APACHE KAFKA Cluster and Zookeeper Setup/Administration in AWS

DOCUMENT HISTORY

VERSION	DATE	AUTHOR	CHANGES
1.0	07/07/2018	Abhishek Dhar	First Draft of Document

Acronyms

ACRONYMS	DEFINITION
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
AWS	Amazon Web Service
EC2	Amazon Elastic Cloud
API	Application Programming Interface
ACL	Access Control List

TABLE OF CONTENTS

1 Objective

1.1 Objective

This document is not intended to illustrate or talk about KAFKA since there are plenty of online resources available that discusses KAFKA. This document however aims to illustrate how to do a KAFKA Cluster setup in Amazon AWS and then leverage the infrastructure to create scalable applications.

Intention

1. One Cluster Setup in production in AWS
2. Zookeeper
   a. Setup, usage and maintenance
3. KAFKA Setup
   a. Setup, configuration, maintenance, settings and optimization, recovery
4. Tools setup
   a. ZooNavigator
   b. KAFKA Manager (Administrative tasks)
   c. Confluence schema registry
   d. Landoop KAFKA Topics UI

1.2 What is KAFKA

Kafka® (http://kafka.apache.org/) is used for building real-time data pipelines and streaming apps. It is horizontally scalable, fault-tolerant, wicked fast, and runs in production in thousands of companies.

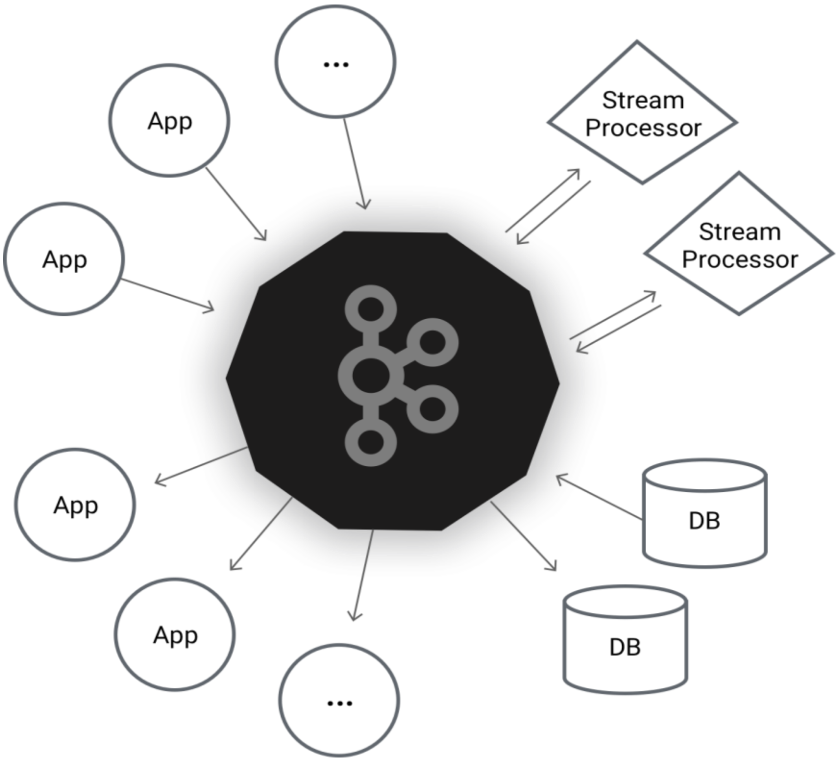


Figure 1. KAFKA (http://kafka.apache.org/)

Kafka is generally used for two broad classes of applications:

- Building real-time streaming data pipelines that reliably get data between systems or applications

- Building real-time streaming applications that transform or react to the streams of data

To understand how Kafka does these things, let's dive in and explore Kafka's capabilities from the bottom up.

First a few concepts:

- Kafka is run as a cluster on one or more servers that can span multiple datacenters.
- The Kafka cluster stores streams of records in categories called topics.
- Each record consists of a key, a value, and a timestamp.

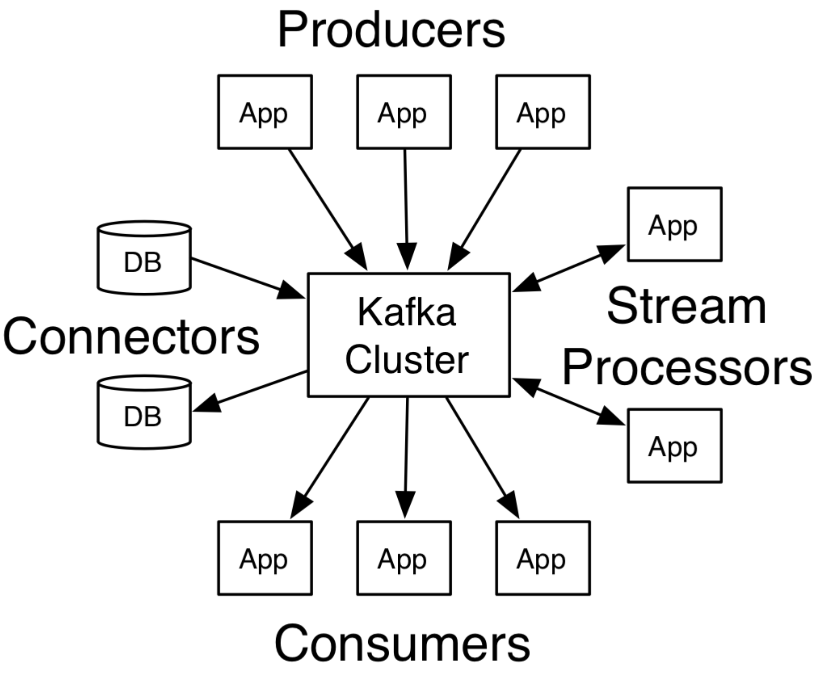


Figure 2. KAFKA Aspects (http://kafka.apache.org/)

Kafka has four core APIs:

- The Producer API allows an application to publish a stream of records to one or more Kafka topics.
- The Consumer API allows an application to subscribe to one or more topics and process the stream of records produced to them.
- The Streams API allows an application to act as a stream processor, consuming an input stream from one or more topics and producing an output stream to one or more output topics, effectively transforming the input streams to output streams.
- The Connector API allows building and running reusable producers or consumers that connect Kafka topics to existing applications or data systems. For example, a connector to a relational database might capture every change to a table

In Kafka the communication between the clients and the servers is done with a simple, high-performance, language agnostic TCP protocol. This protocol is versioned and maintains backwards compatibility with older version. We provide a Java client for Kafka, but clients are available in many languages.

1.3 ZooKeeper Quorum Architecture

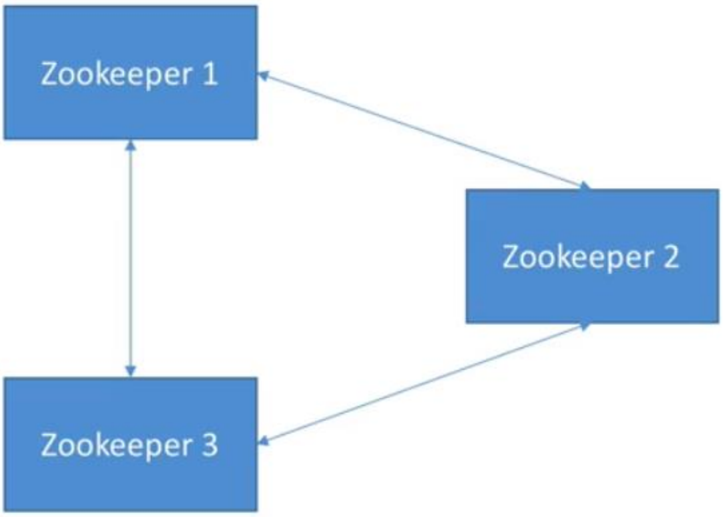


Figure 3. Zookeeper Quorum

Zookeeper is a distributed key value store and has voting mechanism.

1.4 KAFKA Cluster Architecture

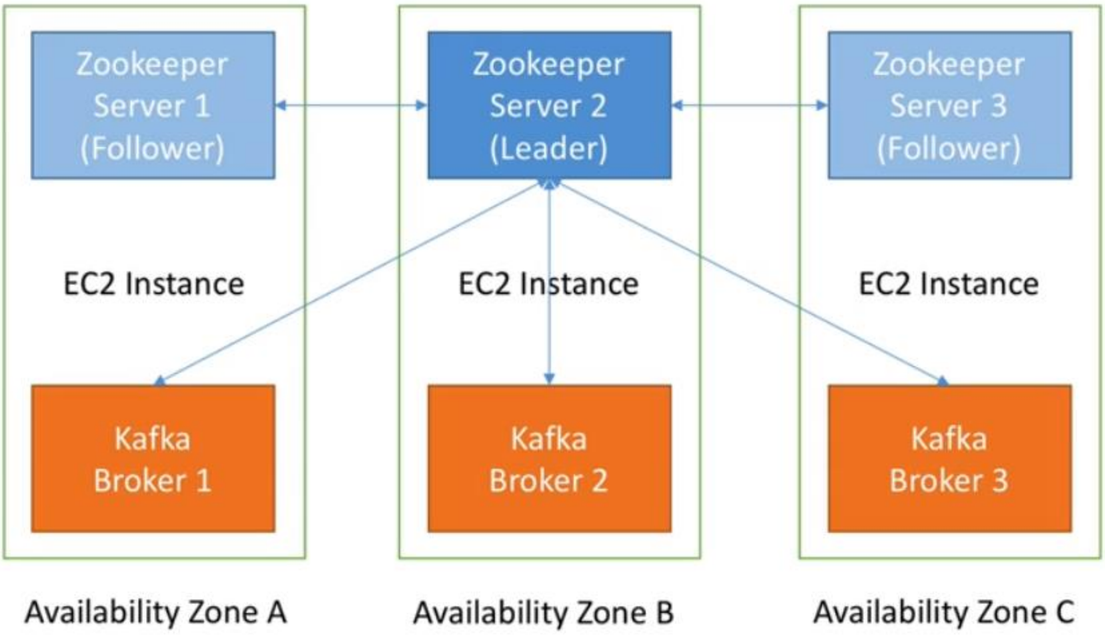


Figure 3. KAFKA and ZooKeeper co located

Resilient and Distributed Robust Architecture dictates that we have three EC2 servers in three availability zones (So if one goes down we still have two working) which are hosting ZooKeeper and KAFKA brokers. In ZooKeeper there is one leader and two followers, and all KAFKA brokers talk to ZooKeeper leader.

1.5 Consolidated Architecture

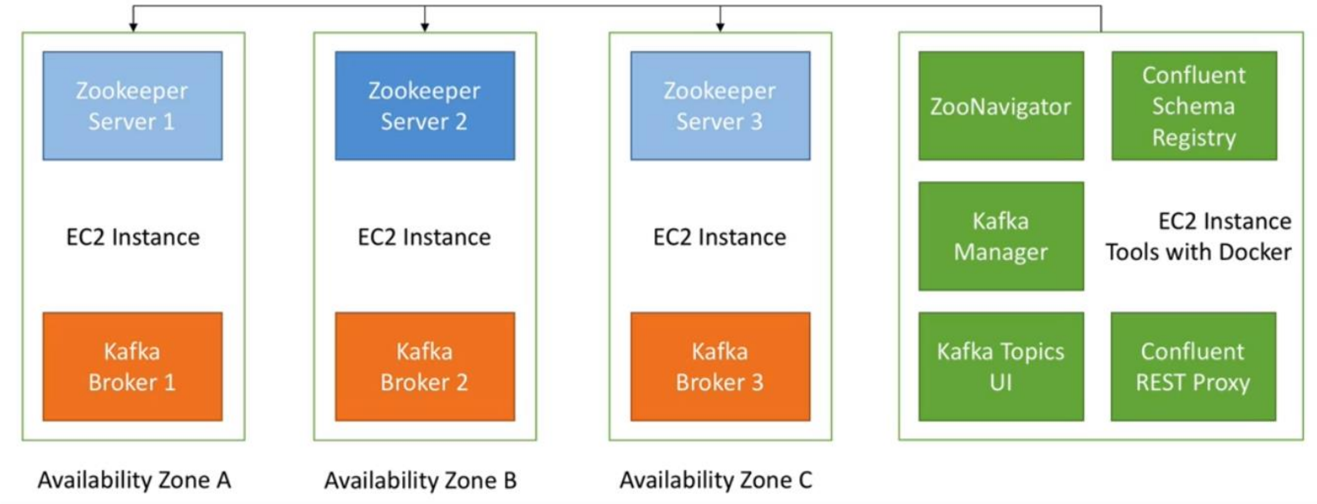


Figure 4. Consolidated Architecture

We shall have one more EC2 instance Tools with DOCKER which is going to host all Tools that we would need in order to control/manage and do administration of KAFKA Brokers and Zookeeper Servers.

NOTE:

- Zookeeper and KAFKA clusters must know their Hostname and/or IP and a reboot should not change the IP/Host-Name
  - We have to use Elastic Public IP accessible from outside
  - We can also use secondary ENI (constant private IP) and not accessible from outside and accessible from within network
  - If we use DNS then we don't have to keep track of IP but constraint of public/private DNS applies here

2 Zookeeper

2.1 What is Zookeeper

It is must for distributed application (it is almost like a filesystem). It has capability to do configuration management of distributed systems and it has ability to do self-election and consensus building (leader election). It also does coordination and Locks. For case of KAFKA, it stores the KEY VALUE pairs. This is major cornerstone for HADOOP as well and is quite stable. We are going to use 3.4.x (Stable Channel).

1. Zookeeper internal data structure is a Tree (nodes)
2. Each node is called zNode
3. Each node has a Path
4. Each node can be persistent (stay alive) or ephemeral (disconnects)
5. Each node can store data
6. Each zNode can be monitored for changes

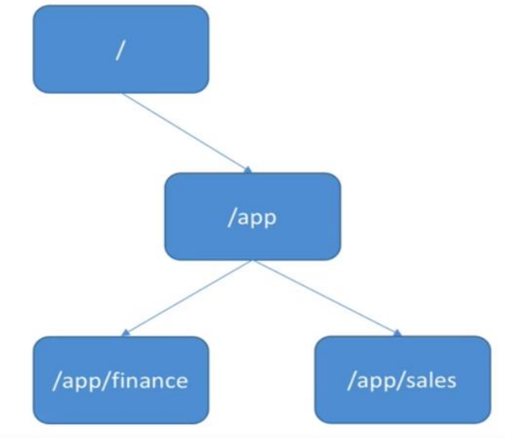


Figure 4. Zookeeper

2.2 What is Zookeeper's role in KAFKA

Zookeeper keeps track of KAFKA brokers via Heart-Beat mechanism (if a broker doesn't send heart-beat then ZooKeeper assumes that broker to be dead) and also broker registration.

Zookeeper also maintains list of Topics (Configurations, partitions, replication factors, additional configuration, list of SYNC replicas)

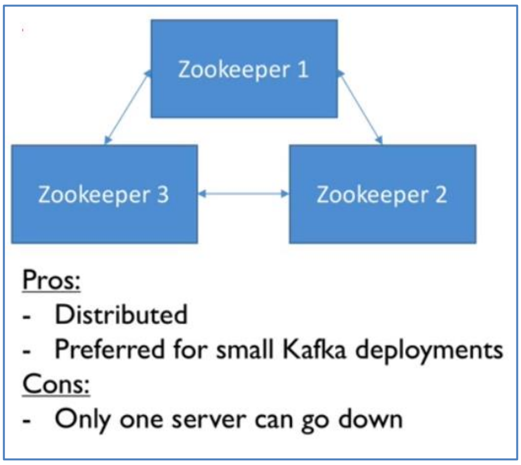
It also does Broker Leader election in case leader Broker (Controller) goes down.

It also stores the KAFKA cluster ID and if security is enabled then it also stores ACL (Access control list) for Topics/Consumer Groups and Users.

Note: Consumer Offsets are now stored in KAFKA and not maintained by Zookeeper anymore

2.3 Zookeeper quorum sizing

Since ZooKeeper needs to select a leader when one goes down and that voting has to be very strict and hence we cannot have even number of servers and we need to have odd number of servers (2N+1) and hence for 2N+1 servers, we can afford to lose N servers and still Zookeeper can function and elect leader. Having only one Zookeeper is neither resilient and nor distributed.

