Hardware:

8 GB RAM , 30 GB HDD , Centos 7 or above OS. Access to internet.

Software Inventory:

- Zookeeper Version: apache-zookeeper-3.8.0-bin.tar
- Apache kafka : 2.13-3.2.1
- JDK 11.0.16
- Eclipse for Linux. (Any Latest version for JEE Development)
- Status : Color is Verified

Last Updated: Dec 25 - 2022.

1. Prerequisites:

Option I

Start the VM using VM player and Logon to the server using telnet or directly in the VM console. Enter the root credentials to logon.

You can copy files from the host to VM using winscp.exe.

Option II.

Using docker:
Instantiate a container, kafka0.
You can copy files from the host to container using docker copy command.

Execute the following command, it will perform the following:

- Create a network : spark-net
- download the image, centos:7
- start a container with the name, kafka0 and mount host folder in /opt

#docker network create --driver bridge spark-net

#docker run --name kafka0 --hostname kafka0 -p 9092:9092 -p 8081:8081 -p 2181:2181 –p 9999:9999 -i -t --privileged --network spark-net -v /Users/henrypotsangbam/Documents/Software:/Software centos:8 /usr/sbin/init

Optional:
#docker run --name kafka0 --hostname kafka0 -p 9092:9092 -p 9081:8081 -p 9082:8082 -p 3181:2181 -p 9990:9999 -p 9021:9021 -i -t --privileged --network spark-net -v /Volumes/Samsung_T5/software/:/Software -v /Volumes/Samsung_T5/software/install/:/opt -v /Volumes/Samsung_T5/software/data/:/data centos:7 /usr/sbin/init

You can verify the container from a separate terminal:

```
(base) Henrys-MacBook-Air:~ henrypotsangbam$ docker ps
CONTAINER ID        IMAGE                                COMMAND             CREATED             STATUS
        PORTS                                        NAMES
0945477d457b        ehenry0227/learning:spark-kafka-raw  "/bin/bash"         34 seconds ago      Up 33 secon
ds      0.0.0.0:6062->6062/tcp, 0.0.0.0:8081->8081/tcp  kafka0
(base) Henrys-MacBook-Air:~ henrypotsangbam$
```

Perform the installation after this as a normal server.

Update the server.properties.

// Don’t change the listeners address if the client also run in the host machine.

advertised.listeners=PLAINTEXT://localhost:9092

After installation to start the zookeeper and kafka broker:

Open two separate terminals and execute the following

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

Kafka 2nd Cluster: (It will be used as DC2 for Kafka Mirroring)

```
#docker run --name kafka1 --hostname kafka1  -p 7092:9092 -p 7081:8081 -p 4181:2181 -p
8999:9999 -i -t --privileged --network spark-net -v
/Volumes/Samsung_T5/software/:/Software -v
/Volumes/Samsung_T5/software/install/:/opt -v
/Volumes/Samsung_T5/software/data/:/data centos:7 /usr/sbin/init
```

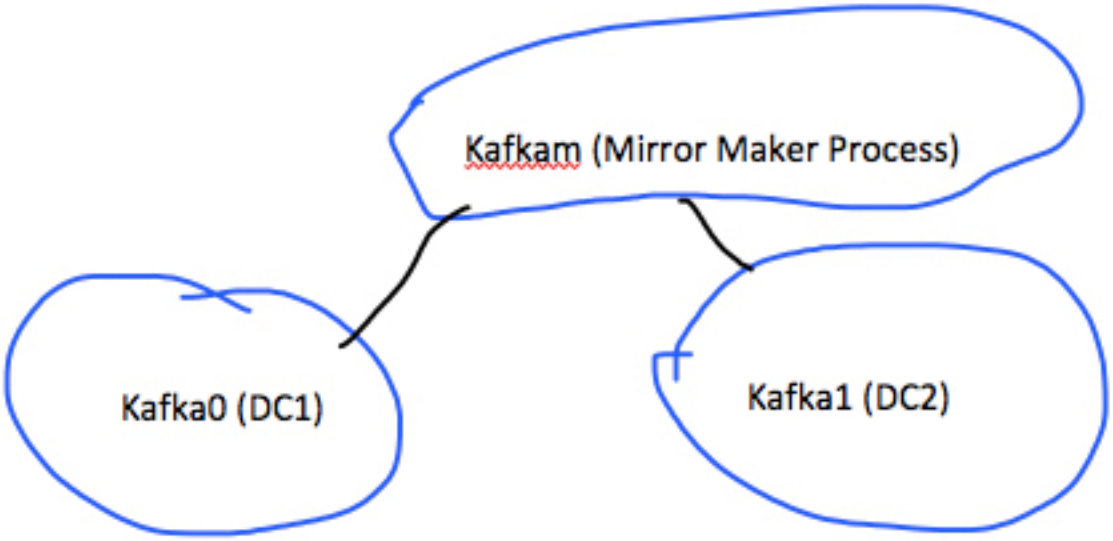
Install the kafka as done before if required or copy the kafka folder in different name to persevere the libraries.

Kafka Mirror Maker: (It will execute the Kafka Mirroring process)

```
#docker run --name kafkam --hostname kafkam  -p 6092:9092 -p 6081:8081  -i -t --
privileged --network spark-net -v /Users/henrypotsangbam/Documents/Docker:/opt
centos:7 /usr/sbin/init
```

Kafka Mirror Architecture:

12:46 PM



Note:
If you are using docker ensure to update the server.properties with the following entries for accessing the broker from the host machine.

// Changes Begin

listeners=PLAINTEXT://0.0.0.0:9092,PLAINTEXT_HOST://0.0.0.0:8081
advertised.listeners=PLAINTEXT://kafka0:9092,PLAINTEXT_HOST://localhost:8081
listener.security.protocol.map=PLAINTEXT:PLAINTEXT,PLAINTEXT_HOST:PLAINTEXT

// Changes End

use container, kafka0 to connect from Docker. However, use localhost:8081 for connecting from the Host machine.

kafka_2.13-3.2.1.tgz
jdk-11.0.16_linux-aarch64_bin.tar
apache-zookeeper-3.8.0-bin.tar.gz

2. Installation of Kafka – 90 Mins

You need to install java before installing zookeeper and Kafka.

Installation of Java
#tar -xvf jdk-11.0.16_linux* -C /opt
#cd /opt
#mv jdk* jdk

Set the above path in the PATH variable and JAVA_HOME

Update profile as follow:

#vi ~/.bashrc

export JAVA_HOME=/opt/jdk
export PATH=$PATH:$JAVA_HOME/bin

Update the shell scripts using the following command.
#bash

Installing Zookeeper

You can choose any of the options given below:

Option I (Fresh Installation): (We will use this for our lab)

The following steps install Zookeeper with a basic configuration in /opt/zookeeper.
Its configured to store data in /opt/data/zookeeper:

Extract the zookeeper archive file in /opt and rename the installation folder for brevity.

```
# tar -xvf apache-zookeeper* -C /opt
#cd /opt
#mv a*zookeeper* /opt/zookeeper
#mkdir -p /opt/data/zookeeper
```

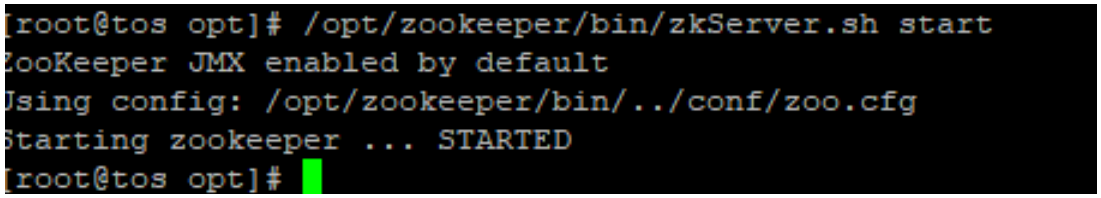
Create a zookeeper configuration file and update with the following values.

```
#vi /opt/zookeeper/conf/zoo.cfg
 tickTime=2000
 dataDir=/opt/data/zookeeper
 clientPort=2181
```

Update the zoo.cfg with the above entries. You can save the file using esc+wq!

Start the zookeeper using the following scripts.

/opt/zookeeper/bin/zkServer.sh start



Option II (Part of the Apache Kafka) – Skip.

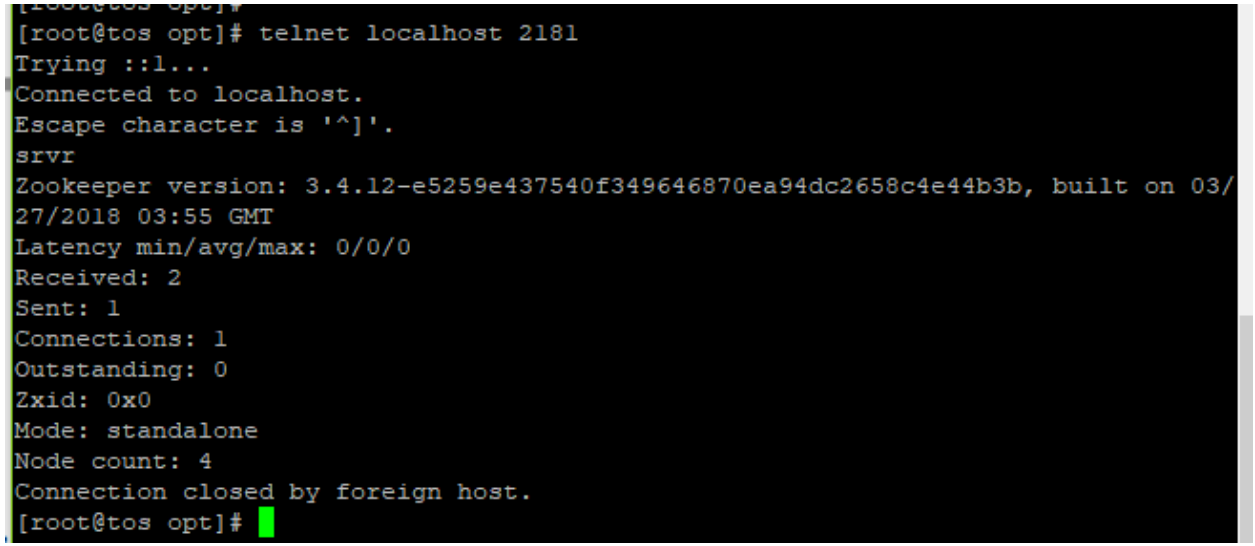
```
#bin/zookeeper-server-start.sh config/zookeeper.properties
```

Option II Ends Here.

