALL PRIVILEGES ON * . * TO 'Harry'@'localhost';
Query OK, 0 rows affected (0.00 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.00 sec)

mysql> exit
Bye
ubuntu@ip-10-0-2-171:~$ sudo service mysql status
● mysql.service - MySQL Community Server
   Loaded: loaded (/lib/systemd/system/mysql.service; enabled; vendor preset: enabled)
   Active: active (running) since Wed 2020-04-29 07:20:24 UTC; 3min 7s ago
 Main PID: 2590 (mysqld)
    Tasks: 29 (limit: 1152)
   CGroup: /system.slice/mysql.service
           └─2590 /usr/sbin/mysqld --daemonize --pid-file=/run/mysqld/mysqld.pid

Apr 29 07:20:24 ip-10-0-2-171 systemd[1]: Starting MySQL Community Server...
Apr 29 07:20:24 ip-10-0-2-171 systemd[1]: Started MySQL Community Server.
ubuntu@ip-10-0-2-171:~$
```

h- Configuration in public instance (owncloudapp-server)

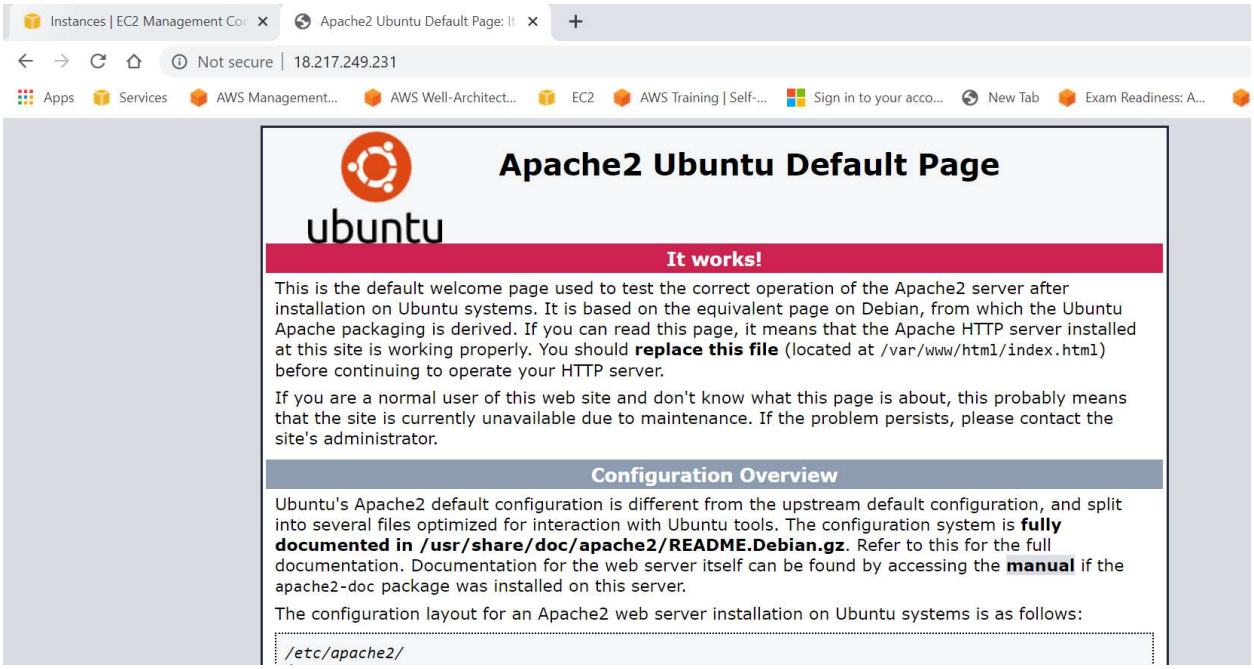
```
ubuntu@ip-10-0-2-171:~$ exit
logout
Connection to 10.0.2.171 closed.