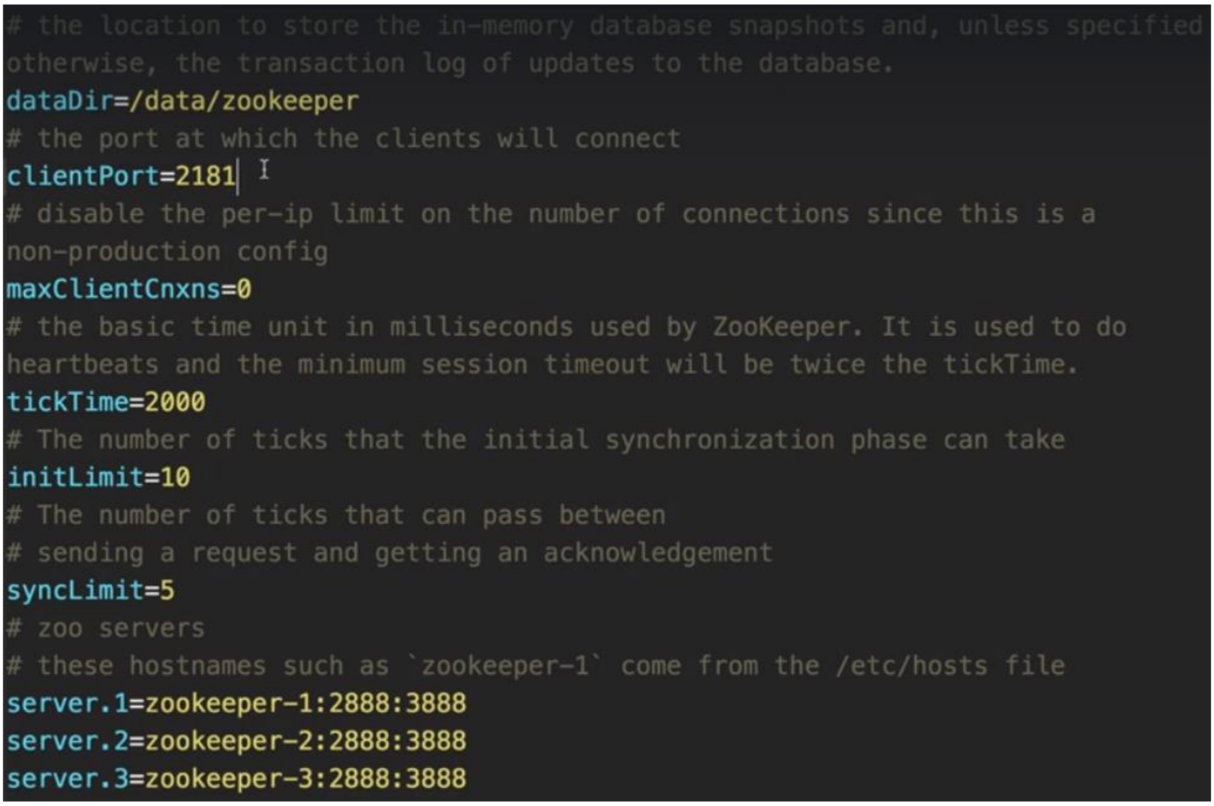


Pros:
- Distributed
- Preferred for small Kafka deployments

Cons:
- Only one server can go down

Figure 5. Zookeeper Quorum size of Three (Adopted)

2.4 Zookeeper Configuration



```
# the location to store the in-memory database snapshots and, unless specified
otherwise, the transaction log of updates to the database.
dataDir=/data/zookeeper
# the port at which the clients will connect
clientPort=2181
# disable the per-ip limit on the number of connections since this is a
non-production config
maxClientCnxns=0
# the basic time unit in milliseconds used by ZooKeeper. It is used to do
heartbeats and the minimum session timeout will be twice the tickTime.
tickTime=2000
# The number of ticks that the initial synchronization phase can take
initLimit=10
# The number of ticks that can pass between
# sending a request and getting an acknowledgement
syncLimit=5
# zoo servers
# these hostnames such as `zookeeper-1` come from the /etc/hosts file
server.1=zookeeper-1:2888:3888
server.2=zookeeper-2:2888:3888
server.3=zookeeper-3:2888:3888
```

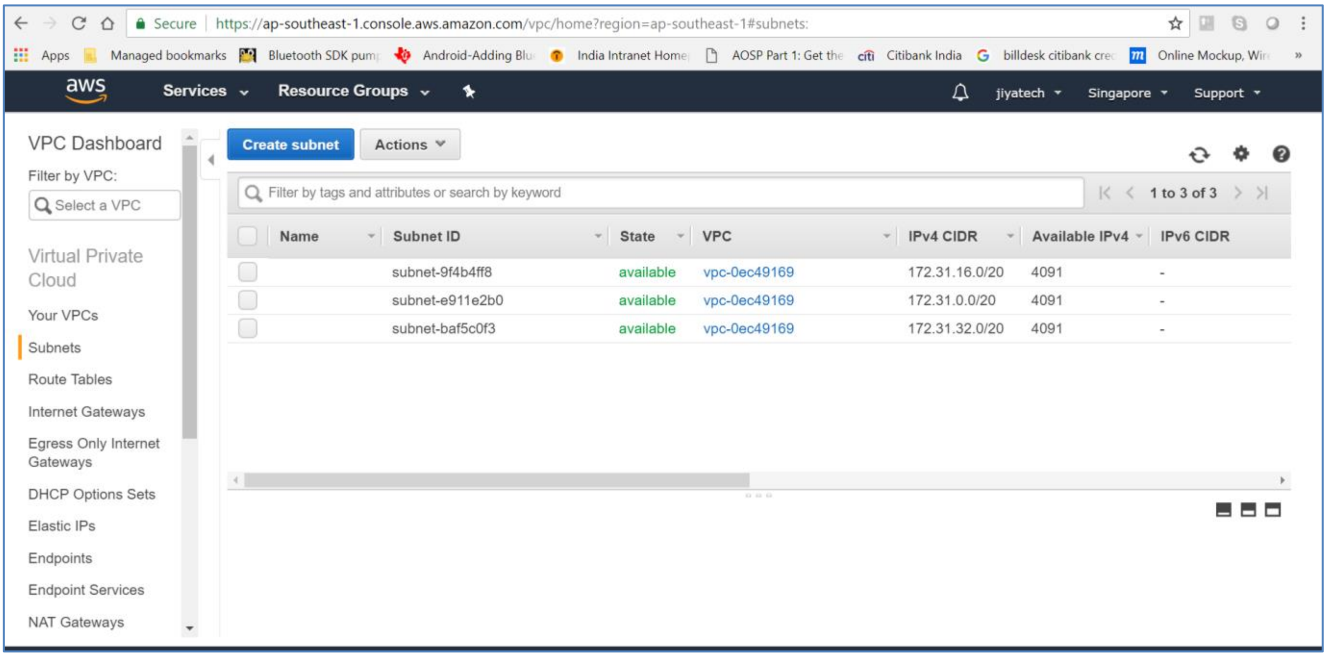
Figure 6. Zookeeper.Properties File

1. Specifies where ZooKeeper stores data
2. Specifies the port at which client will connect
3. How many clients can connect with zookeeper (0 is unlimited)
4. 2 Seconds is the Heart Beat Time
5. Init Time (10 * 2000 milliseconds) is used for initial synchronization
6. Sync Limit specifies the time of ticks requires to receive an acknowledge for a request
7. It also defines the ZooKeeper clusters of three servers and the PORTS it needs to open up

3 AWS Setup

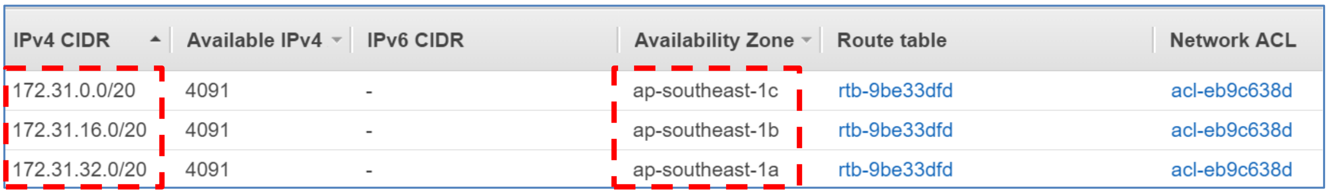
3.1 Zookeeper AWS Setup

Create an account in https://console.aws.amazon.com and select a region that is closest to you. Then search for a service called VPC and then select subnets (For Mumbai region there are two subnets but we atleast need three subnets and hence switch to some other region like Singapore and then keep a track of Availability zones corresponding to the subnets)



Name	Subnet ID	State	VPC	IPv4 CIDR	Available IPv4	IPv6 CIDR
	subnet-9f4b4ff8	available	vpc-0ec49169	172.31.16.0/20	4091	-
	subnet-e911e2b0	available	vpc-0ec49169	172.31.0.0/20	4091	-
	subnet-baf5c0f3	available	vpc-0ec49169	172.31.32.0/20	4091	-

Figure 7. VPC Subnets in Singapore region



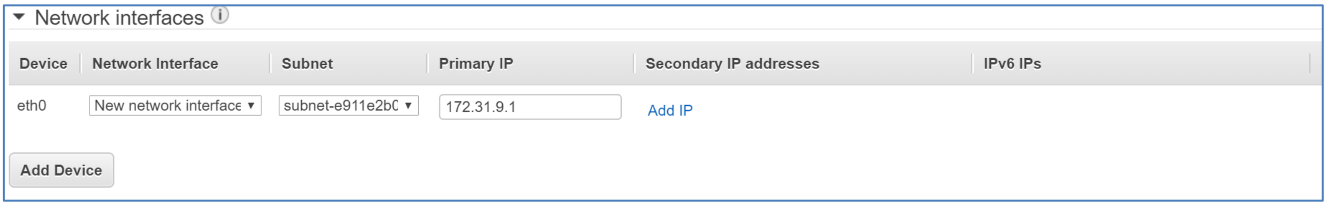
IPv4 CIDR	Available IPv4	IPv6 CIDR	Availability Zone	Route table	Network ACL
172.31.0.0/20	4091	-	ap-southeast-1c	rtb-9be33dfd	acl-eb9c638d
172.31.16.0/20	4091	-	ap-southeast-1b	rtb-9be33dfd	acl-eb9c638d
172.31.32.0/20	4091	-	ap-southeast-1a	rtb-9be33dfd	acl-eb9c638d

Figure 8. Subnets mapped to Availability Zones after sorting IPv4 security Field

Then search for a service called EC2 and then click on Launch instance (We are going to create our EC2 instances now). The select "**Ubuntu Server 16.04 LTS (HVM), SSD Volume Type**" and then select instance type as "**t2.medium**" and then click on "Next Configure Instance Details (Do Not Click Configure/Launch)"

Keep instance count as 1 and come to section subnet and then select the availability zone corresponding to 173.31.0.**0**/20 (In my case as seen above it is C)

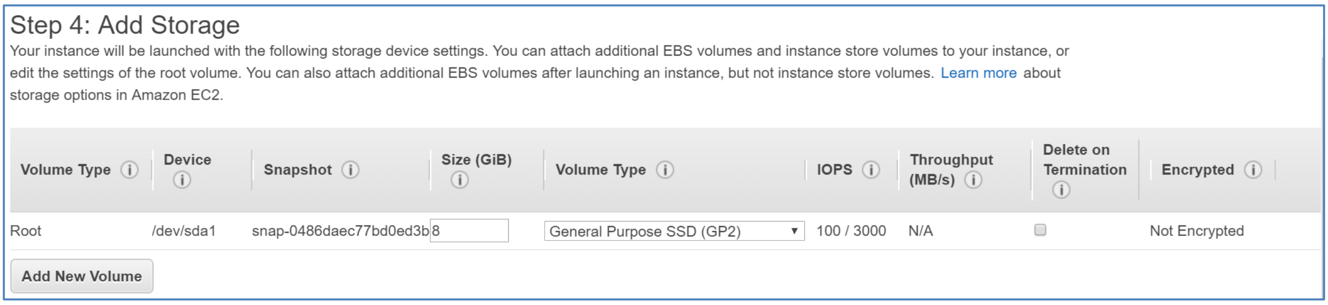
The go to Network Interface (Scroll down) and set the below provided IP (172.31.9.1). If you cannot set this IP then it means you have chosen the wrong subnet and hence go back and rectify that



Device	Network Interface	Subnet	Primary IP	Secondary IP addresses	IPv6 IPs
eth0	New network interface	subnet-e911e2b0	172.31.9.1		

Figure 8. Setting Network Interface

The go down and click "Add Storage"



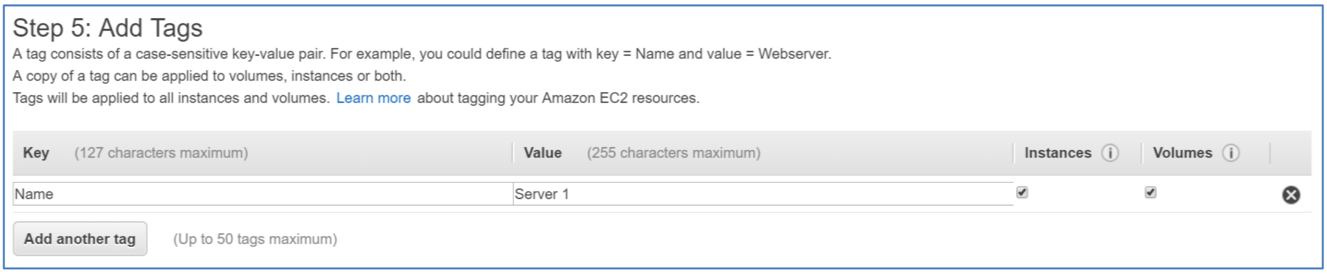
Step 4: Add Storage

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	Encrypted
Root	/dev/sda1	snap-0486daec77bd0ed3b	8	General Purpose SSD (GP2)	100 / 3000	N/A	□	Not Encrypted

Add New Volume

Figure 8. Configuring Storage for Instance



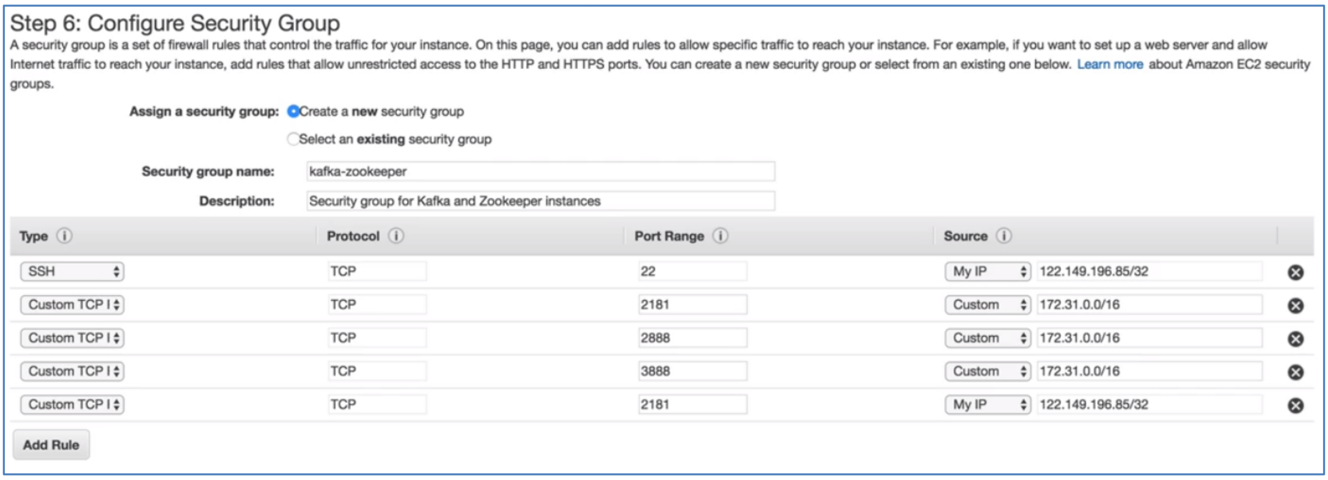
Step 5: Add Tags

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver.
A copy of a tag can be applied to volumes, instances or both.
Tags will be applied to all instances and volumes. Learn more about tagging your Amazon EC2 resources.

Key (127 characters maximum)	Value (255 characters maximum)	Instances	Volumes
Name	Server 1	☑	☑

Add another tag (Up to 50 tags maximum)

Figure 9 Adding TAGS to identify the Server



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 Internet traffic to reach your instance, add rules 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 name: kafka-zookeeper

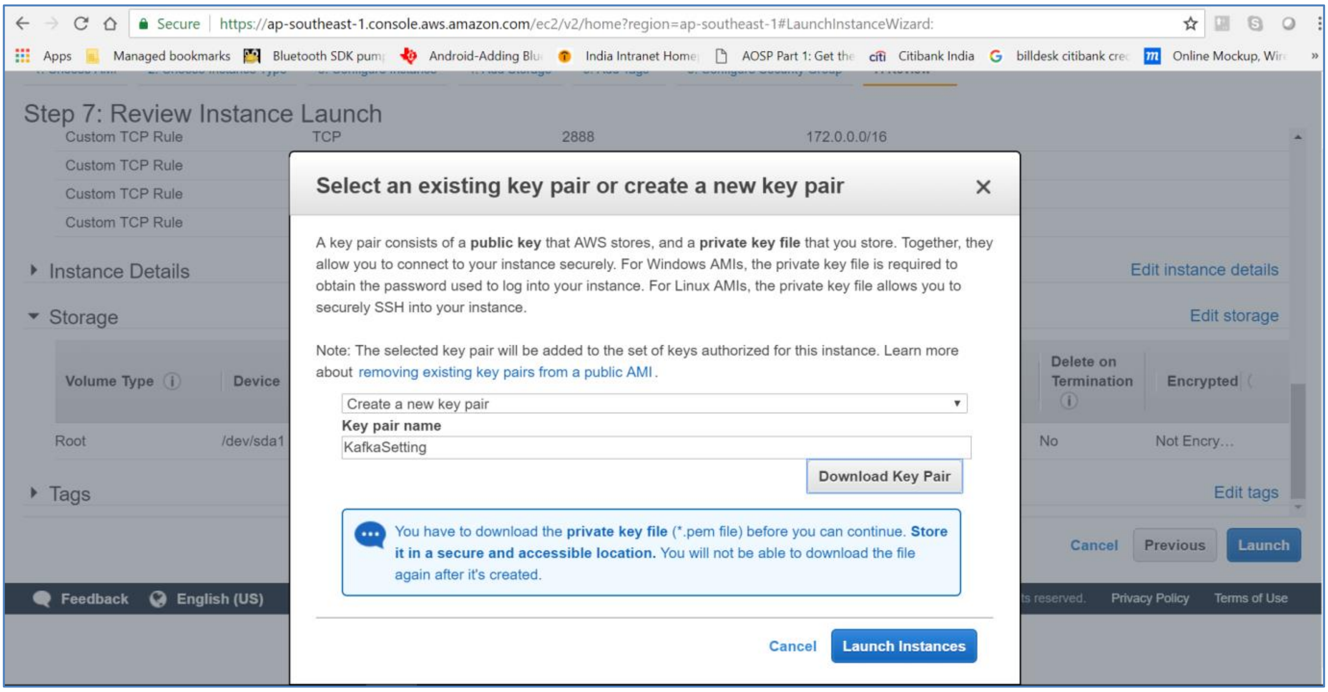
Description: Security group for Kafka and Zookeeper instances

Type	Protocol	Port Range	Source	
SSH	TCP	22	My IP	122.149.196.85/32
Custom TCP I	TCP	2181	Custom	172.31.0.0/16
Custom TCP I	TCP	2888	Custom	172.31.0.0/16
Custom TCP I	TCP	3888	Custom	172.31.0.0/16
Custom TCP I	TCP	2181	My IP	122.149.196.85/32

Add Rule

Figure 10 Setting Security Group for ZooKeeper

We use IP **172.31.0.0/16** for accessing Zookeeper ports 2181/2888/3888 and you can either allow all IPs to access Zookeeper (not recommended) or keep only MY IP to access the same. Then click on review and lunch and in the review screen you have review your settings made for ZooKeeper.



https://ap-southeast-1.console.aws.amazon.com/ec2/v2/home?region=ap-southeast-1#LaunchInstanceWizard:
Step 7: Review Instance Launch
Instance Details
Storage
Tags
Edit instance details
Edit storage
Edit tags
Cancel
Previous
Launch
Feedback
English (US)

Custom TCP Rule	TCP	2888	172.0.0.0/16
Custom TCP Rule			
Custom TCP Rule			
Custom TCP Rule			

Volume Type	Device	Delete on Termination	Encrypted
Root	/dev/sda1	No	Not Encry…

Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about removing existing key pairs from a public AMI.