You can now validate that Zookeeper is running correctly in standalone mode by connecting to the client port and sending the four-letter command srvr:
#yum install telnet

#telnet localhost 2181

- srvr



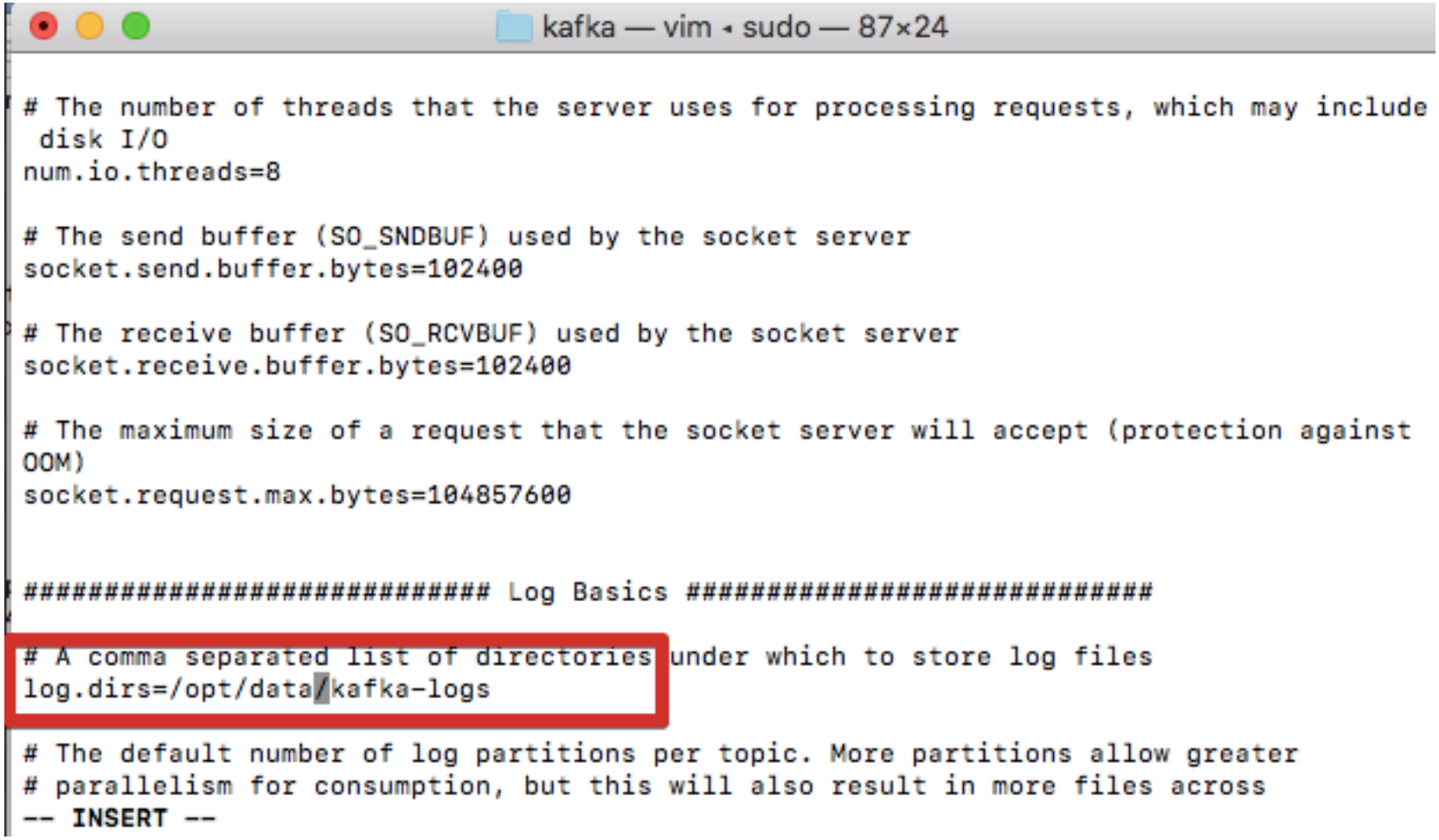
After zookeeper installation, let us install the Kafka Broker.

Installation of Kafka Broker

The following example installs Kafka in /opt/kafka, configured to use the Zookeeper server started previously and to store the message log segments stored in /tmp/kafka-logs:

```
# tar -xvf kafka_2*–C /opt
#cd /opt
# mv kafka_2* /opt/kafka
# mkdir /opt/data/kafka-logs
```

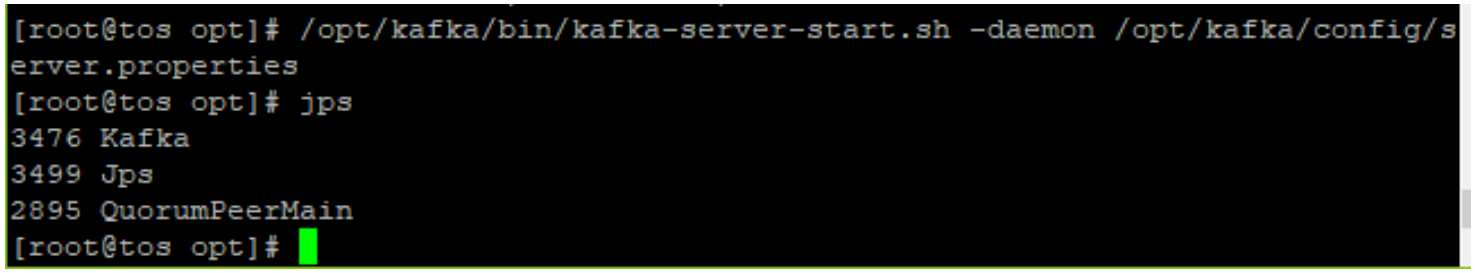
Update the /opt/kafka/config/server.properties to store the Kafka Log in the above mention folder.



If you are using docker, kindly refer the prerequisite section for setting specific to docker.

Start the broker with the following command

/opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties



#mkdir /opt/scripts

All the common execution scripts will be stored in the above folder.
The following scripts will start a zookeeper along with a broker. Create the following files and update with the following scripts. It will start the zookeeper and kafka broker using the mention script.

#cd /opt/scripts
#vi startABroker.sh
############################ Scripts Begin ####################
#!/usr/bin/env bash

```
# Start Zookeeper.
/opt/zookeeper/bin/zkServer.sh start

#Start Kafka Server
/opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties


echo "Started Successfully"

//########################################## Scripts End
####################
To shutdown the Broker, find the process and kill.
ps -eaf  | grep java
or
create a scripts : /opt/scripts/stopBroker.sh with the following commands in it.
#!/usr/bin/env bash
/opt/kafka/bin/kafka-server-stop.sh
```

To Stop Zookeeper create the following script. Don't include the ---- line.

```
#vi /opt/scripts/stopZookeeper.sh
Update the following commands in the above script and save it.
-----------------------------------------------------------------
#!/usr/bin/env bash
# Stop Zookeeper.
```

/opt/zookeeper/bin/zkServer.sh stop
echo "Stop zookeeper Successfully"

To reinitialize the Cluster.
#vi reinitializeCluster.sh

```
#!/usr/bin/env bash

rm -fr /opt/kafka/data/kafka-logs/*
rm -fr /opt/kafka/data/zookeeper/*

cp /opt/kafka/config/server.properties_plain /opt/kafka/config/server.properties

echo "Reinitialize Successfully"
```

Lab Installation completes End here.

3. Installation Confluent Kafka (Local) – 30 Minutes

The purpose of this lab is to demonstrates the basic and most powerful capabilities of Confluent Platform – Schema Registry.

Install Confluent kafka with the following step.

Inflate the confluent kafka compress file as shown below:

#tar -xvf confluent-7.2.2.tar -C /opt

Rename the folder.

#cd /opt

mv confluent-7.2.2 confluent

Set the environment variable for the Confluent Platform directory.

```
export CONFLUENT_HOME=/opt/confluent
```

Set your PATH variable:

vi ~/.bashrc

```
export PATH=/opt/confluent/bin:${PATH};
```

type the following to activate the script.

#bash

---------- Lab Ends Here ----------

4. Basic Kafka Operations - CLI (Topic) – 30 Mins

In this lab you will be able to create a topic and perform some operations to understand the information about topic like partition and replication.
You need to start the broker using startABroker.sh. The script should be in /opt/scripts folder
#sh startABroker.sh
#jps

```
[root@tos scripts]# sh startABroker.sh
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
Started Successfully
[root@tos scripts]# jps
11665 Jps
11646 Kafka
11375 QuorumPeerMain
[root@tos scripts]#
```

Once the Kafka broker is started, we can verify that it is working by performing some simple operations against the broker; creating a test topic etc.