ubuntu@ip-10-0-1-139:/opt$ sudo apt-get update
Hit:1 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:4 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic/universe amd64 Packages [8570 kB]
Get:5 http://security.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Get:6 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic/universe Translation-en [4941 kB]
Get:7 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic/multiverse amd64 Packages [151 kB]
Get:8 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic/multiverse Translation-en [108 kB]
Get:9 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [928 kB]
Get:10 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [318 kB]
Get:11 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/restricted amd64 Packages [46.6 kB]
Get:12 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/restricted Translation-en [11.5 kB]
Get:13 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 Packages [1068 kB]
Get:14 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/universe Translation-en [332 kB]
Get:15 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/multiverse amd64 Packages [11.0 kB]
Get:16 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates/multiverse Translation-en [4760 B]
Get:17 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-backports/main amd64 Packages [7516 B]
Get:18 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-backports/main Translation-en [4764 B]
Get:19 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-backports/universe amd64 Packages [7060 B]
Get:20 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-backports/universe Translation-en [4188 B]
Get:21 http://security.ubuntu.com/ubuntu bionic-security/main amd64 Packages [697 kB]
Get:22 http://security.ubuntu.com/ubuntu bionic-security/main Translation-en [222 kB]
Get:23 http://security.ubuntu.com/ubuntu bionic-security/restricted amd64 Packages [35.9 kB]
Get:24 http://security.ubuntu.com/ubuntu bionic-security/restricted Translation-en [9188 B]
Get:25 http://security.ubuntu.com/ubuntu bionic-security/universe amd64 Packages [657 kB]
Get:26 http://security.ubuntu.com/ubuntu bionic-security/universe Translation-en [218 kB]
Get:27 http://security.ubuntu.com/ubuntu bionic-security/multiverse amd64 Packages [7176 B]
Get:28 http://security.ubuntu.com/ubuntu bionic-security/multiverse Translation-en [2764 B]
Fetched 18.6 MB in 4s (4855 kB/s)
Reading package lists... Done
ubuntu@ip-10-0-1-139:/opt$
```

sudo apt-get update

sudo apt-get install apache2

sudo service apache2 start

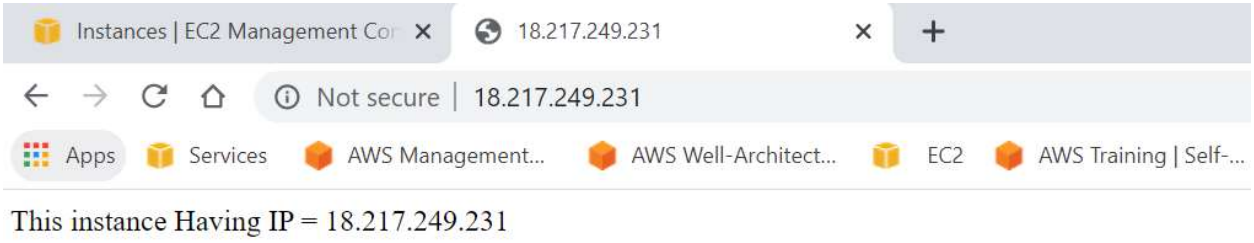
sudo service apache2 status



IP_ADDR=$(curl http://169.254.169.254/latest/meta-data/public-ipv4)

sudo chown ubuntu:ubuntu -R /var/www/html

sudo echo "This instance Having IP = $IP_ADDR" > /var/www/html/index.html



#install php server

sudo apt install php libapache2-mod-php php-mysql

#Make index.php as the default first load page

sudo nano /etc/apache2/mods-enabled/dir.conf

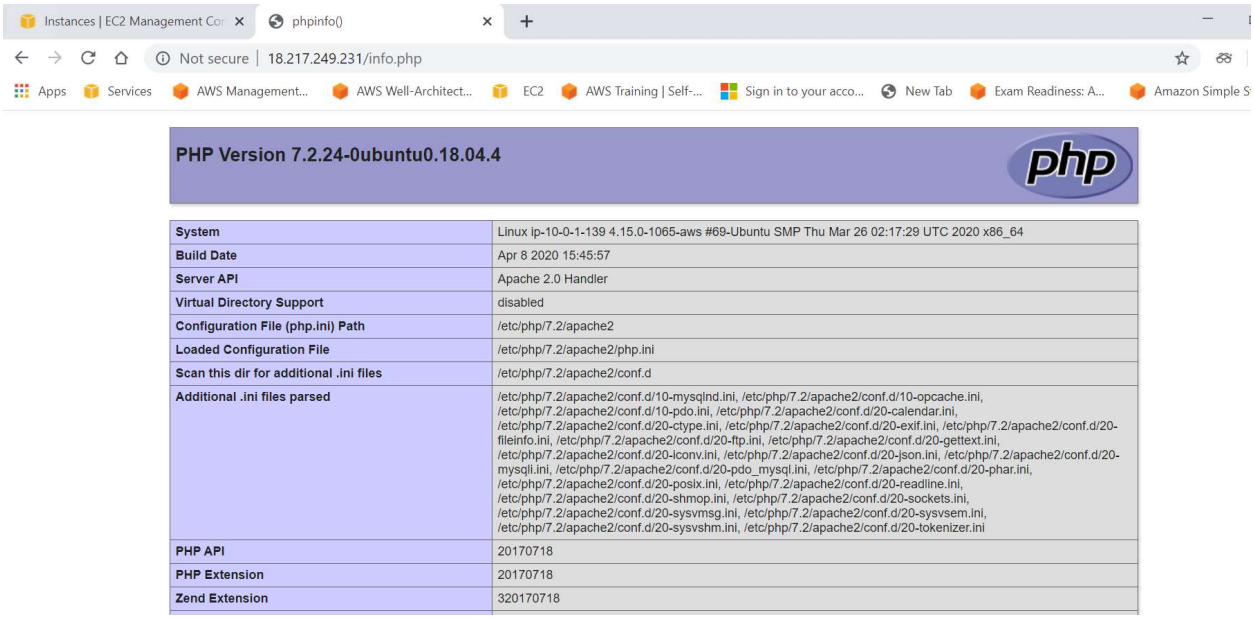
#Restart the web server

sudo systemctl restart apache2

sudo apt install php-cli

sudo nano /var/www/html/info.php

```
update-alternatives: using /usr/bin/phar7.2 to provide /usr/bin/phar (phar) in auto mode
update-alternatives: using /usr/bin/phar.phar7.2 to provide /usr/bin/phar.phar (phar.phar) in auto mode

Creating config file /etc/php/7.2/cli/php.ini with new version
Setting up libapache2-mod-php7.2 (7.2.24-0ubuntu0.18.04.4) ...