Create a new key pair

Key pair name: KafkaSetting

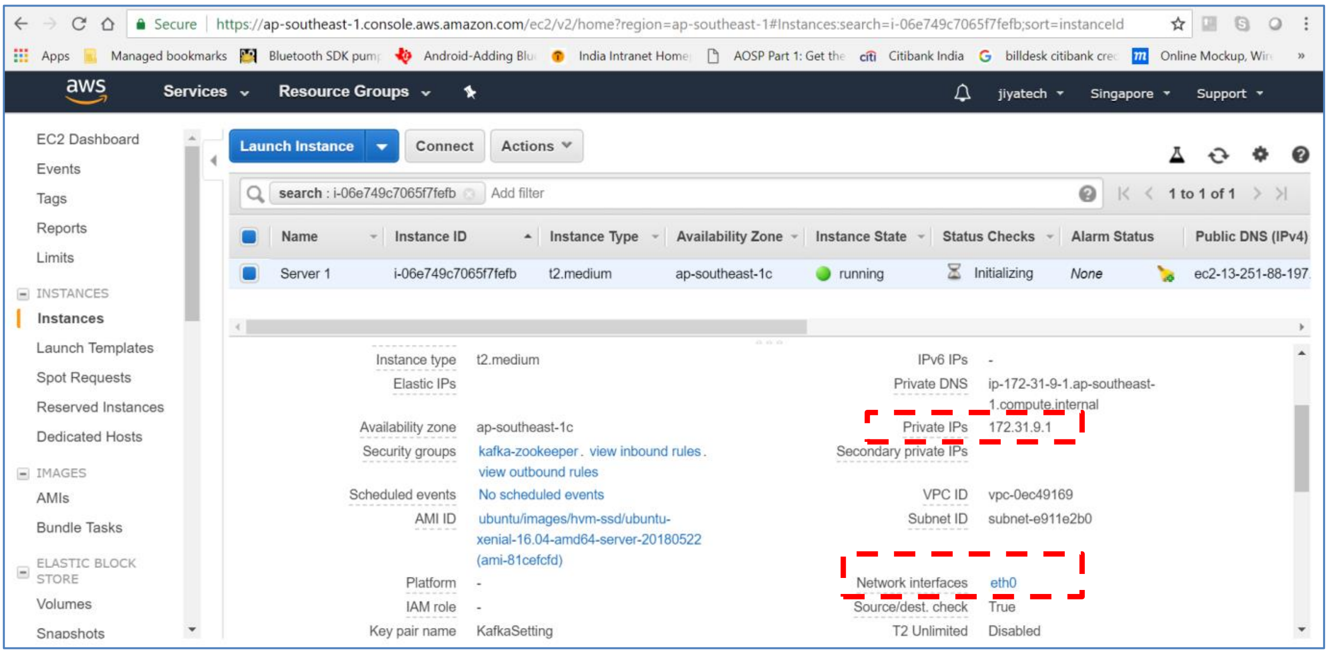
Download Key Pair

You have to download the **private key file** (*.pem file) before you can continue. **Store it in a secure and accessible location.** You will not be able to download the file again after it's created.

Cancel | Launch Instances

Figure 11 Creating a New Key Pair to SSH into instance

Create a new KEY PAIR and download the file and save it securely before clicking on Launch Instances.



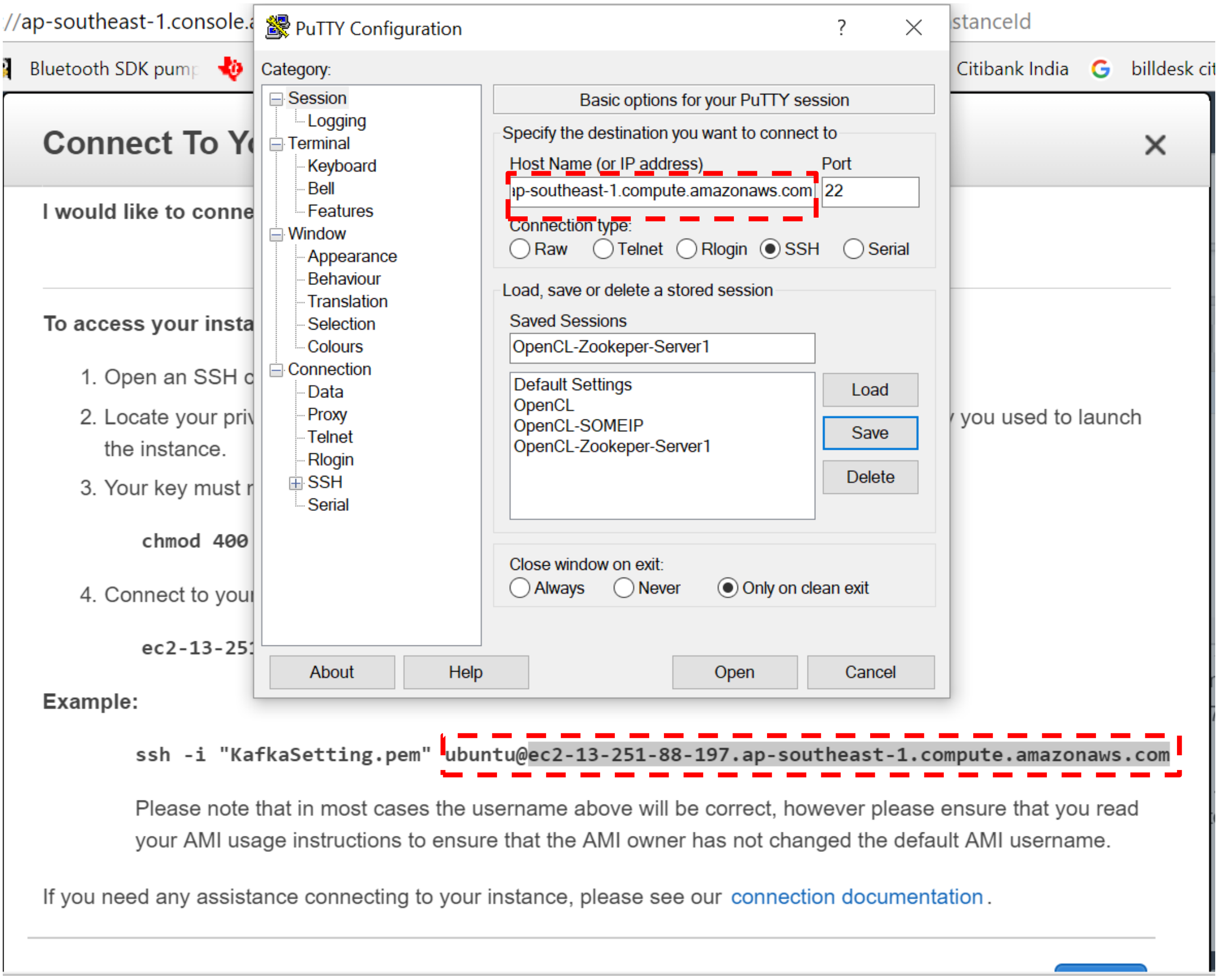
Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)
Server 1	i-06e749c7065f7fefb	t2.medium	ap-southeast-1c	running	Initializing	None	ec2-13-251-88-197.

Instance type	t2.medium	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-9-1.ap-southeast-1.compute.internal
Availability zone	ap-southeast-1c	Private IPs	172.31.9.1
Security groups	kafka-zookeeper . view inbound rules . view outbound rules	Secondary private IPs	
Scheduled events	No scheduled events	VPC ID	vpc-0ec49169
AMI ID	ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-20180522 (ami-81cefcfd)	Subnet ID	subnet-e911e2b0
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	KafkaSetting	T2 Unlimited	Disabled

Figure 12 Ensuring not losing IP on Termination

Click on Network Interfaces from below under Description. Then click on **interface id** and then right click on the instance and select **change termination behavior** and we uncheck **delete on termination.** So we never lose the Private IP. If we go back to instances, we shall see our created instance in running state with a **Public IP** (In the description tab below)

Download and install PUTTY so that we can SSH into the instance we created. Follow this tutorial https://linuxacademy.com/howtoguides/posts/show/topic/17385-use-putty-to-access-ec2-linux-instances-via-ssh-from-windows



Connect To Yo

I would like to conne

To access your insta

1. Open an SSH c
2. Locate your priv y you used to launch the instance.
3. Your key must r

   chmod 400

4. Connect to your

   ec2-13-25

Example:

```
ssh -i "KafkaSetting.pem" ubuntu@ec2-13-251-88-197.ap-southeast-1.compute.amazonaws.com
```

Please note that in most cases the username above will be correct, however please ensure that you read your AMI usage instructions to ensure that the AMI owner has not changed the default AMI username.

If you need any assistance connecting to your instance, please see our connection documentation.

Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): ıp-southeast-1.compute.amazonaws.com Port: 22

Connection type: ○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions: OpenCL-Zookeper-Server1

Default Settings
OpenCL
OpenCL-SOMEIP
OpenCL-Zookeper-Server1

Close window on exit: ○ Always ○ Never ● Only on clean exit

3.2 Single zookeeper machine setup

SSH into the machine and run these commands

```
sudo apt-get update && \
sudo apt-get -y install wget ca-certificates zip net-tools vim nano tar netcat
```

# Java Open JDK 8

```
sudo apt-get -y install default-jdk
java -version
```

# Disable RAM Swap - can set to 0 on certain Linux distro and persist it across reboot

```
sudo sysctl vm.swappiness=1
echo 'vm.swappiness=1' | sudo tee --append /etc/sysctl.conf
```

# Add hosts entries (mocking DNS) - put relevant IPs here (IPs provided below should be good)

```
echo "172.31.9.1 kafka1
172.31.9.1 zookeeper1
172.31.19.230 kafka2
172.31.19.230 zookeeper2
172.31.35.20 kafka3
172.31.35.20 zookeeper3" | sudo tee --append /etc/hosts
```

# download Zookeeper and Kafka. Recommended is latest Kafka (0.10.2.1) and Scala 2.12

```
wget http://apache.mirror.digitalpacific.com.au/kafka/0.10.2.1/kafka_2.12-0.10.2.1.tgz
tar -xvzf kafka_2.12-0.10.2.1.tgz
rm kafka_2.12-0.10.2.1.tgz
mv kafka_2.12-0.10.2.1 kafka
cd kafka/
```

# Zookeeper quickstart (This is just to test if Zookeeper can start)

```
bin/zookeeper-server-start.sh config/zookeeper.properties
```

# Start Zookeeper in the background

```
bin/zookeeper-server-start.sh -daemon config/zookeeper.properties
```

# Test Zookeeper

```
bin/zookeeper-shell.sh localhost:2181
ls /
```

# demonstrate the use of a 4 letter word (it should say “imok”)

```
echo "ruok" | nc localhost 2181 ; echo
```

# Install Zookeeper boot scripts (Put the content of script below in this file and SAVE)

```
sudo nano /etc/init.d/zookeeper
```

```
#!/bin/bash
#/etc/init.d/zookeeper
DAEMON_PATH=/home/ubuntu/kafka/bin
DAEMON_NAME=zookeeper
# Check that networking is up.
#[ ${NETWORKING} = "no" ] && exit 0

PATH=$PATH:$DAEMON_PATH

# See how we were called.
case "$1" in
  start)
       # Start daemon.
       pid=`ps ax | grep -i 'org.apache.zookeeper' | grep -v grep | awk '{print $1}'`
       if [ -n "$pid" ]
         then
```

```
              echo "Zookeeper is already running";
            else
             echo "Starting $DAEMON_NAME";
             $DAEMON_PATH/zookeeper-server-start.sh -daemon
/home/ubuntu/kafka/config/zookeeper.properties
            fi
            ;;
         stop)
            echo "Shutting down $DAEMON_NAME";
            $DAEMON_PATH/zookeeper-server-stop.sh
            ;;
         restart)
            $0 stop
            sleep 2
            $0 start
            ;;
         status)
            pid=`ps ax | grep -i 'org.apache.zookeeper' | grep -v grep | awk '{print $1}'`
            if [ -n "$pid" ]
             then
             echo "Zookeeper is Running as PID: $pid"
            else
             echo "Zookeeper is not Running"
            fi
            ;;
         *)
            echo "Usage: $0 {start|stop|restart|status}"
            exit 1
        esac

        exit 0
```

```
# Install Zookeeper boot scripts

        sudo chmod +x /etc/init.d/zookeeper

        sudo chown root:root /etc/init.d/zookeeper

# you can safely ignore the warning

        sudo update-rc.d zookeeper defaults

# stop zookeeper

        sudo service zookeeper stop

# stop zookeeper

        sudo service zookeeper stop

# verify it's stopped

        nc -vz localhost 2181

# start zookeeper

        sudo service zookeeper start

# verify it's started
```

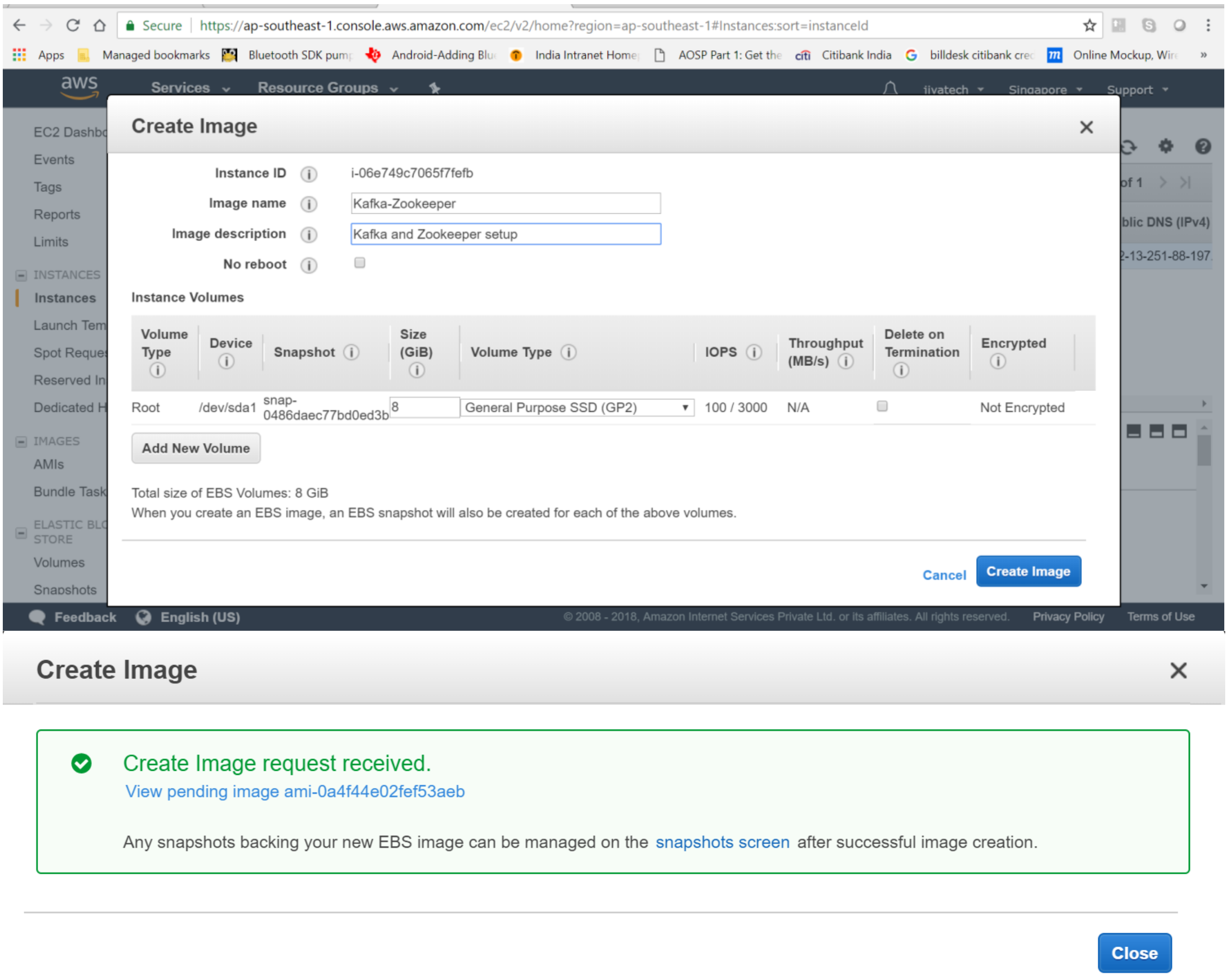
```
        nc -vz localhost 2181
        echo "ruok" | nc localhost 2181 ; echo (it should say “imok”)
# check the logs
        cat logs/zookeeper.out
```

3.3 ZOOKEEPER COMMAND LINE INTERFACE

```
# Starting Zookeeper and connecting to it
        sudo service zookeeper start
        ubuntu@ip-172-31-9-1:~/kafka$ bin/zookeeper-shell.sh localhost:2181
# display help
        help
# display root and create a Node
        ls /
        create /my-node "foo"
        ls /
# Get data corresponding to nodes created
        get /my-node
        get /zookeeper
# Create Deeper Nodes inside Zookeeper
        create /my-node/deeper-node "bar"
        ls /
        ls /my-node
        ls /my-node/deeper-node
        get /my-node/deeper-node
# removes are recursive
        rmr /my-node
        ls /
# create a watcher
        create /node-to-watch ""
        get /node-to-watch true
        set /node-to-watch "has-changed"
        rmr /node-to-watch
```

3.4 ZOOKEEPER QUORUM SETUP – PART 1

Right click on instance in the dashboard and select “Create Image” (We create AMI image so that we can replicate setup on all instances for setting up Zookeeper quorum). This will create a new Image (Open up two screens snapshot screen and image screen in order to check if image/snapshot has been created or not and this takes about 5-Mins)



Create Image ✕

Instance ID: i-06e749c7065f7fefb

Image name: Kafka-Zookeeper

Image description: Kafka and Zookeeper setup

No reboot: □

Instance Volumes

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encrypted
Root	/dev/sda1	snap-0486daec77bd0ed3b	8	General Purpose SSD (GP2)	100 / 3000	N/A	□	Not Encrypted

Add New Volume

Total size of EBS Volumes: 8 GiB
When you create an EBS image, an EBS snapshot will also be created for each of the above volumes.

Cancel | Create Image

Create Image ✕

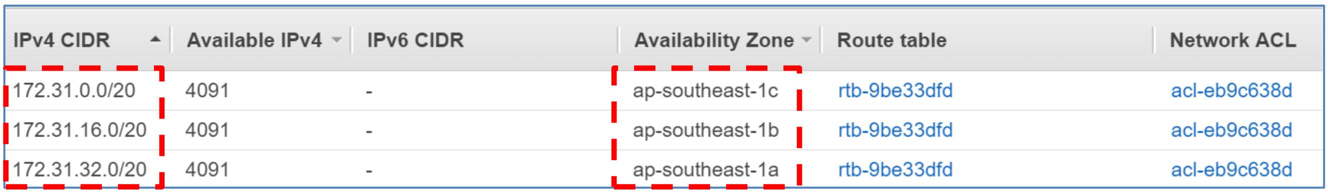
Create Image request received.
View pending image ami-0a4f44e02fef53aeb

Any snapshots backing your new EBS image can be managed on the snapshots screen after successful image creation.