Create and verify details about topic:

/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server kafka0:9092 --replication-factor 1 --partitions 1 --topic test

/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server localhost:9092 --replication-factor 1 --partitions 12 --topic IBM

/opt/kafka/bin/kafka-topics.sh --bootstrap-server localhost:9092 --describe --topic test

#/opt/kafka/bin/kafka-topics.sh --bootstrap-server localhost:9092 --describe --topic IBM

```
[root@tos opt]# /opt/kafka/bin/kafka-topics.sh --create --zookeeper localhost:21
81 --replication-factor 1 --partitions 1 --topic test
Created topic "test".
[root@tos opt]# /opt/kafka/bin/kafka-topics.sh --zookeeper localhost:2181 --desc
ribe --topic test
Topic:test      PartitionCount:1        ReplicationFactor:1     Configs:
        Topic: test     Partition: 0    Leader: 0       Replicas: 0     Isr: 0
[root@tos opt]#
```

Verify the no of partition in the output.

list and describe topic.

#/opt/kafka/bin/kafka-topics.sh --bootstrap-server localhost:9092 --list

```
[root@tos ~]# /opt/kafka/bin/kafka-topics.sh --zookeeper localhost:2181 --list
__consumer_offsets
my-failsafe-topic
test
```

List and describe Topics

What does the tool do?
This tool lists the information for a given list of topics. If no topics are provided in the command line, the tool queries zookeeper to get all the topics and lists the information for them. The fields that the tool displays are - topic name, partition, leader, replicas, isr.

How to use the tool?

List only single topic named "test" (prints only topic name)

#/opt/kafka/bin/kafka-topics.sh --list --bootstrap-server localhost:9092 --topic test

List all topics (prints only topic names)
#/opt/kafka/bin/kafka-topics.sh --list --bootstrap-server localhost:9092

```
[root@tos scripts]# jps
12960 Jps
12314 Kafka
12043 QuorumPeerMain
[root@tos scripts]# /opt/kafka/bin/kafka-topics.sh --list --zookeeper tos.master.com:2181 --topic
 test
test
[root@tos scripts]# /opt/kafka/bin/kafka-topics.sh --list --zookeeper localhost:2181
CustomerCountry
__consumer_offsets
henry-topic
my-failsafe-topic
my-kafka-topic
my-kafka-topic1
test
test-topic
```

Describe only single topic named "test" (prints details about the topic)

#/opt/kafka/bin/kafka-topics.sh --describe --bootstrap-server localhost:9092 --topic test

Describe all topics (prints details about the topics)
#/opt/kafka/bin/kafka-topics.sh --describe --bootstrap-server localhost:9092

```
[root@tos scripts]#
[root@tos scripts]# /opt/kafka/bin/kafka-topics.sh --describe --zookeeper localhost:2181 --topic
test
Topic:test      PartitionCount:1        ReplicationFactor:1     Configs:
        Topic: test     Partition: 0    Leader: 0       Replicas: 0     Isr: 0
[root@tos scripts]# /opt/kafka/bin/kafka-topics.sh --describe --zookeeper localhost:2181
Topic:CustomerCountry   PartitionCount:1        ReplicationFactor:1     Configs:
        Topic: CustomerCountry  Partition: 0    Leader: 1       Replicas: 1     Isr: 1
Topic:__consumer_offsets        PartitionCount:50       ReplicationFactor:1     Configs:segment.b
ytes=104857600,cleanup.policy=compact,compression.type=producer
        Topic: __consumer_offsets       Partition: 0    Leader: 1       Replicas: 1     Isr: 1
        Topic: __consumer_offsets       Partition: 1    Leader: 2       Replicas: 2     Isr: 2
```

We will understand the output in details later.

Create Topics
What does the tool do?
By default, Kafka auto creates topic if "auto.create.topics.enable" is set to true on the server. This creates a topic with a default number of partitions, replication factor and uses Kafka's default scheme to do replica assignment. Sometimes, it may be required that we would like to customize a topic while creating it. This tool helps to create a topic and also specify the number of partitions, replication factor and replica assignment list for the topic.

How to use the tool?

create topic with default settings

#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server localhost:9092 --topic topic1 --partitions 2 --replication-factor 1

```
[root@tos scripts]# /opt/kafka/bin/kafka-topics.sh --create --zookeeper localhost:2181 --topic to
pic1 --partitions 2 --replication-factor 1
Created topic "topic1".
[root@tos scripts]#
```

Create a topic with replication 2.

#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server localhost:9092 --topic topic2 --partitions 2 --replication-factor 2

```
[root@kafka0 /]# /opt/kafka/bin/kafka-topics.sh --create --zookeeper localhost:2181 --topic topic2 --partition
s 2 --replication-factor 2
Error while executing topic command : Replication factor: 2 larger than available brokers: 1.
[2022-01-10 07:44:51,716] ERROR org.apache.kafka.common.errors.InvalidReplicationFactorException: Replication
factor: 2 larger than available brokers: 1.
 (kafka.admin.TopicCommand$)
[root@kafka0 /]# /opt/kafka/bin/kafka-topics.sh --describe --zookeeper localhost:2181 --topic topic2
Error while executing topic command : Topic 'topic2' does not exist as expected
[2022-01-10 07:45:26,938] ERROR java.lang.IllegalArgumentException: Topic 'topic2' does not exist as expected
        at kafka.admin.TopicCommand$.kafka$admin$TopicCommand$$ensureTopicExists(TopicCommand.scala:542)
        at kafka.admin.TopicCommand$ZookeeperTopicService.describeTopic(TopicCommand.scala:447)
        at kafka.admin.TopicCommand$.main(TopicCommand.scala:69)
        at kafka.admin.TopicCommand.main(TopicCommand.scala)
 (kafka.admin.TopicCommand$)
[root@kafka0 /]#
```

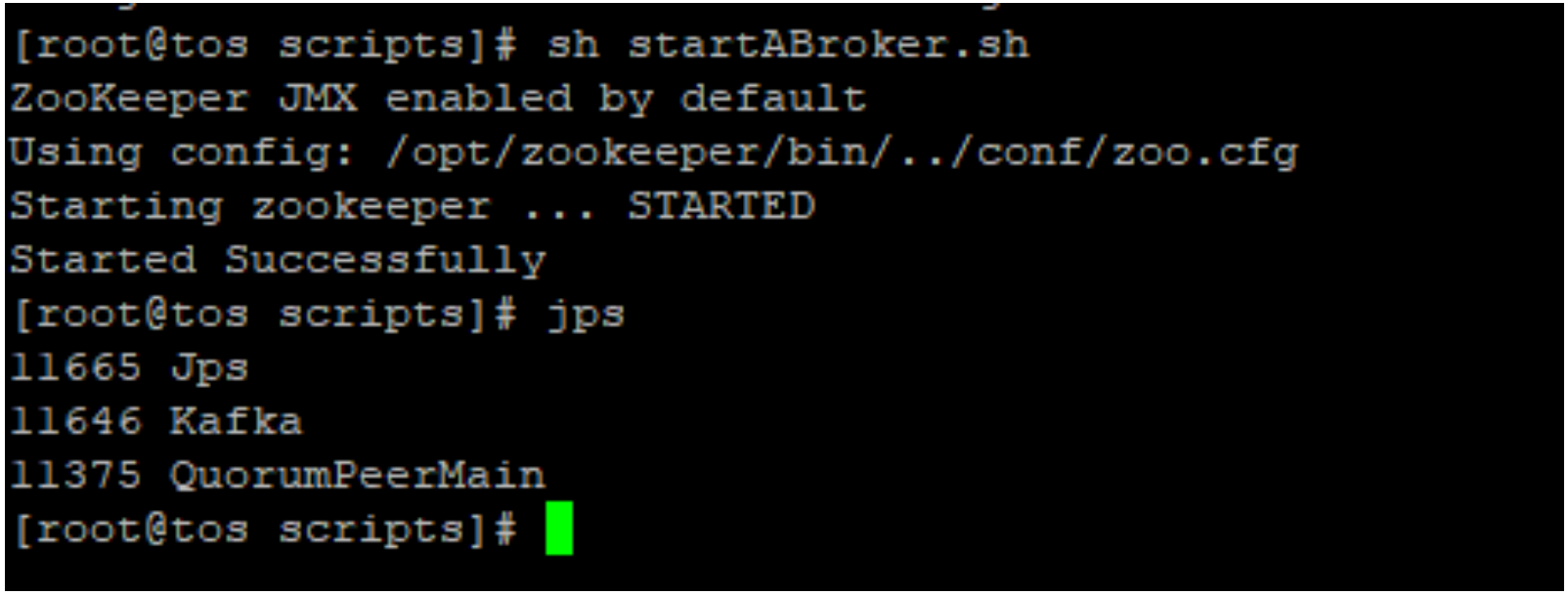
As shown above, it generates an error. Since there is only a single broker. It will fix later.

Lab CLI completes End here.