Creating config file /etc/php/7.2/apache2/php.ini with new version
Module mpm_event disabled.
Enabling module mpm_prefork.
apache2_switch_mpm Switch to prefork
apache2_invoke: Enable module php7.2
Setting up php-mysql (1:7.2+60ubuntu1) ...
Setting up libapache2-mod-php (1:7.2+60ubuntu1) ...
Setting up php7.2 (7.2.24-0ubuntu0.18.04.4) ...
Setting up php (1:7.2+60ubuntu1) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Processing triggers for libc-bin (2.27-3ubuntu1) ...
ubuntu@ip-10-0-1-139:/opt$ sudo nano /etc/apache2/mods-enabled/dir.conf
ubuntu@ip-10-0-1-139:/opt$ sudo systemctl restart apache2
ubuntu@ip-10-0-1-139:/opt$ sudo apt install php-cli
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  php-cli
0 upgraded, 1 newly installed, 0 to remove and 15 not upgraded.
Need to get 3160 B of archives.
After this operation, 12.3 kB of additional disk space will be used.
Get:1 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic/main amd64 php-cli all 1:7.2+60ubuntu1 [3160 B]
Fetched 3160 B in 0s (0 B/s)
Selecting previously unselected package php-cli.
(Reading database ... 57469 files and directories currently installed.)
Preparing to unpack .../php-cli_1%3a7.2+60ubuntu1_all.deb ...
Unpacking php-cli (1:7.2+60ubuntu1) ...
Setting up php-cli (1:7.2+60ubuntu1) ...
ubuntu@ip-10-0-1-139:/opt$ sudo nano /var/www/html/info.php
ubuntu@ip-10-0-1-139:/opt$
```



PHP Version 7.2.24-0ubuntu0.18.04.4

System	Linux ip-10-0-1-139 4.15.0-1065-aws #69-Ubuntu SMP Thu Mar 26 02:17:29 UTC 2020 x86_64
Build Date	Apr 8 2020 15:45:57
Server API	Apache 2.0 Handler
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/etc/php/7.2/apache2
Loaded Configuration File	/etc/php/7.2/apache2/php.ini
Scan this dir for additional .ini files	/etc/php/7.2/apache2/conf.d
Additional .ini files parsed	/etc/php/7.2/apache2/conf.d/10-mysqlnd.ini, /etc/php/7.2/apache2/conf.d/10-opcache.ini, /etc/php/7.2/apache2/conf.d/10-pdo.ini, /etc/php/7.2/apache2/conf.d/20-calendar.ini, /etc/php/7.2/apache2/conf.d/20-ctype.ini, /etc/php/7.2/apache2/conf.d/20-exif.ini, /etc/php/7.2/apache2/conf.d/20-fileinfo.ini, /etc/php/7.2/apache2/conf.d/20-ftp.ini, /etc/php/7.2/apache2/conf.d/20-gettext.ini, /etc/php/7.2/apache2/conf.d/20-iconv.ini, /etc/php/7.2/apache2/conf.d/20-json.ini, /etc/php/7.2/apache2/conf.d/20-mysqli.ini, /etc/php/7.2/apache2/conf.d/20-pdo_mysql.ini, /etc/php/7.2/apache2/conf.d/20-phar.ini, /etc/php/7.2/apache2/conf.d/20-posix.ini, /etc/php/7.2/apache2/conf.d/20-readline.ini, /etc/php/7.2/apache2/conf.d/20-shmop.ini, /etc/php/7.2/apache2/conf.d/20-sockets.ini, /etc/php/7.2/apache2/conf.d/20-sysvmsg.ini, /etc/php/7.2/apache2/conf.d/20-sysvsem.ini, /etc/php/7.2/apache2/conf.d/20-sysvshm.ini, /etc/php/7.2/apache2/conf.d/20-tokenizer.ini
PHP API	20170718
PHP Extension	20170718
Zend Extension	320170718

curl https://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04/Release.key | sudo apt-key add -

echo 'deb http://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04/ /' | sudo tee /etc/apt/sources.list.d/owncloud.list

sudo apt update

```
ubuntu@ip-10-0-1-139:/opt$ curl https://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04/Release.key | sudo apt-key add -
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  4485  100  4485    0     0   6462      0 --:--:-- --:--:-- --:--:--  6453
OK
ubuntu@ip-10-0-1-139:/opt$ echo 'deb http://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04/ /' | sudo tee /etc/apt/sources.li
st.d/owncloud.list
deb http://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04/ /
ubuntu@ip-10-0-1-139:/opt$ sudo apt update
Hit:1 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://us-east-2.ec2.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Hit:4 http://security.ubuntu.com/ubuntu bionic-security InRelease
Ign:5 https://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04  InRelease
Get:6 https://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04  Release [984 B]
Get:7 https://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04  Release.gpg [481 B]
Get:8 https://attic.owncloud.org/download/repositories/10.0/Ubuntu_18.04  Packages [738 B]
Fetched 165 kB in 2s (68.6 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
15 packages can be upgraded. Run 'apt list --upgradable' to see them.