Close

Figure 13 Zookeeper AMI Image

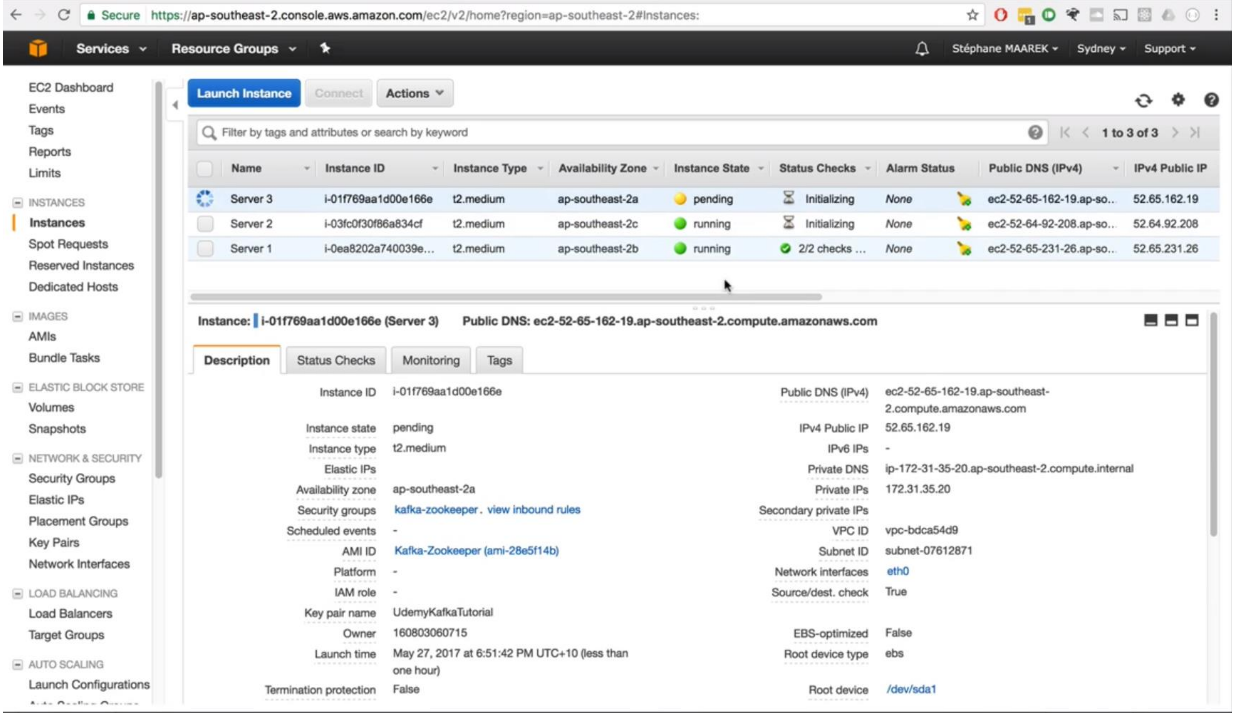
When image/snapshot is created then while being in AMI screen click Launch. Then select General Purpose (T2.Medium) and click Configure Instance Details.



IPv4 CIDR	Available IPv4	IPv6 CIDR	Availability Zone	Route table	Network ACL
172.31.0.0/20	4091	-	ap-southeast-1c	rtb-9be33dfd	acl-eb9c638d
172.31.16.0/20	4091	-	ap-southeast-1b	rtb-9be33dfd	acl-eb9c638d
172.31.32.0/20	4091	-	ap-southeast-1a	rtb-9be33dfd	acl-eb9c638d

The first was created using SUBNET C and this time we select next in line and that is **SUBNET B** and then scroll down and select primary IP as **172.31.19.230** and then click “Add Storage” and don’t change anything (8GB) and then click on **Add Tags. (Name** and **Server 2)** and then click on **Security Group.** Instead of creating a new security group use the old one “**kafka-zookeeper**” previously created security group and then click **Review and Launch** and **Launch.** Use the existing KEY PAIR we created earlier “**kafkaSetting**”. The click on **View Instances** and we shall see that second instance getting created.

GO back again to AMI in main Dashboard (left Pane) and select the one created earlier “**Kafka-Zookeeper**” and right click and click on **Launch** and then select (**General Purpose T2.Medium**) and this time in the configuration screen select **SUBNET A**. The scroll down and select Primary IP as **172.31.35.20.** The select Add Storage and keep everything same and then select Add Tags and name this instance **(Name** and **Server 3)** and then click on **Security Group.** Instead of creating a new security group use the old one "**kafka-zookeeper**" previously created security group and then click **Review and Launch** and **Launch.** Use the existing KEY PAIR we created earlier "**kafkaSetting**". The click on **View Instances** and we shall see that second instance getting created.



Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP
Server 3	i-01f769aa1d00e166e	t2.medium	ap-southeast-2a	pending	Initializing	None	ec2-52-65-162-19.ap-so...	52.65.162.19
Server 2	i-03fc0f30f86a834cf	t2.medium	ap-southeast-2c	running	Initializing	None	ec2-52-64-92-208.ap-so...	52.64.92.208
Server 1	i-0ea8202a740039e...	t2.medium	ap-southeast-2b	running	2/2 checks ...	None	ec2-52-65-231-26.ap-so...	52.65.231.26

Instance: i-01f769aa1d00e166e (Server 3) Public DNS: ec2-52-65-162-19.ap-southeast-2.compute.amazonaws.com

Instance ID	i-01f769aa1d00e166e	Public DNS (IPv4)	ec2-52-65-162-19.ap-southeast-2.compute.amazonaws.com
Instance state	pending	IPv4 Public IP	52.65.162.19
Instance type	t2.medium	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-35-20.ap-southeast-2.compute.internal
Availability zone	ap-southeast-2a	Private IPs	172.31.35.20
Security groups	kafka-zookeeper. view inbound rules	Secondary private IPs	
Scheduled events	-	VPC ID	vpc-bdca54d9
AMI ID	Kafka-Zookeeper (ami-28e5f14b)	Subnet ID	subnet-07612871
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	UdemyKafkaTutorial		
Owner	160803060715	EBS-optimized	False
Launch time	May 27, 2017 at 6:51:42 PM UTC+10 (less than one hour)	Root device type	ebs
Termination protection	False	Root device	/dev/sda1

Figure 13 Three Instances of Quorum Launched

Open three PUTTY windows and connect to all these three servers created independent (Use the same KEY for authentication). Upon logging if we do ls then we should get kafka in all three terminals suggesting that three instances has been created from same AMI image.

3.5 Zookeeper Quorum setup – PART 2

Execute command "**sudo service zookeeper start**" in all the three servers opened via SSH through PUTTY in order to start Zookeeper in all the three instances and then run command "**nc -vz localhost 2181**" and check for success message in all three instances.

Instead of using **localhost** in the above command use **zookeeper1** in first server and check if it works same (We did setup Mock DNS previously for this to work). The run "**nc -vz zookeeper1 2181**" from second server and check if second server can connect to first server or not and then run the same command from server 3 and check if that also can connect to server 1. Then run the same command "**nc -vz zookeeperx 2181**" in all three instances (Where x stands for 1, 2 or 3) in order to check whether server 1 server 2 and server 3 all can talk amongst themselves via mock DNS name of zookeeperx.

Then run command "**sudo service zookeeper stop**" to stop zookeeper in all the three servers. Then create Data Dictionary in all the three instances by running this command in all three "**sudo mkdir -p /data/zookeeper**" and then make UBUNTU as owner of that directory by running this command "**sudo chown -R ubuntu:ubuntu /data/".** Then run this command in server 1 "**echo "1" > /data/zookeeper/myid**" to declare server identity for first server as 1 (Repeat the same for server 2 and server 3 and replace echo 1 with echo 2 and echo 3 for server 2 and server 3 respectively). You can run **cat /data/zookeeper/myid** in all three servers to determine if what was written as server ID got reflected properly or not. Then run this command in all three "**rm /home/ubuntu/kafka/config/zookeeper.properties**" to remove default properties and then run "**nano /home/ubuntu/kafka/config/zookeeper.properties**" in all three to create a new property file.

The create this configuration in all three servers file (Save CTRL+X Y Enter)

```
# the location to store the in-memory database snapshots and, unless specified otherwise, the transaction log of updates to the database.
dataDir=/data/zookeeper
# the port at which the clients will connect
clientPort=2181
# disable the per-ip limit on the number of connections since this is a non-production config
maxClientCnxns=0
# the basic time unit in milliseconds used by ZooKeeper. It is used to do heartbeats and the minimum session timeout will be twice the tickTime.
tickTime=2000
# The number of ticks that the initial synchronization phase can take
initLimit=10
# The number of ticks that can pass between
# sending a request and getting an acknowledgement
syncLimit=5
# zoo servers
# these hostnames such as `zookeeper-1` come from the /etc/hosts file
server.1=zookeeper1:2888:3888
server.2=zookeeper2:2888:3888
server.3=zookeeper3:2888:3888
```

Enter directory **kafka** and verify by running **cat config/zookeeper.properties** in all three instances. The starting from first server and then second and then run this command (Don't bother about error, that will be resolved when zookeeper runs in all three), "**sudo service zookeeper start**" (Once you run in all three servers, one will assume LEADER role and other two will assume FOLLOWER role)

Then run this command "**echo "ruok" | nc zookeeperx 2181 ; echo**" in first/second/third server and x stands for 1/2/3 (We should get "imok" in all three cases for all three servers)

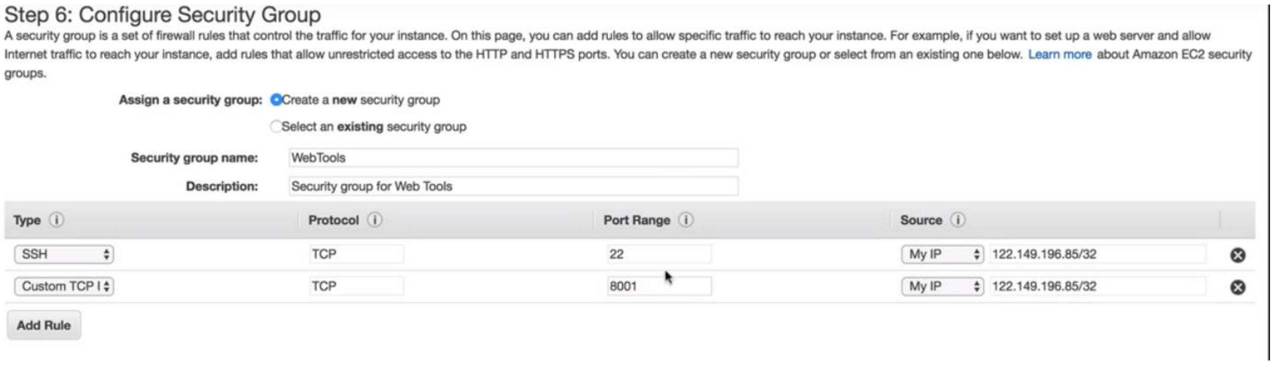
Then run this command "**echo "stat" | nc zookeeperx 2181 ; echo**" in first server and x stands for 1/2/3 (We should get **Mode: follower** for two servers and **Mode: leader** for one)

Run ZooKeeper SHELL in all three servers by running command in all three (**bin/zookeeper-shell.sh zookeeperx:2181** replace "**x**" with 1 when running in first server and 2 when running in second server and 3 when running in third server) and then running ls / command in all three shall return zookeeper

4 WEB TOOLS AWS EC2 MACHINE (DOCKER)

Go to dashboard and Launch an Instance and select "Ubuntu Server 16.04 LTS (HVM), SSD Volume Type" and then select "T2.Small" and there is no need to add subnet or IP in configure instance details screen. Default data in storage screen is also fine and no need to make any changes. Then add a KEY VALUE pair (Name Web Tools) in Add Tags screen.

We however create a new Security Group for Web Tools.



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 Internet traffic to reach your instance, add rules 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 name: WebTools

Description: Security group for Web Tools

Type	Protocol	Port Range	Source	
SSH	TCP	22	My IP 122.149.196.85/32	⊗
Custom TCP I	TCP	8001	My IP 122.149.196.85/32	⊗

Figure 14 Security Group Settings for Web Tools

Launch the Web Tools with the same KEY VALUE Pair created earlier and connect to this instance using SSH.

Run these commands

```
sudo apt-get update

# Install packages to allow apt to use a repository over HTTPS (Required for DOCKER):
sudo apt-get install -y \
    apt-transport-https \
    ca-certificates \
    curl \
    software-properties-common

# Add Docker’s official GPG key:
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add –

# set up the stable repository.
sudo add-apt-repository \
   "deb [arch=amd64] https://download.docker.com/linux/ubuntu \
   $(lsb_release -cs) \
   stable"

# install docker
sudo apt-get update
sudo apt-get install -y docker-ce docker-compose

# give ubuntu permissions to execute docker
sudo usermod -aG docker $(whoami)
# log out
exit
# log back in

# make sure docker is working
docker run hello-world
```

If everything works fine then this is the output you should be getting

```
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
9bb5a5d4561a: Pull complete
```

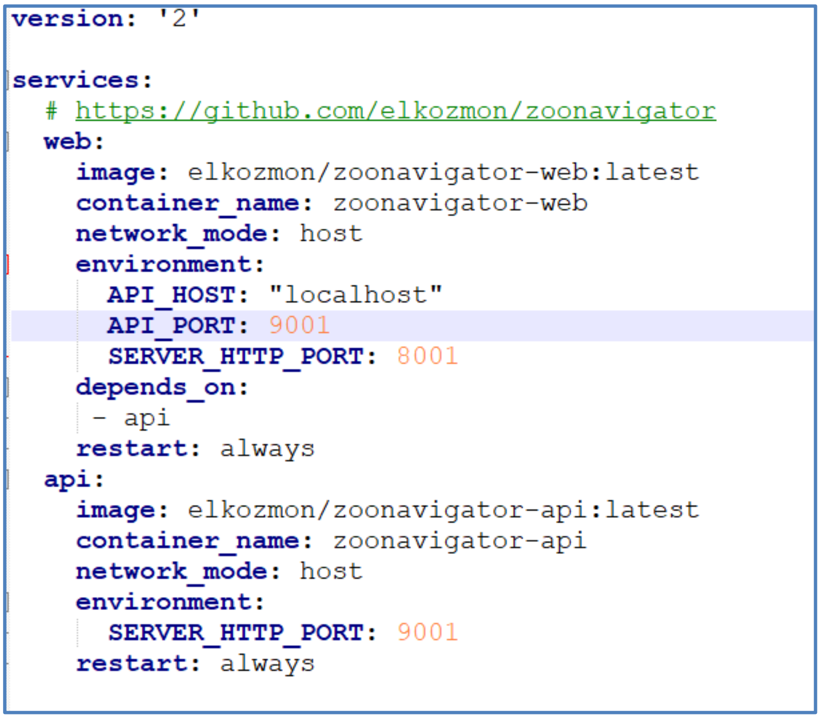
```
Digest: sha256:3e1764d0f546ceac4565547df2ac4907fe46f007ea229fd7ef2718514bcec35d
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/engine/userguide/
```

```
# Add hosts entries (mocking DNS) - put relevant IPs here
echo "172.31.9.1 kafka1
172.31.9.1 zookeeper1
172.31.19.230 kafka2
172.31.19.230 zookeeper2
172.31.35.20 kafka3
172.31.35.20 zookeeper3" | sudo tee --append /etc/hosts
```

Check by running “**nc -vz zookeeper1 2181**” whether we can connect to ZooKeeper1 Server

4.1 MANAGEMENT TOOLS FOR ZOOKEEPER (ZOONAVIGATOR)

Connect to Web Tool AWS EC2 instance we created via SSH. Create a new file by doing “**nano zoonavigator-docker-compose.yml**” and paste the following content into it.



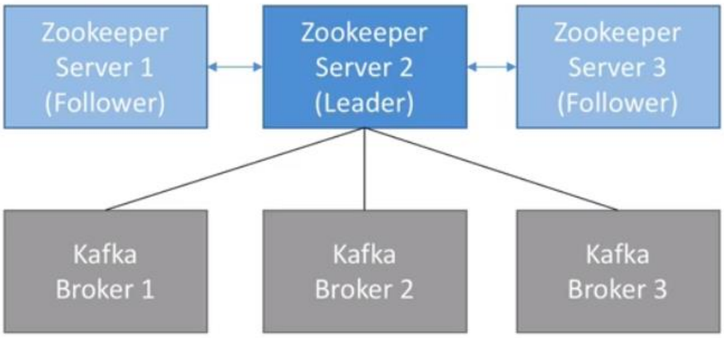
```
version: '2'

services:
  # https://github.com/elkozmon/zoonavigator
  web:
    image: elkozmon/zoonavigator-web:latest
    container_name: zoonavigator-web
    network_mode: host
    environment:
      API_HOST: "localhost"
      API_PORT: 9001
      SERVER_HTTP_PORT: 8001
    depends_on:
     - api
    restart: always
  api:
    image: elkozmon/zoonavigator-api:latest
    container_name: zoonavigator-api
    network_mode: host
    environment:
      SERVER_HTTP_PORT: 9001
    restart: always
```

Now run this command “**docker-compose -f zoonavigator-docker-compose.yml up -d**”. It will pull all Docker images and create all Docker containers. Verify by giving command **docker ps**

Open a Browser and Navigate to http://13.250.44.236:8001/connect (IP address in your case is the Public IP of Web Tools EC2 instance) and for connection string use this “**zookeeper1:2181,zookeeper2:2181,zookeeper3:2181**” and that opens a UI allowing you to create NODES in Zookeeper.