5. Basic Kafka Operations - CLI (Producer & Consumer) – 30 Mins

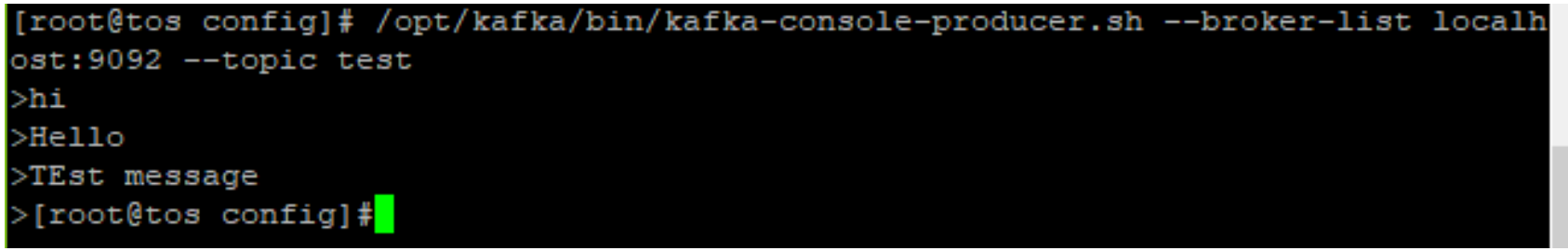
In this lab we will send message to the broker and consumer message using the kafka inbuilt commands.
You need to complete the previous lab before proceeding ahead.
You need to start the broker using startABroker.sh if not done earlier. The script should be in /opt/scripts folder

#sh startABroker.sh
#jps



Sent message to **test** topic: Open a console to send message to the topic, test. Enter some text as shown below.

```
# /opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9092 --topic test
Test Message 1
Test Message 2
^D
#
```



Consume messages from a test topic: As soon as you enter the following script in a separate terminal, you should be able to consume the messages that we have type in the producer console.

```
# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic test
--from-beginning
```

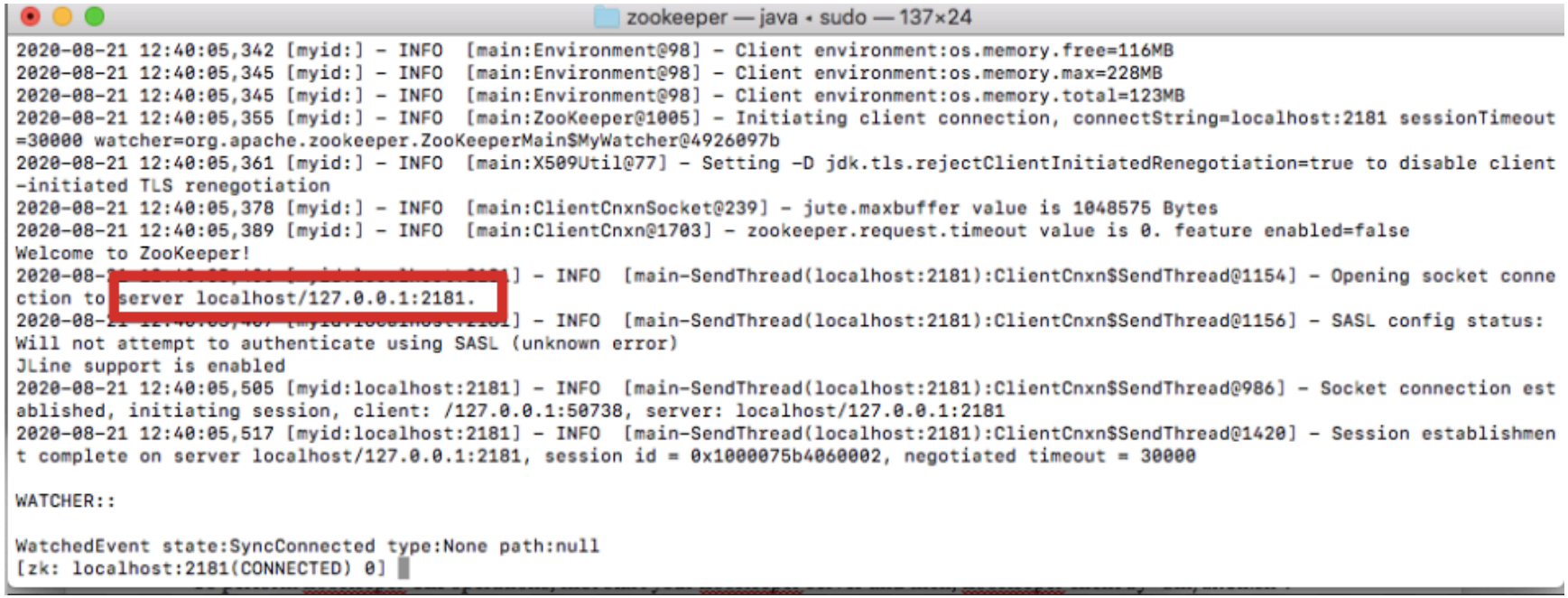
```
(base) Henrys-MacBook-Air:kafka henrypotsangbam$ /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server
localhost:9092 --topic test --from-beginning
Test Message 1
Test Message 2
Sending third message
```

Lab CLI ends here.

6. Zookeeper – 120 Minutes

In this lab, we will perform familiarization of ZK cli features and configure zookeeper ensemble:

To perform ZooKeeper CLI operations, first start your ZooKeeper server and then, ZooKeeper client by executing “bin/zkCli.sh”, which is in the Broker installation folder.
/opt/zookeeper/bin
#bin/zkCli.sh



or New CLI

```
[root@kafka0 kafka]# bin/zookeeper-shell.sh localhost:2181
Connecting to localhost:2181
Welcome to ZooKeeper!
JLine support is disabled

WATCHER::

WatchedEvent state:SyncConnected type:None path:null


ls /
[admin, brokers, cluster, config, consumers, controller, controller_epoch, feature, isr_change_notification, l
atest_producer_id_block, log_dir_event_notification, zookeeper]
ls -R /
/
/admin
/brokers
/cluster
```

As highlighted above, the cli is connected to the zookeeper running on localhost listening at port 2181.

Let us get all znode:

#ls /

```
[zk: localhost:2181(CONNECTED) 1] ls /
[admin, brokers, cluster, config, consumers, controller, controller_epoch, isr_change_notification, latest_producer_id_block, log_dir_event_notification, zookeeper]
[zk: localhost:2181(CONNECTED) 2]
```

#ls -R /
#ls -R /brokers
#get /brokers/ids/0

```
[zk: localhost:2181(CONNECTED) 22] get  /brokers/ids/0
{"listener_security_protocol_map":{"PLAINTEXT":"PLAINTEXT"},"endpoints":["PLAINTEXT://192.168.0.111:9092"],"jmx_port":-1,"host":"192.168.0.111","timestamp":"1597992632471","port":9092,"version":4}
[zk: localhost:2181(CONNECTED) 23]
```

Information about the broker which is register in the znode.

Here, the Node 0 is own by the broker IP – 192.168.0.111 with the port 9092.
This way you can determine the Node details whenever there are any issues as shown below:

```
[2020-08-21 12:52:15,093] WARN [Consumer clientId=consumer-console-consumer-26076-1, groupId=console-consumer-26076] Connection to node -1 (localhost/127.0.0.1:9020) could not be established. Broker may not be available. (org.apache.kafka.clients.NetworkClient)
[2020-08-21 12:52:15,094] WARN [Consumer clientId=consumer-console-consumer-26076-1, groupId=console-consumer-26076] Bootstrap broker localhost:9020 (id: -1 rack: null) disconnected (org.apache.kafka.clients.NetworkClient)
^CProcessed a total of 0 messages
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$
```

Using the Kafka tool zookeeper-shell.sh (Broker Installation folder) we can connect to a ZooKeeper host in our cluster and look at how data is stored.

#zookeeper-shell.sh localhost:2181
#ls /brokers/topics

If we look at the path /brokers/topics you should see a list of the topics that you have created.

```
(base) Henrys-MacBook-Air:bin henrypotsangbam$ sh zookeeper-shell.sh localhost:2181
Connecting to localhost:2181
Welcome to ZooKeeper!
JLine support is disabled

WATCHER::

WatchedEvent state:SyncConnected type:None path:null

ls
ls [-s] [-w] [-R] path
ls /brokers/topics
[__consumer_offsets, quickstart-events, test, topic1]
```

You should also be able to see the topic ___consumer_offsets. That topic is one that you did not create, it is in fact a private topic used internal by Kafka itself. This topic stored the committed offsets for each topic and partition per group id.

The path /controller exists in zookeeper and we are running one command to look at that current value

zookeeper-shell.sh localhost:2181
get /controller

Now in the next section, let us configure cluster of zookeeper – 3 nodes.
Ensemble

Setting up a ZooKeeper Ensemble

Create 3 zookeepers' configuration to create zookeeper ensemble of 3 nodes:

The <ZOOKEEPER_HOME>/conf/zoo1.cfg file should have the content:

```
dataDir=/opt/data/zookeeper/1
clientPort=2181
initLimit=5
syncLimit=2
server.1=localhost:2888:3888
server.2=localhost:2889:3889
server.3=localhost:2890:3890
```

The <ZOOKEEPER_HOME>/conf/zoo2.cfg file should have the content:

```
dataDir=/opt/data/zookeeper/2
clientPort=2182
initLimit=5
syncLimit=2
server.1=localhost:2888:3888
server.2=localhost:2889:3889
server.3=localhost:2890:3890
```

The <ZOOKEEPER_HOME>/conf/zoo3.cfg file should have the content:

```
dataDir=/opt/data/zookeeper/3
clientPort=2183
initLimit=5
syncLimit=2
server.1=localhost:2888:3888
server.2=localhost:2889:3889
server.3=localhost:2890:3890
```

To complete your multi-node configuration, you will specify a node ID on each of the servers. To do this, you will create a myid file on each node. Each file will contain a number that correlates to the server number assigned in the configuration file.