ubuntu@ip-10-0-1-139:/opt$
```

sudo apt install php-bz2 php-curl php-gd php-imagick php-intl php-mbstring php-xml php-zip owncloud-files

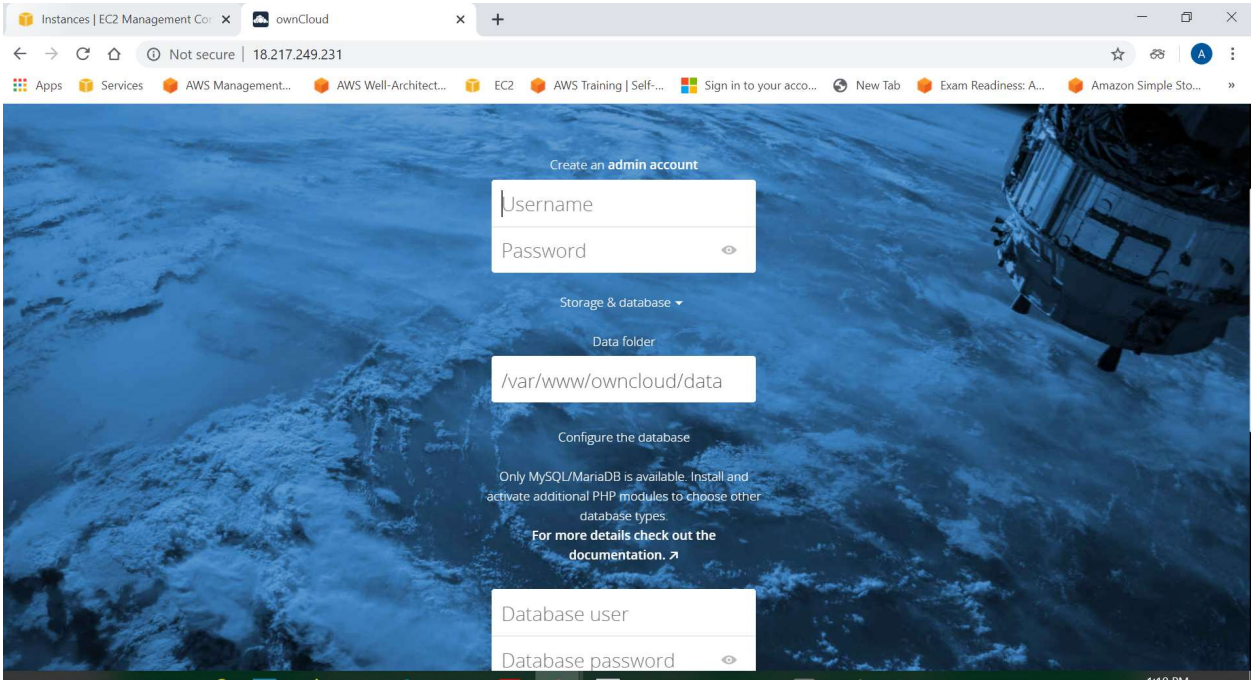
#Change default site directory to owncloud files directory using sudo user

sudo nano /etc/apache2/sites-enabled/000-default.conf

update directory root path to /var/www/owncloud

#restart the server

sudo systemctl reload apache2



3. Lessons & Observations -- In this project we successfully done the owncloud deployment and learn about NAT instance usage and LAMP stack.