5 KAFKA

5.1 KAFKA CLUSTER SIZE

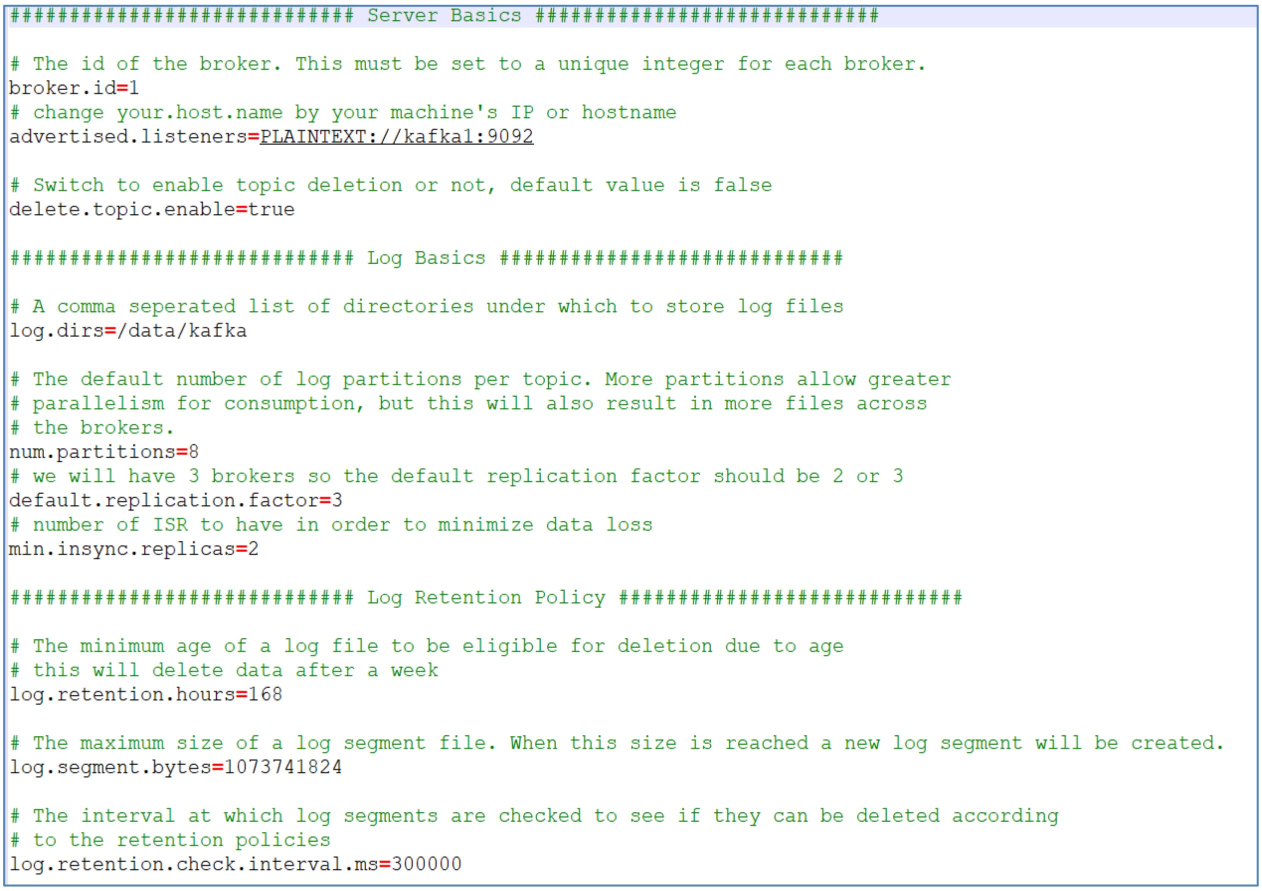


Zookeeper Server 1 (Follower)
Zookeeper Server 2 (Leader)
Zookeeper Server 3 (Follower)
Kafka Broker 1
Kafka Broker 2
Kafka Broker 3

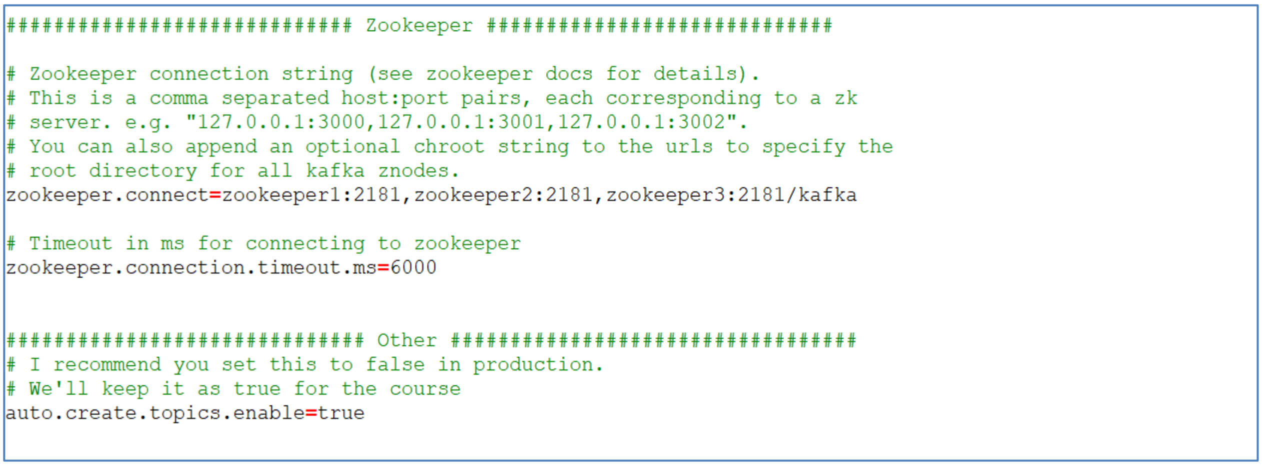
Figure 15 Three Broker Cluster Configuration

N-1 Brokers can be down if N is default topic replication factor. Producer consumer requests are going to be spread out amongst different machines. Data is also going to be spread out amongst different brokers.

5.2 KAFKA CONFIGURATION



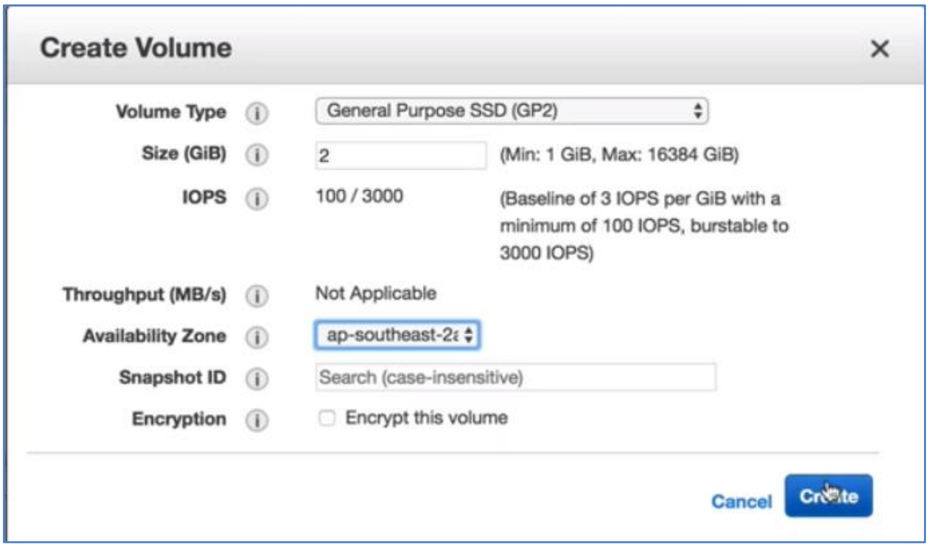
```
############################# Server Basics #############################

# The id of the broker. This must be set to a unique integer for each broker.
broker.id=1
# change your.host.name by your machine's IP or hostname
advertised.listeners=PLAINTEXT://kafka1:9092

# Switch to enable topic deletion or not, default value is false
delete.topic.enable=true

############################# Log Basics #############################

# A comma seperated list of directories under which to store log files
log.dirs=/data/kafka

# The default number of log partitions per topic. More partitions allow greater
# parallelism for consumption, but this will also result in more files across
# the brokers.
num.partitions=8
# we will have 3 brokers so the default replication factor should be 2 or 3
default.replication.factor=3
# number of ISR to have in order to minimize data loss
min.insync.replicas=2

############################# Log Retention Policy #############################

# The minimum age of a log file to be eligible for deletion due to age
# this will delete data after a week
log.retention.hours=168

# The maximum size of a log segment file. When this size is reached a new log segment will be created.
log.segment.bytes=1073741824

# The interval at which log segments are checked to see if they can be deleted according
# to the retention policies
log.retention.check.interval.ms=300000
```



```
############################# Zookeeper #############################

# Zookeeper connection string (see zookeeper docs for details).
# This is a comma separated host:port pairs, each corresponding to a zk
# server. e.g. "127.0.0.1:3000,127.0.0.1:3001,127.0.0.1:3002".
# You can also append an optional chroot string to the urls to specify the
# root directory for all kafka znodes.
zookeeper.connect=zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka

# Timeout in ms for connecting to zookeeper
zookeeper.connection.timeout.ms=6000


############################## Other ##################################
# I recommend you set this to false in production.
# We'll keep it as true for the course
auto.create.topics.enable=true
```

5.3 KAFKA SETUP IN AWS

Go to Volumes in Main Dashboard and then select “**Create Volume**”. Create Three Volumes in three availability zones(A, B and C) with same configuration for rest of the parameters.



Create Volume

Volume Type: General Purpose SSD (GP2)

Size (GiB): 2 (Min: 1 GiB, Max: 16384 GiB)

IOPS: 100 / 3000 (Baseline of 3 IOPS per GiB with a minimum of 100 IOPS, burstable to 3000 IOPS)

Throughput (MB/s): Not Applicable

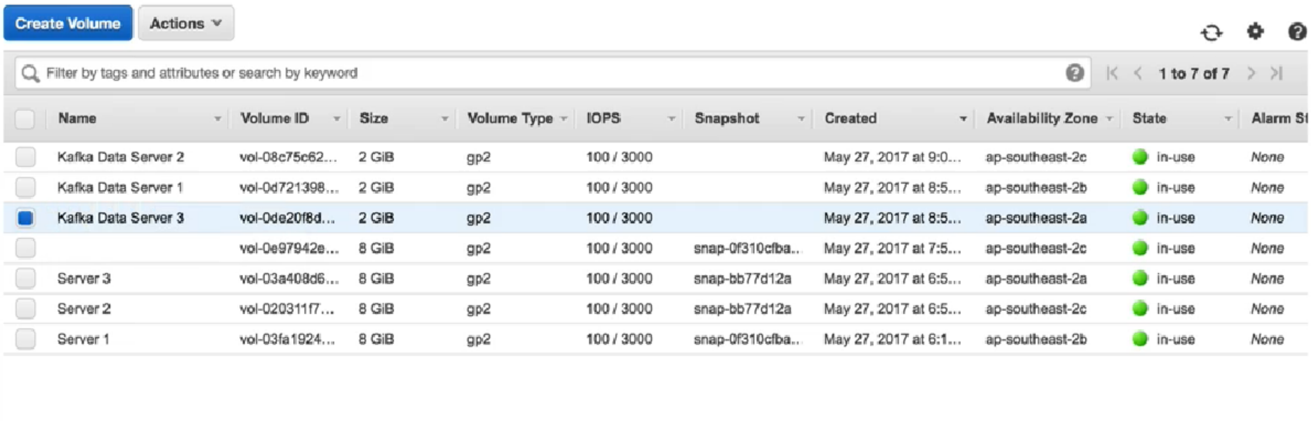
Availability Zone: ap-southeast-2a

Snapshot ID: Search (case-insensitive)

Encryption: □ Encrypt this volume

Figure 16 Creating Volumes for Three Servers

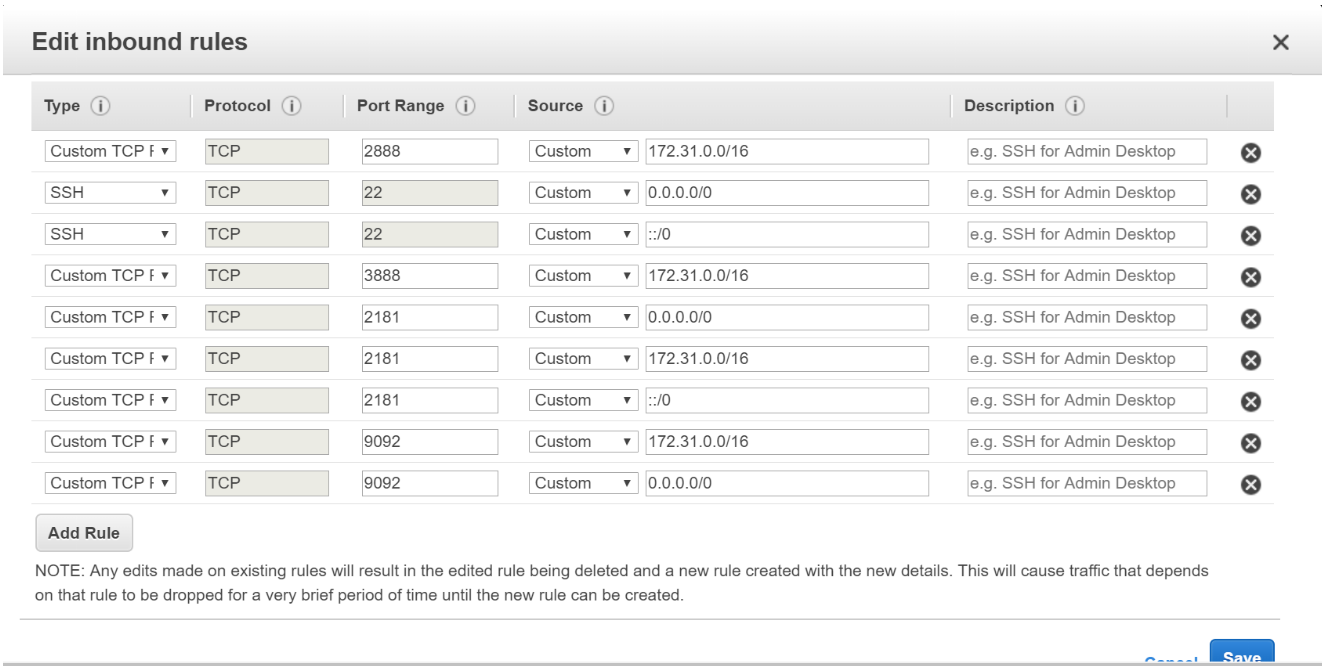
Go to dashboard and select each volume freshly created and then select “**Attach Volume**” and associate one with Server 1, another with Server 2 and another with Server 3 and then in Dashboard give name (Kafka Data Server x where x is 1/2/3)



	Name	Volume ID	Size	Volume Type	IOPS	Snapshot	Created	Availability Zone	State	Alarm St
□	Kafka Data Server 2	vol-08c75c62...	2 GiB	gp2	100 / 3000		May 27, 2017 at 9:0...	ap-southeast-2c	● in-use	None
□	Kafka Data Server 1	vol-0d721398...	2 GiB	gp2	100 / 3000		May 27, 2017 at 8:5...	ap-southeast-2b	● in-use	None
☑	Kafka Data Server 3	vol-0de20f8d...	2 GiB	gp2	100 / 3000		May 27, 2017 at 8:5...	ap-southeast-2a	● in-use	None
□		vol-0e97942e...	8 GiB	gp2	100 / 3000	snap-0f310cfba...	May 27, 2017 at 7:5...	ap-southeast-2c	● in-use	None
□	Server 3	vol-03a408d6...	8 GiB	gp2	100 / 3000	snap-bb77d12a	May 27, 2017 at 6:5...	ap-southeast-2a	● in-use	None
□	Server 2	vol-020311f7...	8 GiB	gp2	100 / 3000	snap-bb77d12a	May 27, 2017 at 6:5...	ap-southeast-2c	● in-use	None
□	Server 1	vol-03fa1924...	8 GiB	gp2	100 / 3000	snap-0f310cfba...	May 27, 2017 at 6:1...	ap-southeast-2b	● in-use	None

Figure 17 Attaching the three volumes created with three servers and Name

Then go to Dashboard and select Security Group and select the pre-existing one "Kafka Zookeeper" and make this change in Inbound traffic (basically allowing inbound traffic in port 9092)



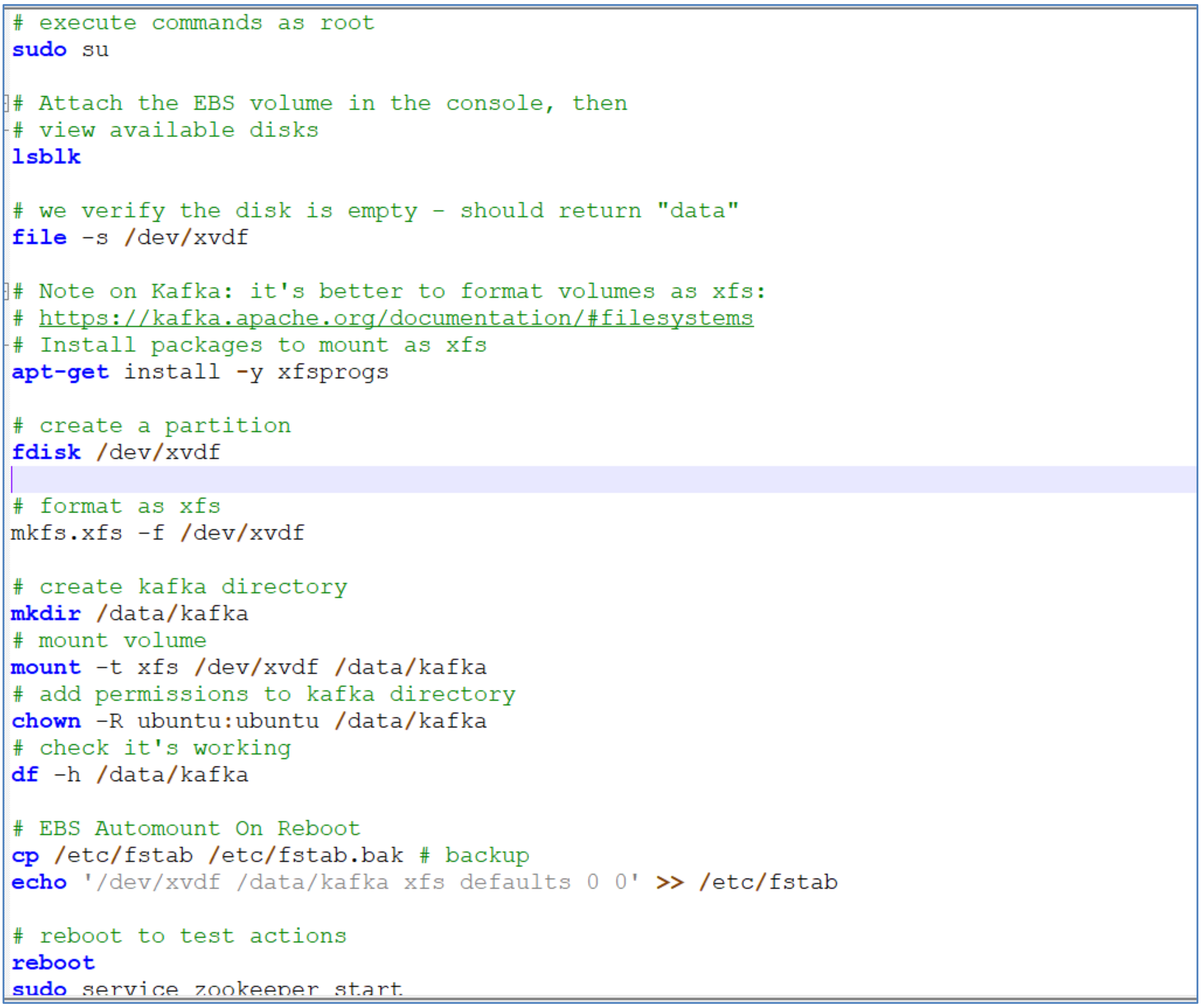
Edit inbound rules

Type	Protocol	Port Range	Source		Description
Custom TCP F	TCP	2888	Custom	172.31.0.0/16	e.g. SSH for Admin Desktop
SSH	TCP	22	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop
SSH	TCP	22	Custom	::/0	e.g. SSH for Admin Desktop
Custom TCP F	TCP	3888	Custom	172.31.0.0/16	e.g. SSH for Admin Desktop
Custom TCP F	TCP	2181	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop
Custom TCP F	TCP	2181	Custom	172.31.0.0/16	e.g. SSH for Admin Desktop
Custom TCP F	TCP	2181	Custom	::/0	e.g. SSH for Admin Desktop
Custom TCP F	TCP	9092	Custom	172.31.0.0/16	e.g. SSH for Admin Desktop
Custom TCP F	TCP	9092	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop

NOTE: Any edits made on existing rules will result in the edited rule being deleted and a new rule created with the new details. This will cause traffic that depends on that rule to be dropped for a very brief period of time until the new rule can be created.