#cd /opt/data/zookeeper/
#mkdir 1 2 3
#vi 1/myid → 1
2/myid → 2
3/myid → 3

```
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo vi 1/myid
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo vi 2/myid
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo vi 3/myid
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ more 1/myid
1
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ pwd
/opt/data/zookeeper
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$
```

To start the servers, you can simply explicitly reference the configuration files:

```
cd <ZOOKEEPER_HOME>
bin/zkServer.sh start conf/zoo1.cfg
bin/zkServer.sh start conf/zoo2.cfg
bin/zkServer.sh start conf/zoo3.cfg
```

```
4078 QuorumPeerMain
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo bin/zkServer.sh start conf/zoo2.cfg
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: conf/zoo2.cfg
Starting zookeeper ... STARTED
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo bin/zkServer.sh start conf/zoo3.cfg
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: conf/zoo3.cfg
Starting zookeeper ... STARTED
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ jps
4136 Jps
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo jps
4131 QuorumPeerMain
4139 Jps
4107 QuorumPeerMain
4078 QuorumPeerMain
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$
```

You will now start a ZooKeeper command line client and connect to ZooKeeper on **node 1**:

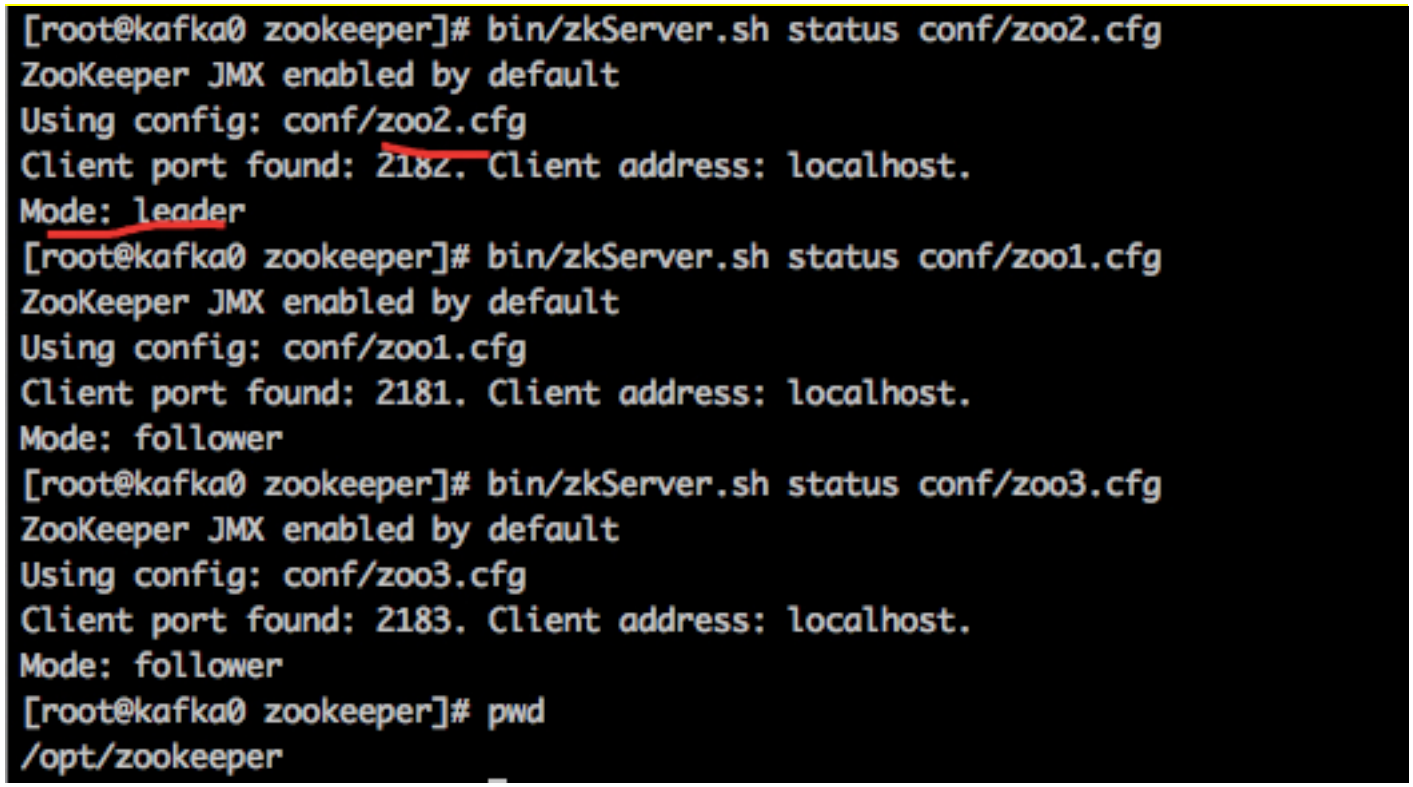
```
#bin/zkCli.sh -server localhost:2181
```

List the newly created znode:

```
#ls /
```

You can verify the leader using command:

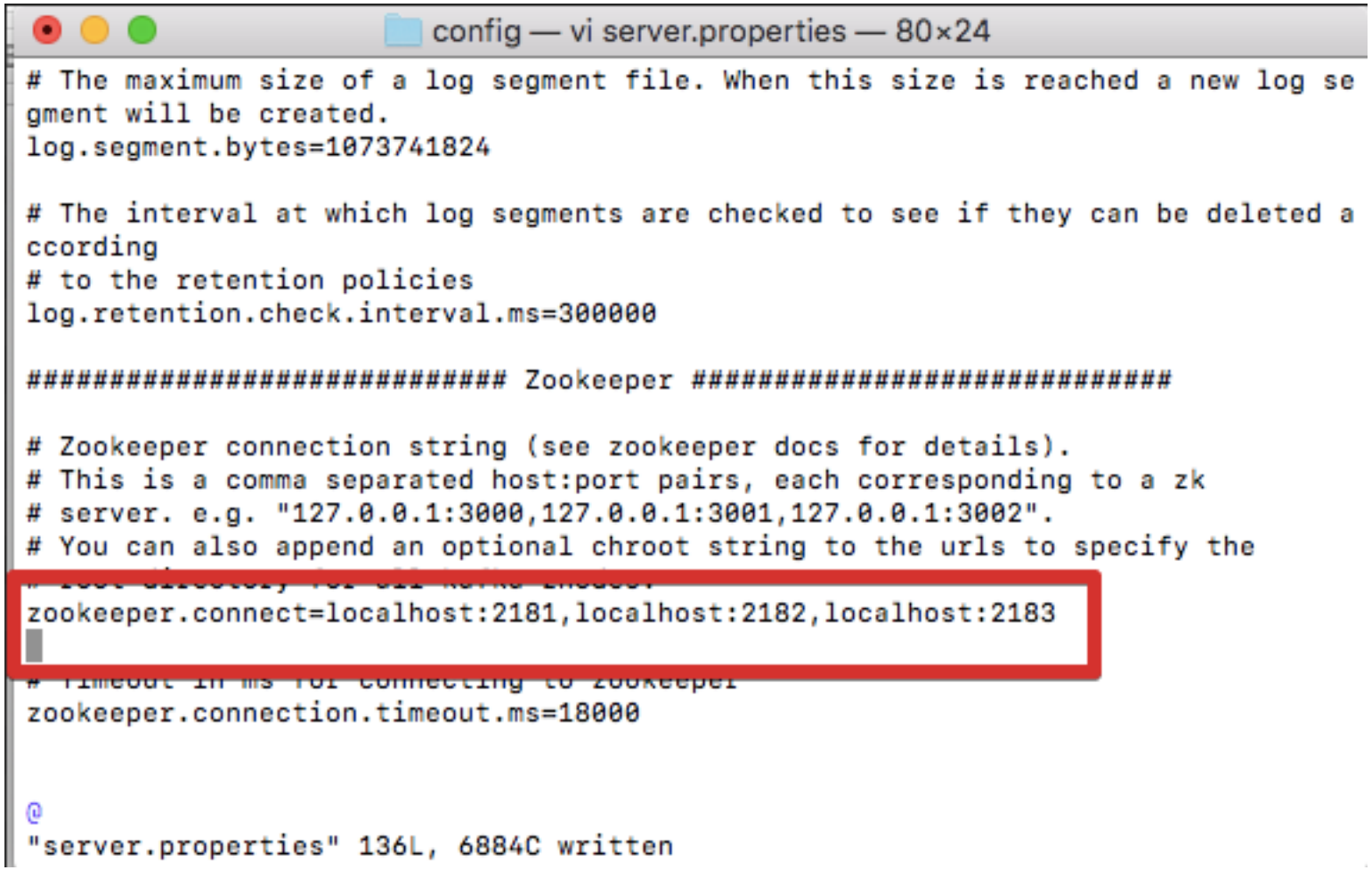
```
#cd /opt/zookeeper
#bin/zkServer.sh status conf/zoo1.cfg
# bin/zkServer.sh status conf/zoo2.cfg
# bin/zkServer.sh status conf/zoo3.cfg
```



Here, the leader is running in 2182 port.

Finally, let us configure the broker to point to the zookeeper ensemble.

The configuration will be in the Kafka conf folder.
Copy conf/server.properties into conf/server1.properties and modify the following two properties in it. Use cp command.



log.dirs=/opt/data/kafka-logs1

Updated the Zookeeper.connect property to connect to all zookeeper nodes.