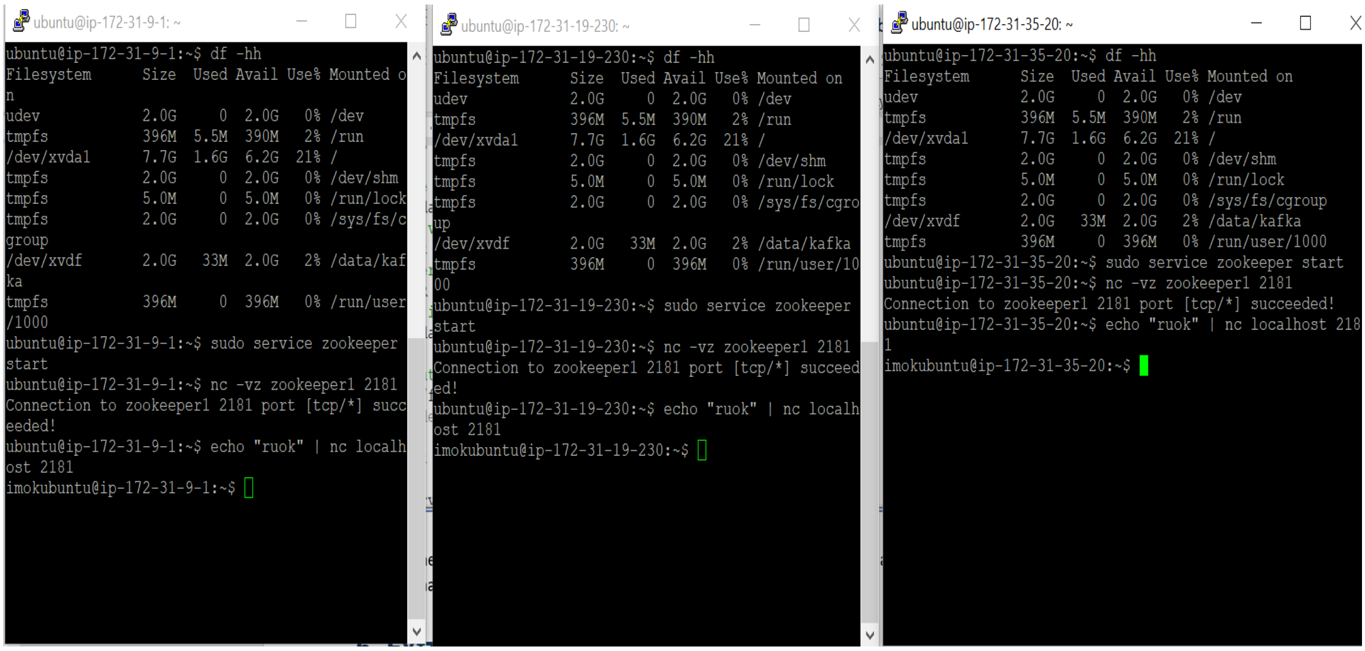
Figure 18 Modify Security Group to associate KAFKA Traffic

Then login to all the three servers via PUTTY and make sure you are in root folder. Execute following commands to mount /dev/xvdf as /dev/kafka and then restart zookeeper



```
# execute commands as root
sudo su

# Attach the EBS volume in the console, then
# view available disks
lsblk

# we verify the disk is empty - should return "data"
file -s /dev/xvdf

# Note on Kafka: it's better to format volumes as xfs:
# https://kafka.apache.org/documentation/#filesystems
# Install packages to mount as xfs
apt-get install -y xfsprogs

# create a partition
fdisk /dev/xvdf

# format as xfs
mkfs.xfs -f /dev/xvdf

# create kafka directory
mkdir /data/kafka
# mount volume
mount -t xfs /dev/xvdf /data/kafka
# add permissions to kafka directory
chown -R ubuntu:ubuntu /data/kafka
# check it's working
df -h /data/kafka

# EBS Automount On Reboot
cp /etc/fstab /etc/fstab.bak # backup
echo '/dev/xvdf /data/kafka xfs defaults 0 0' >> /etc/fstab

# reboot to test actions
reboot
sudo service zookeeper start
```

Then run these commands in all shell to check if /dev/xvdf has been mounted or not and after starting zookeeper check if it has properly started or not



```
ubuntu@ip-172-31-9-1:~$ df -hh
Filesystem      Size  Used Avail Use% Mounted o
n
udev            2.0G     0  2.0G   0% /dev
tmpfs           396M  5.5M  390M   2% /run
/dev/xvda1      7.7G  1.6G  6.2G  21% /
tmpfs           2.0G     0  2.0G   0% /dev/shm
tmpfs           5.0M     0  5.0M   0% /run/lock
tmpfs           2.0G     0  2.0G   0% /sys/fs/c
group
/dev/xvdf       2.0G   33M  2.0G   2% /data/kaf
ka
tmpfs           396M     0  396M   0% /run/user
/1000
ubuntu@ip-172-31-9-1:~$ sudo service zookeeper
start
ubuntu@ip-172-31-9-1:~$ nc -vz zookeeper1 2181
Connection to zookeeper1 2181 port [tcp/*] succ
eeded!
ubuntu@ip-172-31-9-1:~$ echo "ruok" | nc localh
ost 2181
imokubuntu@ip-172-31-9-1:~$
```

```
ubuntu@ip-172-31-19-230:~$ df -hh
Filesystem      Size  Used Avail Use% Mounted on
udev            2.0G     0  2.0G   0% /dev
tmpfs           396M  5.5M  390M   2% /run
/dev/xvda1      7.7G  1.6G  6.2G  21% /
tmpfs           2.0G     0  2.0G   0% /dev/shm
tmpfs           5.0M     0  5.0M   0% /run/lock
tmpfs           2.0G     0  2.0G   0% /sys/fs/cgro
up
/dev/xvdf       2.0G   33M  2.0G   2% /data/kafka
tmpfs           396M     0  396M   0% /run/user/10
00
ubuntu@ip-172-31-19-230:~$ sudo service zookeeper
start
ubuntu@ip-172-31-19-230:~$ nc -vz zookeeper1 2181
Connection to zookeeper1 2181 port [tcp/*] succeed
ed!
ubuntu@ip-172-31-19-230:~$ echo "ruok" | nc localh
ost 2181
imokubuntu@ip-172-31-19-230:~$
```

```
ubuntu@ip-172-31-35-20:~$ df -hh
Filesystem      Size  Used Avail Use% Mounted on
udev            2.0G     0  2.0G   0% /dev
tmpfs           396M  5.5M  390M   2% /run
/dev/xvda1      7.7G  1.6G  6.2G  21% /
tmpfs           2.0G     0  2.0G   0% /dev/shm
tmpfs           5.0M     0  5.0M   0% /run/lock
tmpfs           2.0G     0  2.0G   0% /sys/fs/cgroup
/dev/xvdf       2.0G   33M  2.0G   2% /data/kafka
tmpfs           396M     0  396M   0% /run/user/1000
ubuntu@ip-172-31-35-20:~$ sudo service zookeeper start
ubuntu@ip-172-31-35-20:~$ nc -vz zookeeper1 2181
Connection to zookeeper1 2181 port [tcp/*] succeeded!
ubuntu@ip-172-31-35-20:~$ echo "ruok" | nc localhost 218
1
imokubuntu@ip-172-31-35-20:~$
```

Figure 19 Restart Zookeeper and check if /dev/xvdf has been mounted

5.4 SINGLE KAFKA BROKER SETUP

Enter into all three servers are increase maximum count of open file handles by running this command

```
# Add file limits configs - allow to open 100,000 file descriptors
    echo "* hard nofile 100000
    * soft nofile 100000" | sudo tee --append /etc/security/limits.conf
# reboot for the file limit to be taken into account
    sudo reboot
# restart zookeeper
    sudo service zookeeper start
```

Then work with server 1 only and create server.properties file in server 1 (inside kafka) after removing config/server.properties inside kafka folder and then create a new file by doing nano config/server.properties and paste this content

```
############################# Server Basics #############################

# The id of the broker. This must be set to a unique integer for each broker.
broker.id=1
# change your.host.name by your machine's IP or hostname
advertised.listeners=PLAINTEXT://0.0.0.0:9092

# Switch to enable topic deletion or not, default value is false
delete.topic.enable=true

############################# Log Basics #############################

# A comma seperated list of directories under which to store log files
log.dirs=/data/kafka

# The default number of log partitions per topic. More partitions allow greater
# parallelism for consumption, but this will also result in more files across
# the brokers.
num.partitions=8
# we will have 3 brokers so the default replication factor should be 2 or 3
default.replication.factor=3
# number of ISR to have in order to minimize data loss
min.insync.replicas=2

############################# Log Retention Policy #############################

# The minimum age of a log file to be eligible for deletion due to age
# this will delete data after a week
log.retention.hours=168

# The maximum size of a log segment file. When this size is reached a new log segment will be created.
log.segment.bytes=1073741824

# The interval at which log segments are checked to see if they can be deleted according
# to the retention policies
```

```
log.retention.check.interval.ms=300000

############################## Zookeeper ##############################

# Zookeeper connection string (see zookeeper docs for details).
# This is a comma separated host:port pairs, each corresponding to a zk
# server. e.g. "127.0.0.1:3000,127.0.0.1:3001,127.0.0.1:3002".
# You can also append an optional chroot string to the urls to specify the
# root directory for all kafka znodes.
zookeeper.connect=zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka

# Timeout in ms for connecting to zookeeper
zookeeper.connection.timeout.ms=6000


############################## Other ##################################
# I recommend you set this to false in production.
auto.create.topics.enable=true
```

Then give permission by running this command (**sudo chown -R ubuntu:ubuntu /data/kafka**) in all three servers and then Launch KAFKA Server by running this command "**bin/kafka-server-start.sh config/server.properties**" and that should get started KAFKA Server

If you now log into ZooNavigator via Web Browser then you should see KAFKA alongside ZooKeeper.

Then run this command in all the three servers "**sudo nano /etc/init.d/kafka**" inside KAFKA directory and paste this content (CTRL+X Y Enter)

```
#!/bin/bash
#/etc/init.d/kafka
DAEMON_PATH=/home/ubuntu/kafka/bin
DAEMON_NAME=kafka
# Check that networking is up.
#[ ${NETWORKING} = "no" ] && exit 0

PATH=$PATH:$DAEMON_PATH

# See how we were called.
case "$1" in
 start)
    # Start daemon.
    pid=`ps ax | grep -i 'kafka.Kafka' | grep -v grep | awk '{print $1}'`
    if [ -n "$pid" ]
     then
       echo "Kafka is already running"
    else
     echo "Starting $DAEMON_NAME"
     $DAEMON_PATH/kafka-server-start.sh -daemon /home/ubuntu/kafka/config/server.properties
    fi
```

```
                ;;
            stop)
                echo "Shutting down $DAEMON_NAME"
                $DAEMON_PATH/kafka-server-stop.sh
                ;;
            restart)
                $0 stop
                sleep 2
                $0 start
                ;;
            status)
                pid=`ps ax | grep -i 'kafka.Kafka' | grep -v grep | awk '{print $1}'`
                if [ -n "$pid" ]
                  then
                  echo "Kafka is Running as PID: $pid"
                else
                  echo "Kafka is not Running"
                fi
                ;;
            *)
                echo "Usage: $0 {start|stop|restart|status}"
                exit 1
          esac

exit 0
```

Then make it executable by running this command “**sudo chmod +x /etc/init.d/kafka**” and “**sudo chown root:root /etc/init.d/kafka**” and “**sudo update-rc.d kafka defaults**” in this order

```
# start kafka
    sudo service kafka start
# verify it's working
    nc -vz localhost 9092
# look at the server logs
    cat /home/ubuntu/kafka/logs/server.log
# status of  kafka
    sudo service kafka status
```

Then create TOPIC in KAFKA

```
# create a topic
    bin/kafka-topics.sh --zookeeper zookeeper1:2181/kafka --create --topic first_topic --replication-factor 1 --partitions 3
```

Then produce data in TOPIC in KAFKA (*Before executing this step please modify inside KAFKA **config/server.properties** and modify **min.insync.replicas=1** because as of now we are running only one Broker but later on when quorum is setup then change it back to 1*)

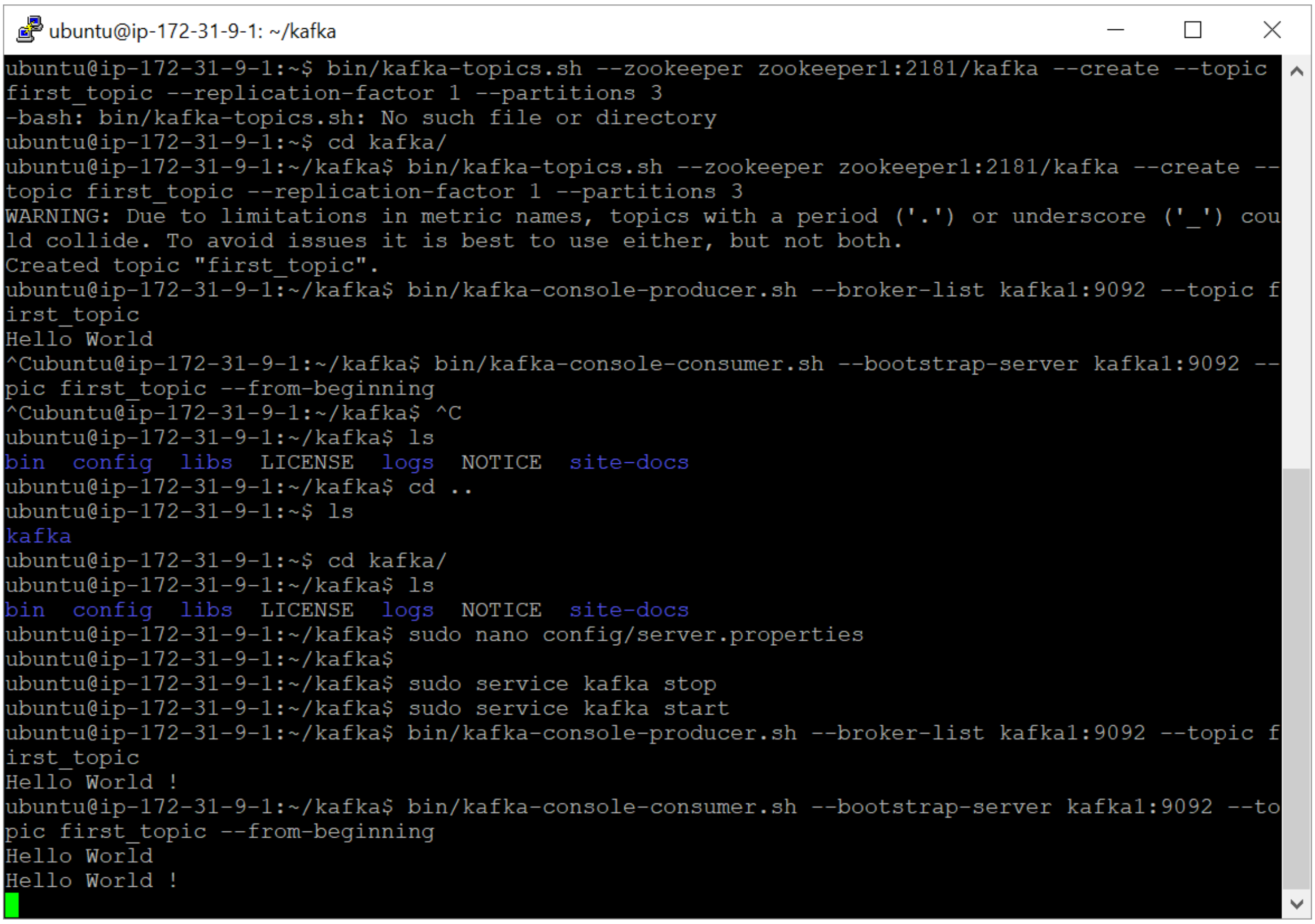
```
bin/kafka-console-producer.sh --broker-list kafka1:9092 --topic first_topic
        hi
        hello
        (exit)
```

# read that data

bin/kafka-console-consumer.sh --bootstrap-server kafka1:9092 --topic first_topic --from-beginning

# list kafka topics

bin/kafka-topics.sh --zookeeper zookeeper1:2181/kafka –list



```
ubuntu@ip-172-31-9-1:~$ bin/kafka-topics.sh --zookeeper zookeeper1:2181/kafka --create --topic
first_topic --replication-factor 1 --partitions 3
-bash: bin/kafka-topics.sh: No such file or directory
ubuntu@ip-172-31-9-1:~$ cd kafka/
ubuntu@ip-172-31-9-1:~/kafka$ bin/kafka-topics.sh --zookeeper zookeeper1:2181/kafka --create --
topic first_topic --replication-factor 1 --partitions 3
WARNING: Due to limitations in metric names, topics with a period ('.') or underscore ('_') cou
ld collide. To avoid issues it is best to use either, but not both.
Created topic "first_topic".
ubuntu@ip-172-31-9-1:~/kafka$ bin/kafka-console-producer.sh --broker-list kafka1:9092 --topic f
irst_topic
Hello World
^Cubuntu@ip-172-31-9-1:~/kafka$ bin/kafka-console-consumer.sh --bootstrap-server kafka1:9092 --
pic first_topic --from-beginning
^Cubuntu@ip-172-31-9-1:~/kafka$ ^C
ubuntu@ip-172-31-9-1:~/kafka$ ls
bin  config  libs  LICENSE  logs  NOTICE  site-docs
ubuntu@ip-172-31-9-1:~/kafka$ cd ..
ubuntu@ip-172-31-9-1:~$ ls
kafka
ubuntu@ip-172-31-9-1:~$ cd kafka/
ubuntu@ip-172-31-9-1:~/kafka$ ls
bin  config  libs  LICENSE  logs  NOTICE  site-docs
ubuntu@ip-172-31-9-1:~/kafka$ sudo nano config/server.properties
ubuntu@ip-172-31-9-1:~/kafka$
ubuntu@ip-172-31-9-1:~/kafka$ sudo service kafka stop
ubuntu@ip-172-31-9-1:~/kafka$ sudo service kafka start
ubuntu@ip-172-31-9-1:~/kafka$ bin/kafka-console-producer.sh --broker-list kafka1:9092 --topic f
irst_topic
Hello World !
ubuntu@ip-172-31-9-1:~/kafka$ bin/kafka-console-consumer.sh --bootstrap-server kafka1:9092 --to
pic first_topic --from-beginning
Hello World
Hello World !
```

5.5 KAFKA MULTI CLUSTER SETUP

Open file inside KAFKA directory in all three server config/server.properties and for first server make Broker ID as 1 and for second 2 and for third 3. Change Advertised Listeners in First server as PLAINTEXT://kafka1:9092 and in second server PLAINTEXT://kafka2:9092 and in third server PLAINTEXT://kafka3:9092 and ensure that min.insync.replicas in all three is set as 2. Save the file in all three servers.

# start kafka

sudo service kafka start

# verify it's working

nc -vz localhost 9092

# look at the server logs

cat /home/ubuntu/kafka/logs/server.log

# status of kafka

sudo service kafka status

if one of the server doesn't start then please check config/server.properties file and see if BROKER ID is correctly set. Sometimes if it still doesn't start then follow this trouble shooting

Getting an Error in Server-2 while starting KAFKA Server

[2018-07-08 20:50:37,888] FATAL Fatal error during KafkaServerStartable startup. Prepare to shutdown (kafka.server.KafkaServerStartable)

kafka.common.InconsistentBrokerIdException: Configured broker.id 2 doesn't match stored broker.id 1 in meta.properties. If you moved your data, make sure your configured broker.id matches. If you intend to create a new broker, you should remove all data in your data directories (log.dirs).

Solution:

By changing BROKER ID in meta.properties file from 1 to 2 and then restarted KAFKA Server

```
ubuntu@ip-172-31-19-230:/tmp$ cd ../../..
ubuntu@ip-172-31-19-230:/$ ls
bin   dev   initrd.img      lib64       mnt   root  snap  tmp  vmlinuz
boot  etc   initrd.img.old  lost+found  opt   run   srv   usr  vmlinuz.old
data  home  lib             media       proc  sbin  sys   var
ubuntu@ip-172-31-19-230:/$ cd data/
ubuntu@ip-172-31-19-230:/data$ ls
kafka  zookeeper
ubuntu@ip-172-31-19-230:/data$ cd kafka/
ubuntu@ip-172-31-19-230:/data/kafka$ ls
cleaner-offset-checkpoint  recovery-point-offset-checkpoint
meta.properties            replication-offset-checkpoint
ubuntu@ip-172-31-19-230:/data/kafka$ cat meta.properties
#
#Sun Jul 08 19:44:26 UTC 2018
version=0
broker.id=1 (Change this to 2 for server 2. This field sometimes doesn't correspond to
"CONFIG/SERVER.PROPERTIES" and it should correspond to BROKER ID as set in CONFIG/SERVER.PROPERTIES)
ubuntu@ip-172-31-19-230:/data/kafka$ sudo nano meta.properties
ubuntu@ip-172-31-19-230:/data/kafka$ sudo nano meta.properties
ubuntu@ip-172-31-19-230:/data/kafka$
```

# make sure to fix the __consumer_offsets topic

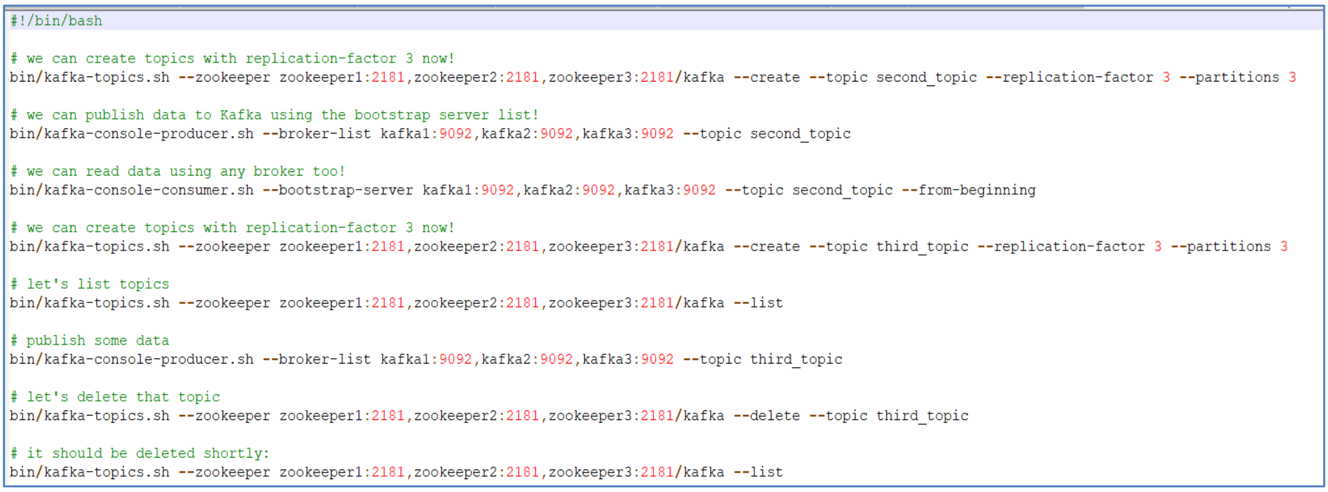
bin/kafka-topics.sh --zookeeper zookeeper1:2181/kafka --config min.insync.replicas=1 --topic __consumer_offsets –alter

# read the topic on broker 1 by connecting to broker 2!

bin/kafka-console-consumer.sh --bootstrap-server kafka2:9092 --topic first_topic --from-beginning

5.6 Testing the Kafka Cluster and Connecting from Outside

Can execute these commands from any server (Can execute this to shell of any of the three brokers). Replication factor is restricted to number of servers/brokers we have and hence limited to three in our case.

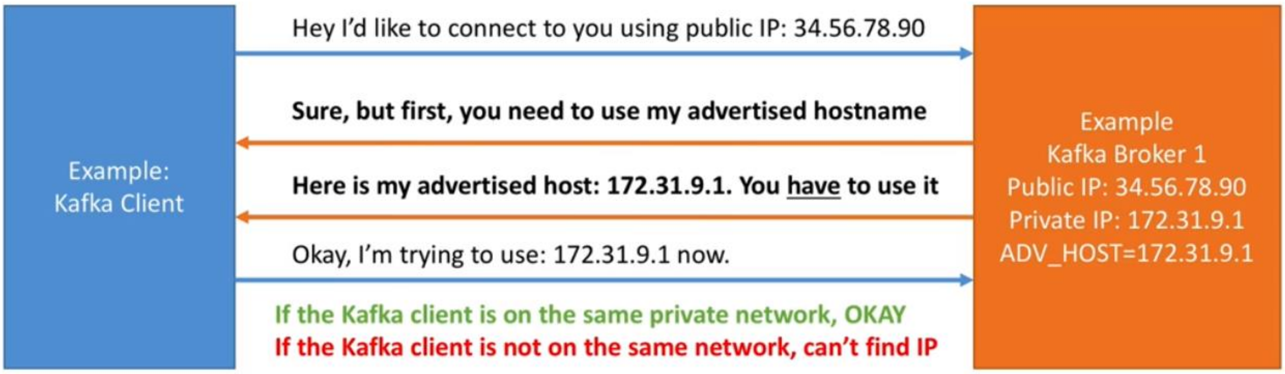


```
#!/bin/bash

# we can create topics with replication-factor 3 now!
bin/kafka-topics.sh --zookeeper zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka --create --topic second_topic --replication-factor 3 --partitions 3

# we can publish data to Kafka using the bootstrap server list!
bin/kafka-console-producer.sh --broker-list kafka1:9092,kafka2:9092,kafka3:9092 --topic second_topic

# we can read data using any broker too!
bin/kafka-console-consumer.sh --bootstrap-server kafka1:9092,kafka2:9092,kafka3:9092 --topic second_topic --from-beginning

# we can create topics with replication-factor 3 now!
bin/kafka-topics.sh --zookeeper zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka --create --topic third_topic --replication-factor 3 --partitions 3

# let's list topics
bin/kafka-topics.sh --zookeeper zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka --list

# publish some data
bin/kafka-console-producer.sh --broker-list kafka1:9092,kafka2:9092,kafka3:9092 --topic third_topic

# let's delete that topic
bin/kafka-topics.sh --zookeeper zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka --delete --topic third_topic

# it should be deleted shortly:
bin/kafka-topics.sh --zookeeper zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka --list
```

1. Creating a TOPIC
2. PUBLISH Data to the Topic
3. READ data from the Topic
4. LIST all Topics
5. DELETE a given topic

We need to be able to connect to KAFKA cluster from outside as well. Go to AWS Dashboard and make a note of each server connection string (The same connection string used to connect to KAFKA cluster)

The easiest way how to reach your Kafka server (version kafka_2.11-1.0.0) on EC2 from consumer in external network is to change the properties file



Example:
Kafka Client
Hey I'd like to connect to you using public IP: 34.56.78.90
Sure, but first, you need to use my advertised hostname
Here is my advertised host: 172.31.9.1. You have to use it
Okay, I'm trying to use: 172.31.9.1 now.
If the Kafka client is on the same private network, OKAY
If the Kafka client is not on the same network, can't find IP
Example
Kafka Broker 1
Public IP: 34.56.78.90
Private IP: 172.31.9.1
ADV_HOST=172.31.9.1

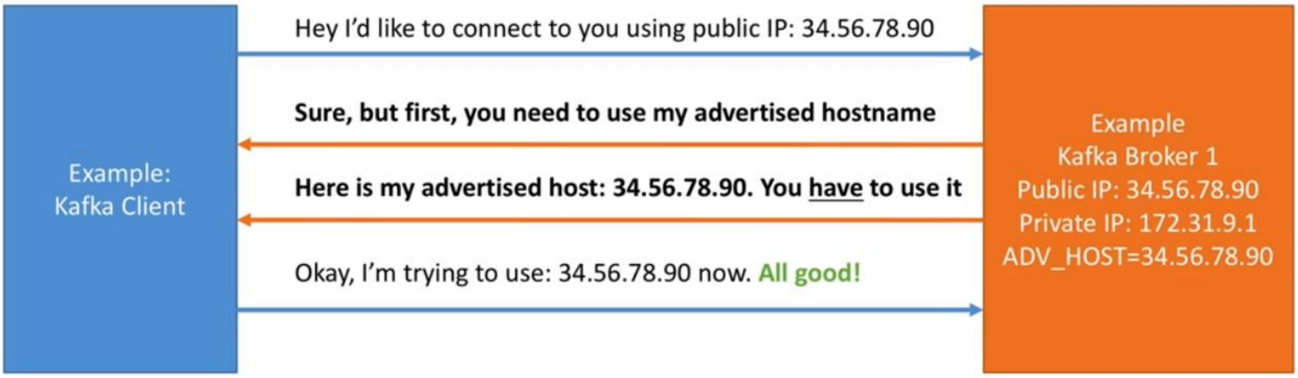

Example:
Kafka Client
Hey I'd like to connect to you using public IP: 34.56.78.90
Sure, but first, you need to use my advertised hostname
Here is my advertised host: 34.56.78.90. You have to use it
Okay, I'm trying to use: 34.56.78.90 now. All good!
Example
Kafka Broker 1
Public IP: 34.56.78.90
Private IP: 172.31.9.1
ADV_HOST=34.56.78.90

Figure 20 Advertised Listener (public/private IP)

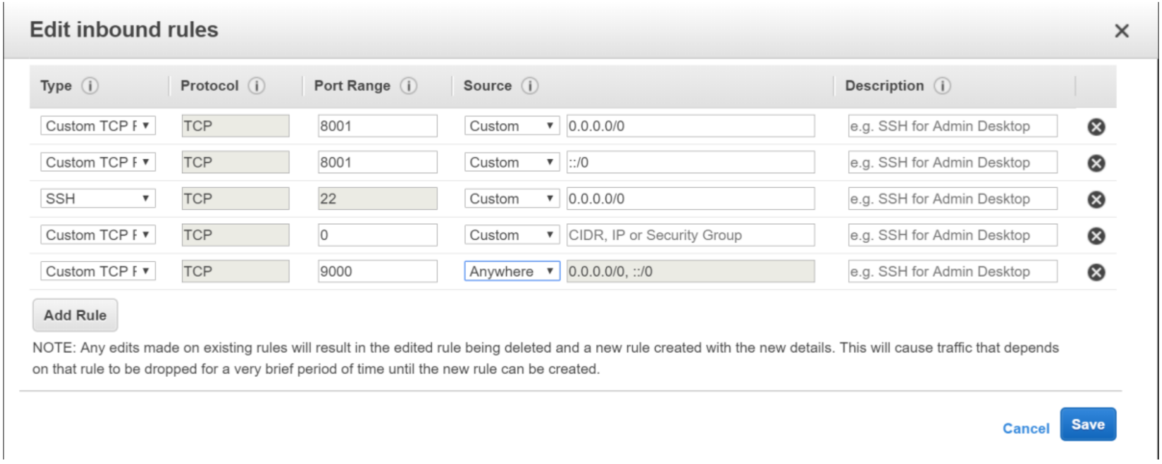
```
config/server.properties
```

And modify the following line and add the connection string corresponding to the connection string for three servers as obtained from Amazon AWS Dashboard. Edit this file in all three servers and change listeners property to hold the connection string corresponding to that particular server

```
listeners=PLAINTEXT://ec2-XXX-XXX-XXX-XXX.eu-central-1.compute.amazonaws.com:9092
```

5.7 KAFKA MANAGER FOR CLUSTER MANAGEMENT

Log into AWS and select Web Tools from Dashboard and modify security group for the same



Edit inbound rules ×

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ		Description ⓘ	
Custom TCP F ▾	TCP	8001	Custom ▾	0.0.0.0/0	e.g. SSH for Admin Desktop	⊗
Custom TCP F ▾	TCP	8001	Custom ▾	::/0	e.g. SSH for Admin Desktop	⊗
SSH ▾	TCP	22	Custom ▾	0.0.0.0/0	e.g. SSH for Admin Desktop	⊗
Custom TCP F ▾	TCP	0	Custom ▾	CIDR, IP or Security Group	e.g. SSH for Admin Desktop	⊗
Custom TCP F ▾	TCP	9000	Anywhere ▾	0.0.0.0/0, ::/0	e.g. SSH for Admin Desktop	⊗

Add Rule

NOTE: Any edits made on existing rules will result in the edited rule being deleted and a new rule created with the new details. This will cause traffic that depends on that rule to be dropped for a very brief period of time until the new rule can be created.

Cancel Save

Figure 21 Adding Port 9000 in Webtool (Accessible)

Log into (SSH) Web Tool EC2 instance. Execute these commands (First phase of commands to check if we can connect to Zookeeper and KAFKA independently)

```
#!/bin/bash

# make sure you open port 9000 on the security group

# make sure you can access the zookeeper endpoints
nc -vz zookeeper1 2181
nc -vz zookeeper2 2181
nc -vz zookeeper3 2181

# make sure you can access the kafka endpoints
nc -vz kafka1 9092
nc -vz kafka2 9092
nc -vz kafka3 9092

# copy the kafka-manager-docker-compose.yml file
nano kafka-manager-docker-compose.yml
```

Insert this content in file Opened

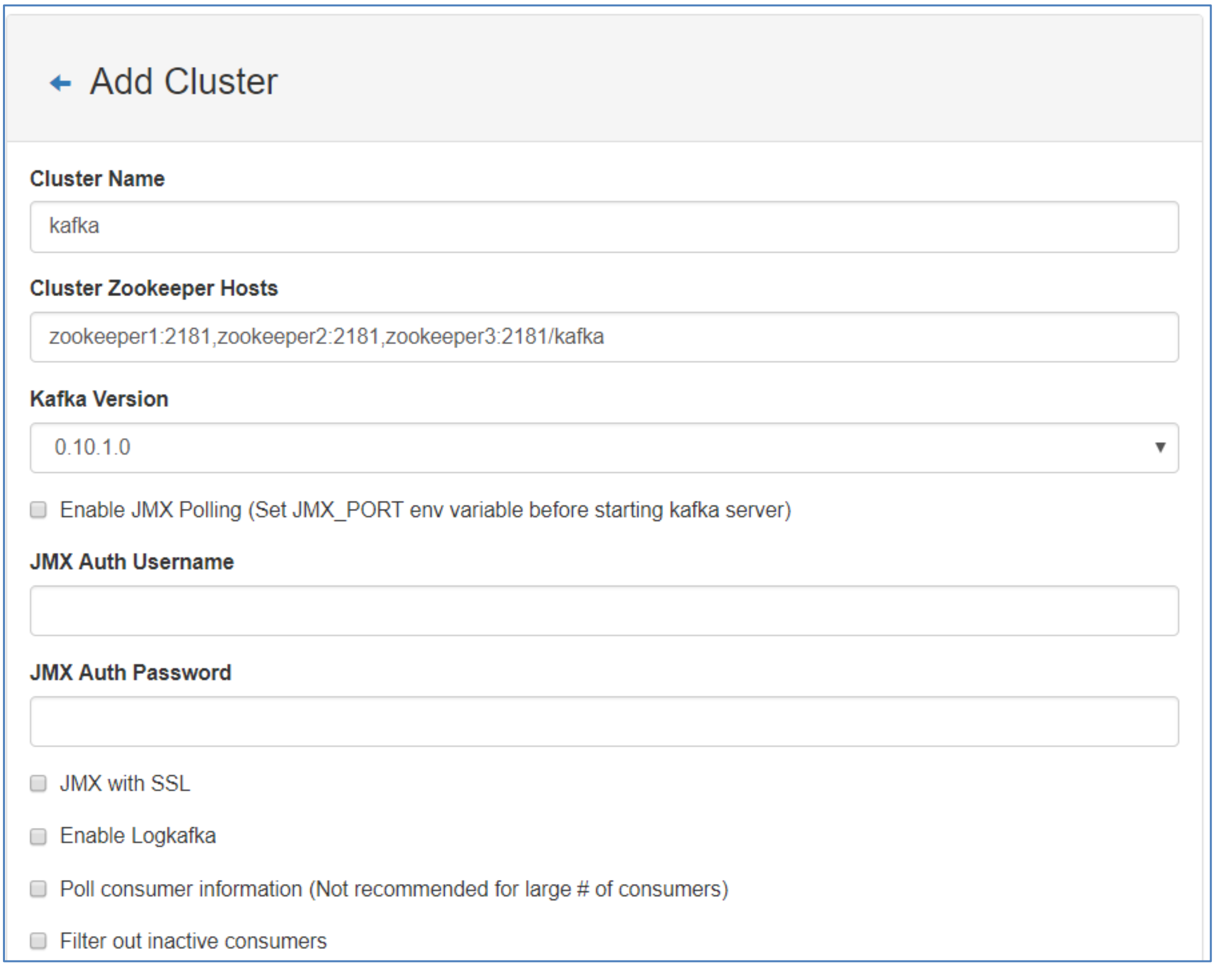
```
version: '2'

services:
  # https://github.com/yahoo/kafka-manager
  kafka-manager:
    image: qnib/plain-kafka-manager
    network_mode: host
    environment:
      ZOOKEEPER_HOSTS: "zookeeper1:2181,zookeeper2:2181,zookeeper3:2181"
      APPLICATION_SECRET: change_me_please
            restart: always
```

```
# launch it
docker-compose -f kafka-manager-docker-compose.yml up -d
```

Do a **docker ps** to check if KAFKA manager is running in Web Tool Instance

Open a web browser and browse into the public IP of your web tool instance (Port 9000 which we opened in security group). That should give you KAFKA manager up and running. Opening ZooNavigator will show KAFKA Manager alongside kafka and zookeeper.