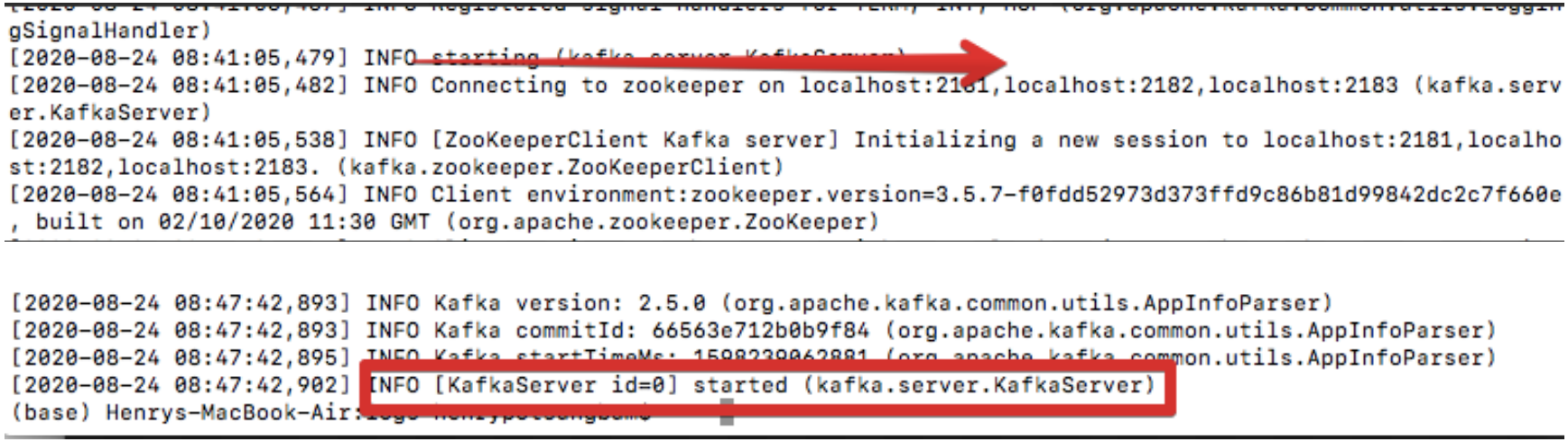
Start all the zookeepers if not done.
#cd /opt/zookeeper

```
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo bin/zkServer.sh start
conf/zoo1.cfg
Password:
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: conf/zoo1.cfg
Starting zookeeper ... STARTED
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo bin/zkServer.sh start
conf/zoo2.cfg
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: conf/zoo2.cfg
Starting zookeeper ... STARTED
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$ sudo bin/zkServer.sh start
conf/zoo3.cfg
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: conf/zoo3.cfg
Starting zookeeper ... STARTED
(base) Henrys-MacBook-Air:zookeeper henrypotsangbam$
```

Start the broker using the modified configuration.

#/opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server1.properties

You can verify from the server.log that the broker is referring to the new property as shown below: /opt/kafka/logs/server.log



Let us perform some activities using the new set up.

/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server localhost:9092 --replication-factor 1 --partitions 2 --topic testz
/opt/kafka/bin/kafka-topics.sh --bootstrap-server localhost:9092 --describe --topic testz

/opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9092 --topic testz
Test Message 1
Test Message 2
To exit : ^D

Consume the above messages:

/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic testz --from-beginning

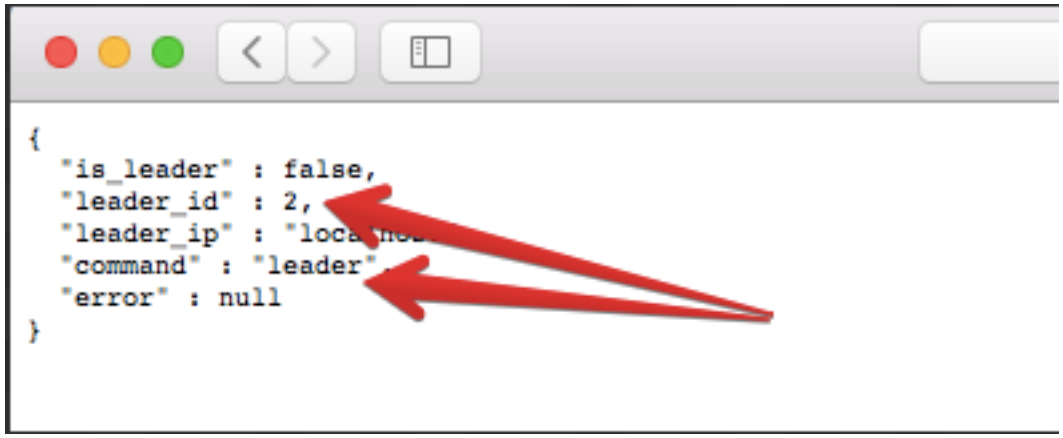
```
(base) Henrys-MacBook-Air:logs henrypotsangbam$ sudo /opt/kafka/bin/kafka-console-producer.sh --broker-list localh
ost:9092 --topic testz
>Test Message 1
Test Message 2
>>(base) Henrys-MacBook-Air:logs henrypotsangbam$ sudo /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server
ocalhost:9092 --topic testz --from-beginning
Test Message 1
Test Message 2
```

Let us verify the Leader of the zookeeper and Kill the leader process.

http://localhost:8080/commands/leader

or CLI :

#/opt/zookeeper/bin/zkServer.sh status /opt/zookeeper/conf/zoo2.cfg




```
[root@kafka0 /]# /opt/zookeeper/bin/zkServer.sh status /opt/zookeeper/conf/zoo2.cfg
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/conf/zoo2.cfg
Client port found: 2182. Client address: localhost.
Mode: leader
[root@kafka0 /]#
```

You can verify the other configuration if 2 is not the leader.

Since 2 is the leader. Let us kill the process Id of the Zookeper id 2.

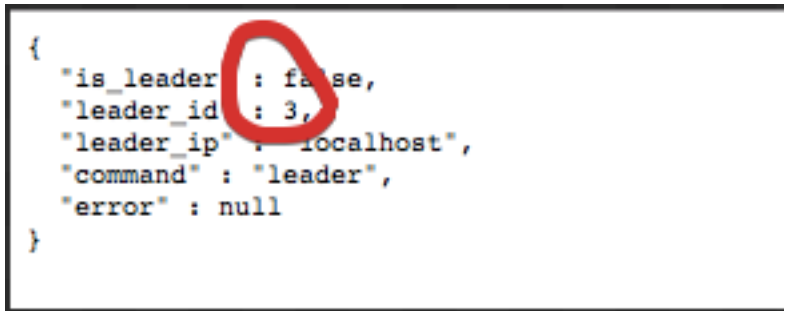
```
#ps -eaf | grep zoo2.cfg
```

```
(base) Henrys-MacBook-Air:config henrypotsangbam$ sudo ps -eaf | grep zoo2.cfg
  501  3725   537   0  9:05AM ttys000    0:00.00 grep zoo2.cfg
    0   684     1   0  8:39AM ttys001    0:05.91 /usr/bin/java -Dzookeeper.log.dir=/opt/zookeeper/bin/../logs -Dzookeeper.log.fil
e=zookeeper-root-server-Henrys-MacBook-Air.local.log -Dzookeeper.root.logger=INFO,CONSOLE -XX:+HeapDumpOnOutOfMemoryError -XX:OnO
utOfMemoryError=kill -9 %p -cp /opt/zookeeper/bin/../zookeeper-server/target/classes:/opt/zookeeper/bin/../build/classes:/opt/zoo
keeper/bin/../zookeeper-server/target/lib/*.jar:/opt/zookeeper/bin/../build/lib/*.jar:/opt/zookeeper/bin/../lib/zookeeper-prometh
eus-metrics-3.6.1.jar:/opt/zookeeper/bin/../lib/zookeeper-jute-3.6.1.jar:/opt/zookeeper/bin/../lib/zookeeper-3.6.1.jar:/opt/zooke
eper/bin/../lib/snappy-java-1.1.7.jar:/opt/zookeeper/bin/../lib/slf4j-log4j12-1.7.25.jar:/opt/zookeeper/bin/../lib/slf4j-api-1.7.
25.jar:/opt/zookeeper/bin/../lib/simpleclient_servlet-0.6.0.jar:/opt/zookeeper/bin/../lib/simpleclient_hotspot-0.6.0.jar:/opt/zoo
keeper/bin/../lib/simpleclient_common-0.6.0.jar:/opt/zookeeper/bin/../lib/simpleclient-0.6.0.jar:/opt/zookeeper/bin/../lib/netty-
transport-native-unix-common-4.1.48.Final.jar:/opt/zookeeper/bin/../lib/netty-transport-native-epoll-4.1.48.Final.jar:/opt/zookee
per/bin/../lib/netty-transport-4.1.48.Final.jar:/opt/zookeeper/bin/../lib/netty-resolver-4.1.48.Final.jar:/opt/zookeeper/bin/../l
ib/netty-handler-4.1.48.Final.jar:/opt/zookeeper/bin/../lib/netty-common-4.1.48.Final.jar:/opt/zookeeper/bin/../lib/netty-codec-4
.1.48.Final.jar:/opt/zookeeper/bin/../lib/netty-buffer-4.1.48.Final.jar:/opt/zookeeper/bin/../lib/metrics-core-3.2.5.jar:/opt/zoo
keeper/bin/../lib/log4j-1.2.17.jar:/opt/zookeeper/bin/../lib/json-simple-1.1.1.jar:/opt/zookeeper/bin/../lib/jline-2.11.jar:/opt/
zookeeper/bin/../lib/jetty-util-9.4.24.v20191120.jar:/opt/zookeeper/bin/../lib/jetty-servlet-9.4.24.v20191120.jar:/opt/zookeeper/
bin/../lib/jetty-server-9.4.24.v20191120.jar:/opt/zookeeper/bin/../lib/jetty-security-9.4.24.v20191120.jar:/opt/zookeeper/bin/../
lib/jetty-io-9.4.24.v20191120.jar:/opt/zookeeper/bin/../lib/jetty-http-9.4.24.v20191120.jar:/opt/zookeeper/bin/../lib/javax.servl
et-api-3.1.0.jar:/opt/zookeeper/bin/../lib/jackson-databind-2.10.3.jar:/opt/zookeeper/bin/../lib/jackson-core-2.10.3.jar:/opt/zoo
keeper/bin/../lib/jackson-annotations-2.10.3.jar:/opt/zookeeper/bin/../lib/commons-lang-2.6.jar:/opt/zookeeper/bin/../lib/commons
-cli-1.2.jar:/opt/zookeeper/bin/../lib/audience-annotations-0.5.0.jar:/opt/zookeeper/bin/../zookeeper-*.jar:/opt/zookeeper/bin/..
/zookeeper-server/src/main/resources/lib/*.jar:/opt/zookeeper/bin/../conf: -Xmx1000m -Dcom.sun.management.jmxremote -Dcom.sun.man
agement.jmxremote.local.only=false org.apache.zookeeper.server.quorum.QuorumPeerMain conf/zoo2.cfg
(base) Henrys-MacBook-Air:config henrypotsangbam$
```

In this case, the process id is 684.
kill -9 684

```
(base) Henrys-MacBook-Air:config henrypotsangbam$ sudo kill -9 684
(base) Henrys-MacBook-Air:config henrypotsangbam$ sudo jps
3745 Jps
659 QuorumPeerMain
3382 ConsoleConsumer
710 QuorumPeerMain
2026 Kafka
(base) Henrys-MacBook-Air:config henrypotsangbam$
```

You can refresh the browser to determine the new leader.



or using cli.

```
[root@kafka0 /]# /opt/zookeeper/bin/zkServer.sh status /opt/zookeeper/conf/zoo2.cfg
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/conf/zoo2.cfg
Client port found: 2182. Client address: localhost.
Error contacting service. It is probably not running.
[root@kafka0 /]# /opt/zookeeper/bin/zkServer.sh status /opt/zookeeper/conf/zoo3.cfg
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/conf/zoo3.cfg
Client port found: 2183. Client address: localhost.
Mode: leader
```

So which node is the leader in your case? Here its 3

Try sending some messages again:

```
(base) Henrys-MacBook-Air:logs henrypotsangbam$ sudo /opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9092 --topic testz
Password:
>Another Message
>
^CProcessed a total of 0 messages
(base) Henrys-MacBook-Air:config henrypotsangbam$ sudo /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic testz --from-beginning
Test Message 1
Test Message 2
Another Message
```

You should be able to consume messages without any issue.

Get some config details from the zookeeper:

```
get /controller
get /brokers/topics/testz
get /brokers/ids/0
get /zookeeper/config
```

```
[zk: localhost:2181(CONNECTED) 19] get /controller
{"version":1,"brokerid":0,"timestamp":"1598239062599"}
[zk: localhost:2181(CONNECTED) 20] get /brokers/topics/testz
{"version":2,"partitions":{"1":[0],"0":[0]},"adding_replicas":{},"removing_replicas":{}}
[zk: localhost:2181(CONNECTED) 21] get /brokers/ids/0
{"listener_security_protocol_map":{"PLAINTEXT":"PLAINTEXT"},"endpoints":["PLAINTEXT://quickstart.cloudera:9092"],"jmx_port":-1,"host":"quickstart.cloudera","timestamp":"1598239062331","port":9092,"version":4}
[zk: localhost:2181(CONNECTED) 22] get /zookeeper/config
server.1=localhost:2888:3888:participant
server.2=localhost:2889:3889:participant
server.3=localhost:2890:3890:participant
version=0
[zk: localhost:2181(CONNECTED) 23]
```

---------- lab Ends Here ----------
Log:

---

server.1=localhost:2888:3888 (2181)
server.2=localhost:2889:3889. (2182) - First Leader
server.3=localhost:2890:3890 -(2183) Second Leader

Scenarios : 2 was leader , after 2 shutdown -> 3 Became a leader

---

7. Kafka cluster – 90 Minutes

Understanding Kafka Failover in a cluster environment.
In this tutorial, we are going to run many Kafka Nodes on our development laptop so, you will need at least 8 GB of RAM for local dev machine. You can run just two servers if you have less memory than 8 GB.

We are going to create a replicated topic and then demonstrate consumer along with broker failover. We also demonstrate load balancing of Kafka consumers.
We show how, with many groups, Kafka acts like a Publish/Subscribe. But, when we put all of our consumers in the same group, Kafka will load share the messages to the consumers in the same group (more like a queue than a topic in a traditional MOM sense).

If not already running, start ZooKeeper.
Also, shut down Kafka from the first tutorial.

Next, you need to copy server properties for three brokers (detailed instructions to follow). Then we will modify these Kafka server properties to add unique Kafka ports, Kafka log locations, and unique Broker ids. Then we will create three scripts to start these servers up using these properties, and then start the servers.
Lastly, we create replicated topic and use it to demonstrate Kafka consumer failover, and Kafka broker failover.

Create three new Kafka server-n.properties files

In this section, we will copy the existing Kafka server.properties to server-0.properties, server-1.properties, and server-2.properties.
Then change server-0.properties to set log.dirs to "/opt/data/kafka-logs/kafka-0.
Then we modify server-1.properties to set port to 9093, broker id to 1,
and log.dirs to "/opt/data/kafka-logs/kafka-1".
Lastly modify server-2.properties to use port 9094, broker id 2,
and log.dirs "/opt/data/kafka-logs/kafka-2".

Copy server properties file as follows: We will store all server's configuration in a single folder config.

```
$ cd /opt
$ mkdir -p kafka-config/config
$ cp kafka/config/server.properties kafka-config/config/server-0.properties
$ cp kafka/config/server.properties kafka-config/config/server-1.properties
$ cp kafka/config/server.properties kafka-config/config/server-2.properties
```

With your favourite text editor update server-0.properties so that log.dirs is set to ./logs/kafka-0. Leave the rest of the file the same. Make sure log.dirs is only defined once.

#vi /opt/kafka-config/config/server-0.properties
broker.id=0
listeners=PLAINTEXT://kafka0:9092
advertised.listeners=PLAINTEXT://kafka0:9092
log.dirs=/opt/data/kafka-logs/kafka-0

With your favorite text editor change log.dirs, broker.id and and log.dirs of server-1.properties as follows.

#vi /opt/kafka-config/config/server-1.properties

```
broker.id=1
listeners=PLAINTEXT://kafka0:9093
advertised.listeners=PLAINTEXT://kafka0:9093
log.dirs=/opt/data/kafka-logs/kafka-1
```

With your favorite text editor change log.dirs, broker.id and and log.dirs of server-2.properties as follows.

#vi /opt/kafka-config/config/server-2.properties

```
broker.id=2
listeners=PLAINTEXT://kafka0:9094
advertised.listeners=PLAINTEXT://kafka0:9094
log.dirs=/opt/data/kafka-logs/kafka-2
```

Create Startup scripts for these three Kafka servers

The startup scripts will just run kafka-server-start.sh with the corresponding properties file.

#vi /opt/kafka-config/start-1st-server.sh

```
#!/usr/bin/env bash
## Run Kafka
/opt/kafka/bin/kafka-server-start.sh   "/opt/kafka-config/config/server-0.properties"
```

#vi /opt/kafka-config/start-2nd-server.sh

```
#!/usr/bin/env bash
## Run Kafka
/opt/kafka/bin/kafka-server-start.sh   "/opt/kafka-config/config/server-1.properties"
```

#vi /opt/kafka-config/start-3rd-server.sh

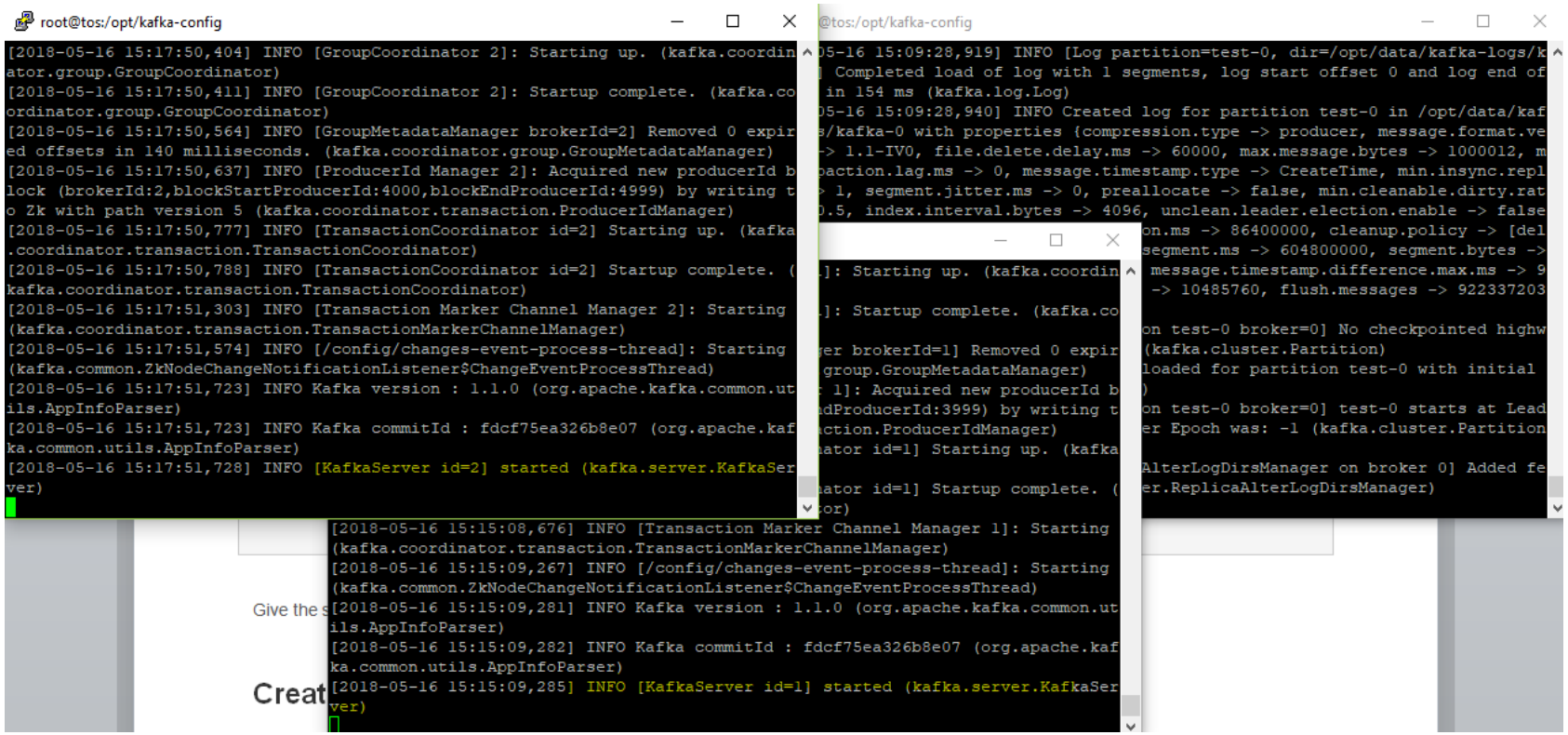
```
#!/usr/bin/env bash
## Run Kafka
/opt/kafka/bin/kafka-server-start.sh   "/opt/kafka-config/config/server-2.properties"
```

Notice we are passing the Kafka server properties files that we created in the last step.
Now run all three in separate terminals/shells.