Then go to KAFKA Manager web UI and Add Cluster and Make these settings



← Add Cluster

Cluster Name

kafka

Cluster Zookeeper Hosts

zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka

Kafka Version

0.10.1.0 ▾

□ Enable JMX Polling (Set JMX_PORT env variable before starting kafka server)

JMX Auth Username

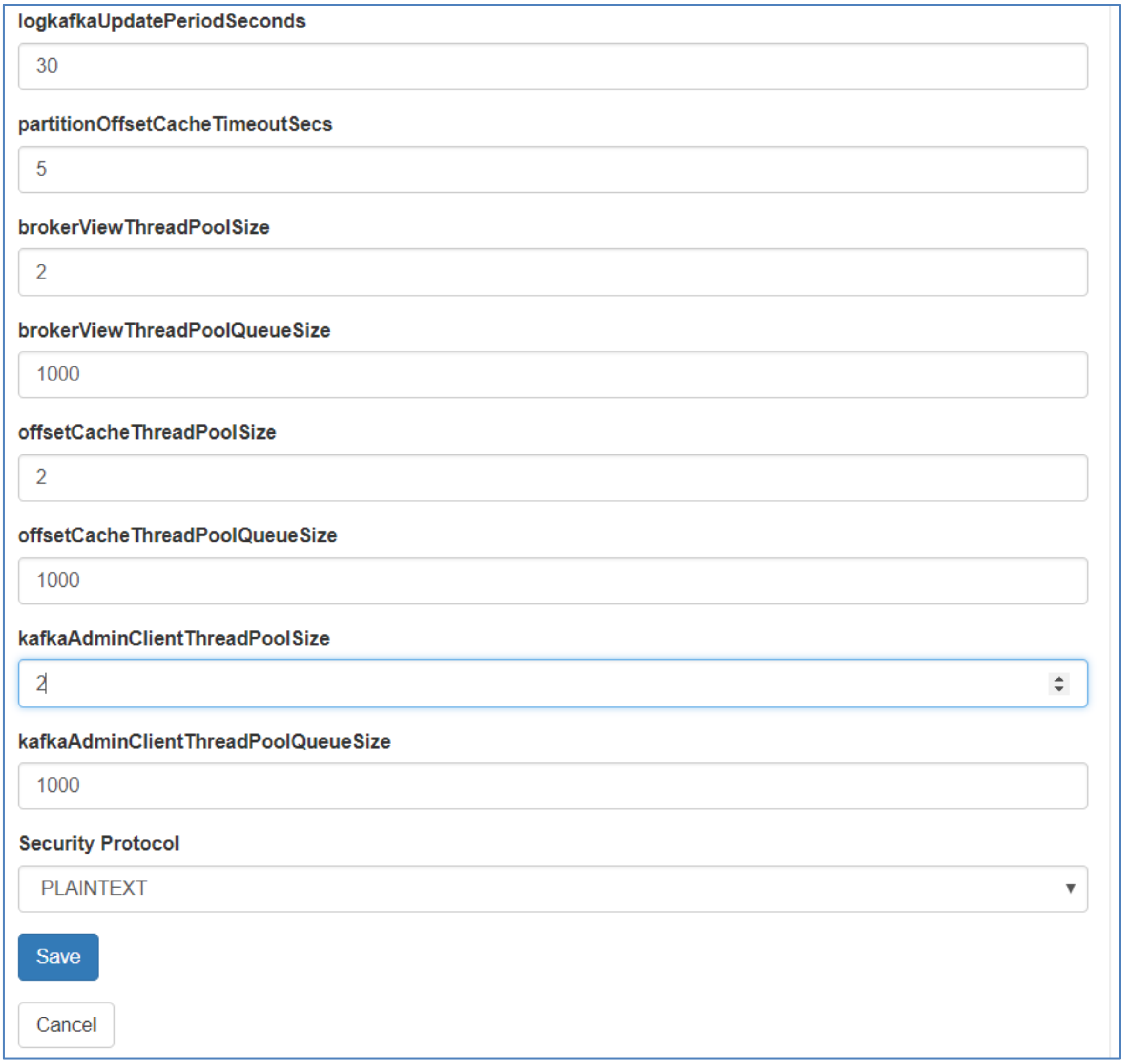
JMX Auth Password

□ JMX with SSL

□ Enable Logkafka

□ Poll consumer information (Not recommended for large # of consumers)

□ Filter out inactive consumers



logkafkaUpdatePeriodSeconds

30

partitionOffsetCacheTimeoutSecs

5

brokerViewThreadPoolSize

2

brokerViewThreadPoolQueueSize

1000

offsetCacheThreadPoolSize

2

offsetCacheThreadPoolQueueSize

1000

kafkaAdminClientThreadPoolSize

2

kafkaAdminClientThreadPoolQueueSize

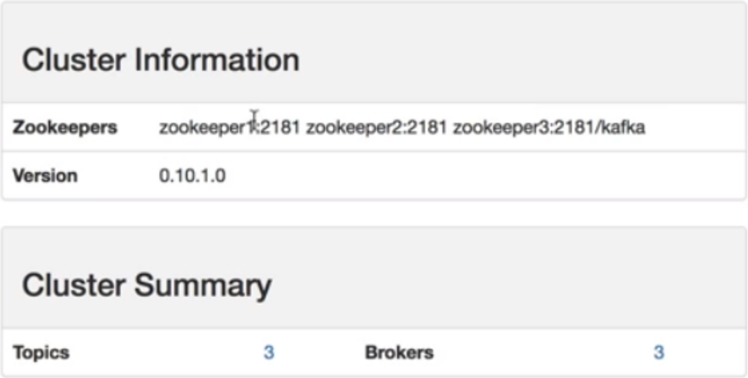
1000

Security Protocol

PLAINTEXT

Figure 22 KAFKA Manager Settings

Going to Cluster view depicts how many Topics are there and How many Brokers.



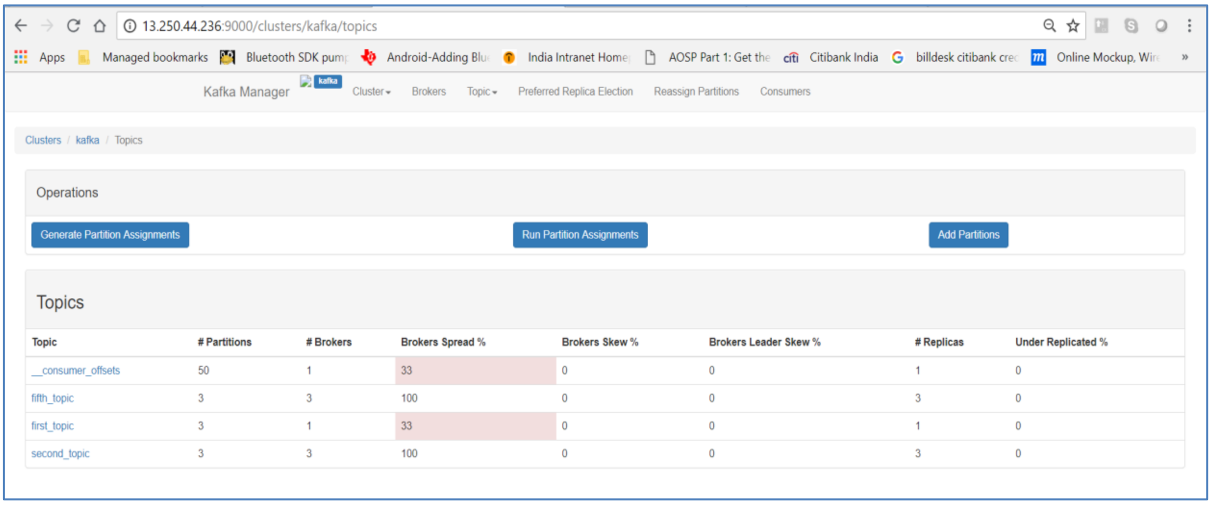
Cluster Information

Zookeepers	zookeeper1:2181 zookeeper2:2181 zookeeper3:2181/kafka
Version	0.10.1.0

Cluster Summary

Topics	3	Brokers	3

Figure 23 KAFKA Manager Cluster View



Topics

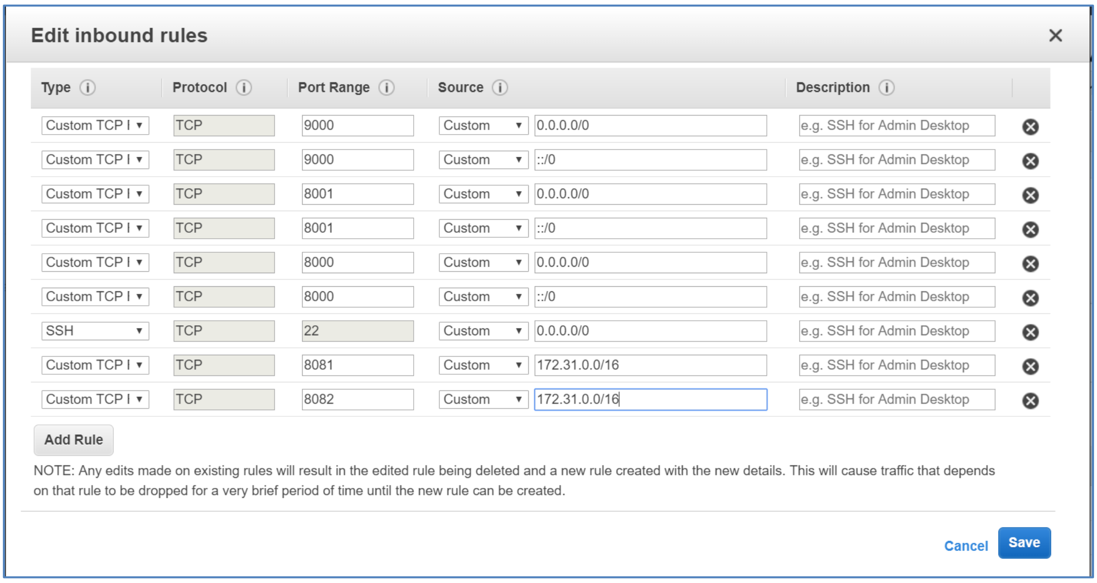
Topic	# Partitions	# Brokers	Brokers Spread %	Brokers Skew %	Brokers Leader Skew %	# Replicas	Under Replicated %
__consumer_offsets	50	1	33	0	0	1	0
fifth_topic	3	3	100	0	0	3	0
first_topic	3	1	33	0	0	1	0
second_topic	3	3	100	0	0	3	0

Figure 23 KAFKA Manager Topic View

It goes onto show that few topics are in red because their spread is not good across brokers. This tool allows you to manage/create/delete partitions/topics.

6 INSTALLING KAFKA TOPICS UI, CONFLUENT REST PROXY AND SCHEMA

SSH into EC2 instance of Web Tool and from AWS dashboard select instance corresponding to Web tool and edit the security group setting and open port 8000 custom TCP for all IPs (You can select My IP if your IP is static)



Edit inbound rules

Type	Protocol	Port Range	Source		Description
Custom TCP I	TCP	9000	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop
Custom TCP I	TCP	9000	Custom	::/0	e.g. SSH for Admin Desktop
Custom TCP I	TCP	8001	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop
Custom TCP I	TCP	8001	Custom	::/0	e.g. SSH for Admin Desktop
Custom TCP I	TCP	8000	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop
Custom TCP I	TCP	8000	Custom	::/0	e.g. SSH for Admin Desktop
SSH	TCP	22	Custom	0.0.0.0/0	e.g. SSH for Admin Desktop
Custom TCP I	TCP	8081	Custom	172.31.0.0/16	e.g. SSH for Admin Desktop
Custom TCP I	TCP	8082	Custom	172.31.0.0/16	e.g. SSH for Admin Desktop

NOTE: Any edits made on existing rules will result in the edited rule being deleted and a new rule created with the new details. This will cause traffic that depends on that rule to be dropped for a very brief period of time until the new rule can be created.

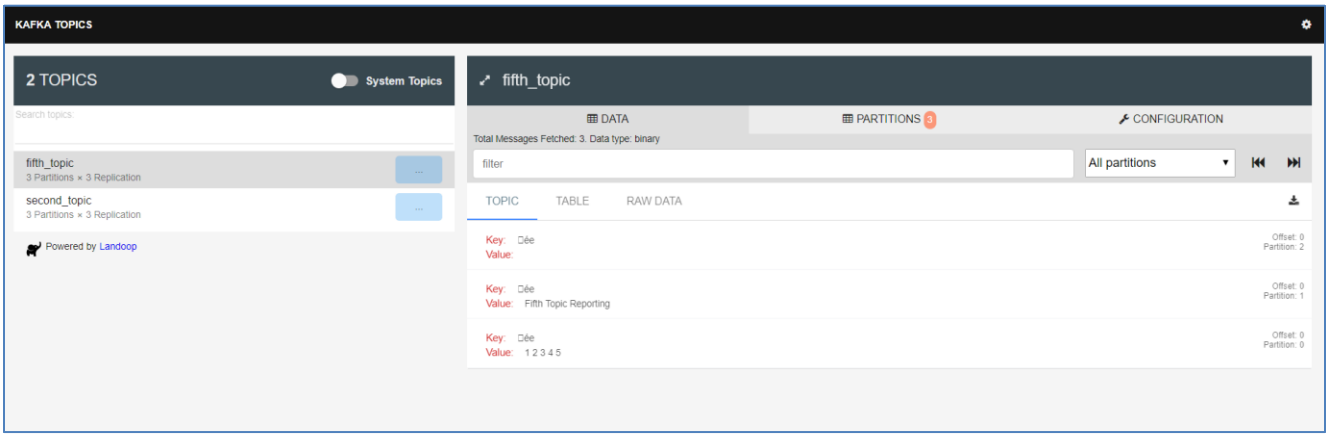
Figure 24 Opening ports in Web tool for Confluent Registry etc.

Log into Web tool and use this command nano kafka-topics-ui-docker-compose.yml and please ensure that “SCHEMA_REGISTRY_HOST_NAME: "13.250.44.236"” and “KAFKA_REST_HOST_NAME: "13.250.44.236"” has the Public IP corresponding to your Web Tool Instance in AWS

```
version: '2'

services:
 # https://github.com/confluentinc/schema-registry
 confluent-schema-registry:
  image: confluentinc/cp-schema-registry:3.2.1
  network_mode: host
  environment:
   SCHEMA_REGISTRY_KAFKASTORE_CONNECTION_URL:
zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka
   SCHEMA_REGISTRY_LISTENERS: http://0.0.0.0:8081
   # please replace this setting by the IP of your web tools server
   #SCHEMA_REGISTRY_HOST_NAME: "54.206.91.106"
   SCHEMA_REGISTRY_HOST_NAME: "13.250.44.236"
  restart: always

 # https://github.com/confluentinc/kafka-rest
 confluent-rest-proxy:
  image: confluentinc/cp-kafka-rest:3.2.1
  network_mode: host
  environment:
   KAFKA_REST_BOOTSTRAP_SERVERS: kafka1:9092,kafka2:9092,kafka3:9092
   KAFKA_REST_ZOOKEEPER_CONNECT:
zookeeper1:2181,zookeeper2:2181,zookeeper3:2181/kafka
   KAFKA_REST_LISTENERS: http://0.0.0.0:8082/
   KAFKA_REST_SCHEMA_REGISTRY_URL: http://localhost:8081/
   # please replace this setting by the IP of your web tools server
   #KAFKA_REST_HOST_NAME: "54.206.91.106"
   KAFKA_REST_HOST_NAME: "13.250.44.236"
  depends_on:
   - confluent-schema-registry
  restart: always

 # https://github.com/Landoop/kafka-topics-ui
 kafka-topics-ui:
  image: landoop/kafka-topics-ui:0.9.2
  network_mode: host
  environment:
   KAFKA_REST_PROXY_URL: http://localhost:8082
   PROXY: "TRUE"
  depends_on:
   - confluent-rest-proxy
         restart: always
```

```
# launch it by running this command
   docker-compose -f  kafka-topics-ui-docker-compose.yml up -d
```

Then you can log into Web browser (Public IP of Web Tool Instance and Port 8000) and you can see all Topics/Partition. It allows you to examine data in each topic



fifth_topic
3 Partitions × 3 Replication

second_topic
3 Partitions × 3 Replication

Total Messages Fetched: 3. Data type: binary

Key: Dée
Value:
Offset: 0
Partition: 2

Key: Dée
Value: Fifth Topic Reporting
Offset: 0
Partition: 1

Key: Dée
Value: 1 2 3 4 5
Offset: 0
Partition: 0

Figure 25 KAFKA Topics UI

7 CONCLUSION

We have seen how to set up Amazon AWS EC2 instances and configure KAFKA and Zookeeper and all associated tools. Zookeeper is the foundation of many “Distributed Processing” based system and KAFKA is a cornerstone of internet enabled projects dealing with massive inflow/outflow of data (example IOT).