Run Kafka servers each in own terminal from /opt/kafka-config

```
#cd /opt/kafka-config
// to make the scripts executable.
#chmod 755 start-1st-server.sh  start-2nd-server.sh start-3rd-server.sh
$ ./start-1st-server.sh

$ ./start-2nd-server.sh

$ ./start-3rd-server.sh
```

Give these servers a couple of minutes to startup and connect to ZooKeeper.

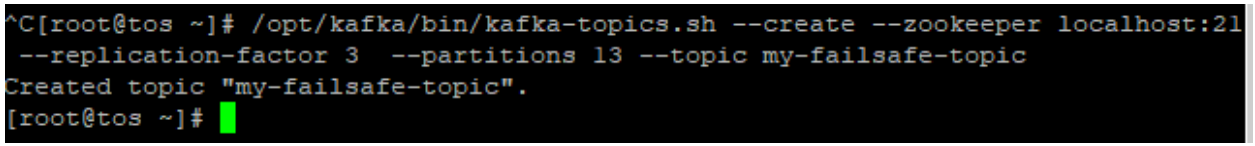


Create a replicated topic my-failsafe-topic

Now we will create a replicated topic that the console producers and console consumers can use.

Open a separate terminal and execute the following;

```
#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server kafka0:9092 --replication-fact
or 3  --partitions 13 --topic my-failsafe-topic
```



Notice that the replication factor gets set to 3, and the topic name is my-failsafe-topic, and like before it has 13 partitions.

Start Kafka Consumer that uses Replicated Topic

Start the consumer with the script in a separate terminal;

```
#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9094,kafka0:9092
--topic my-failsafe-topic  --from-beginning
```

Notice that a list of Kafka servers is passed to --bootstrap-server parameter. Only, two of the three servers get passed that we ran earlier. Even though only one broker is needed, the

consumer client will learn about the other broker from just one server. Usually, you list multiple brokers in case there is an outage so that the client can connect.

```
[root@tos ~]# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localh
ost:9094,localhost:9092 --topic my-failsafe-topic
```

Start Kafka Producer that uses Replicated Topic

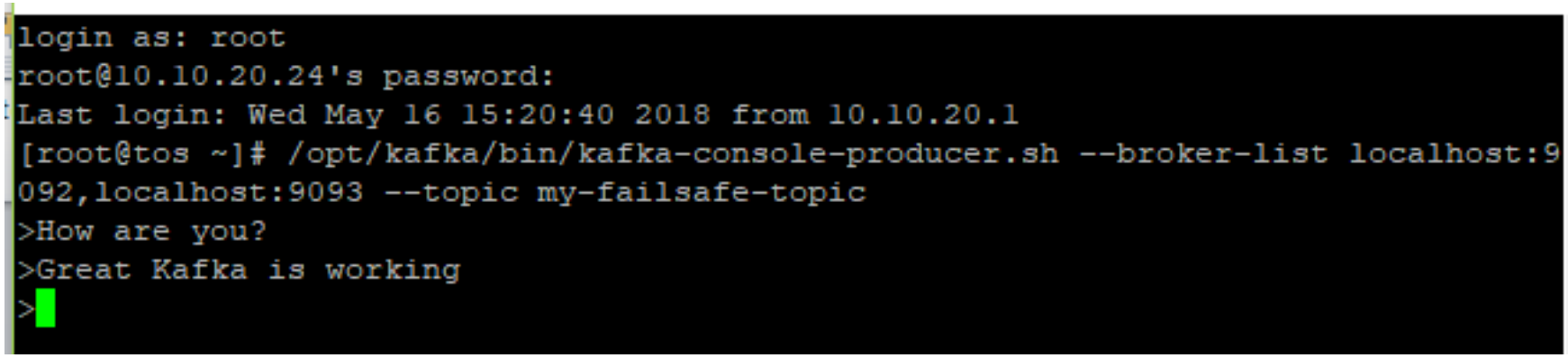
Next, we create a script that starts the producer. Then launch the producer with the script you create.

```
#/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:9092,kafka0:9093 --topic
my-failsafe-topic
```

Notice we start Kafka producer and pass it a list of Kafka Brokers to use via the parameter --broker-list.
Now use the start producer script to launch the producer as follows.

Now send messages
Now send some message from the producer to Kafka and see those messages consumed by the consumer.

Producer Console.



Consumer Console

```
[root@tos ~]# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localh
ost:9094,localhost:9092 --topic my-failsafe-topic
How are you?
Great Kafka is working
```

Now Start two more consumers and send more messages.

Now Start two more consumers in their own terminal window and send more messages from the producer. (Replace the hostname of your server aka localhost)

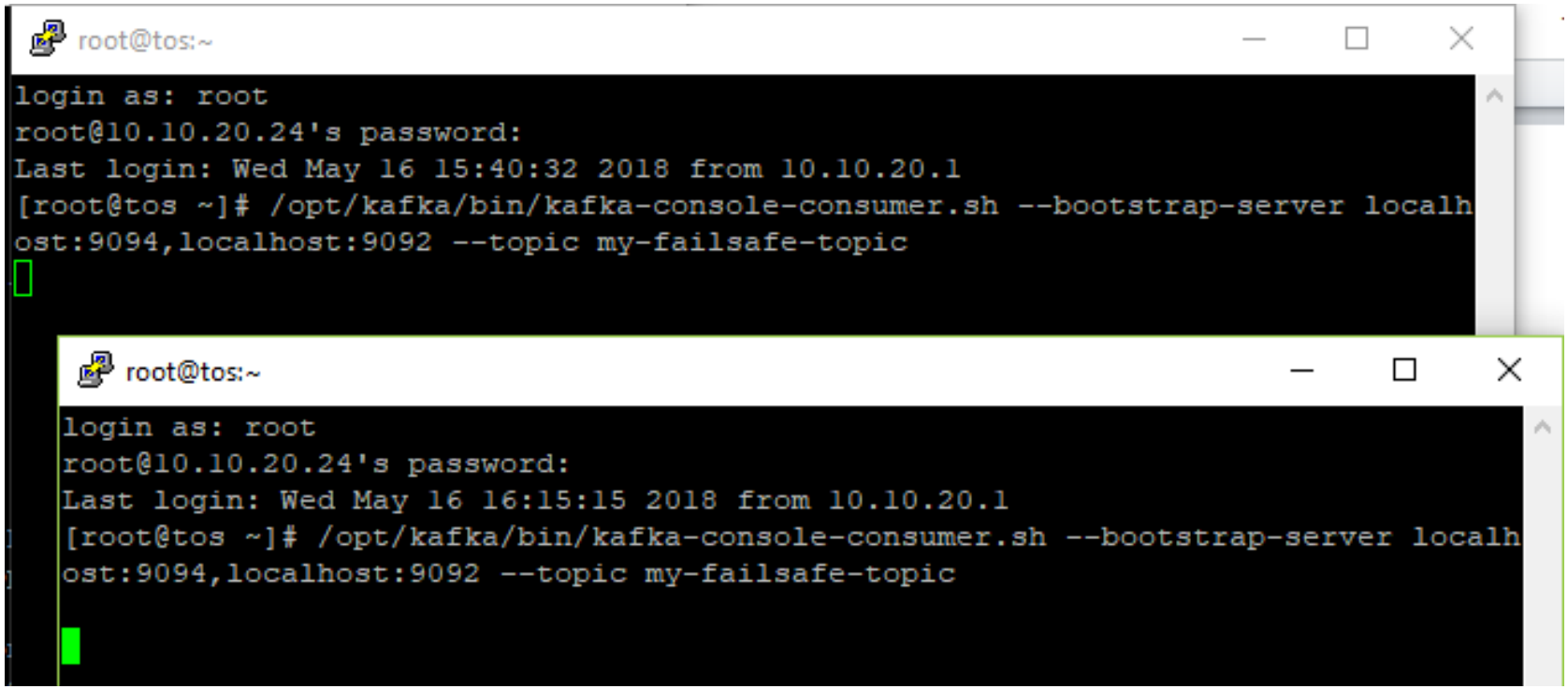
Consumer 1.

```
#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9094,kafka0:9092
--topic my-failsafe-topic     --from-beginning
```

Consumer 2.

```
#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9094,kafka0:9092
--topic my-failsafe-topic     --from-beginning
```

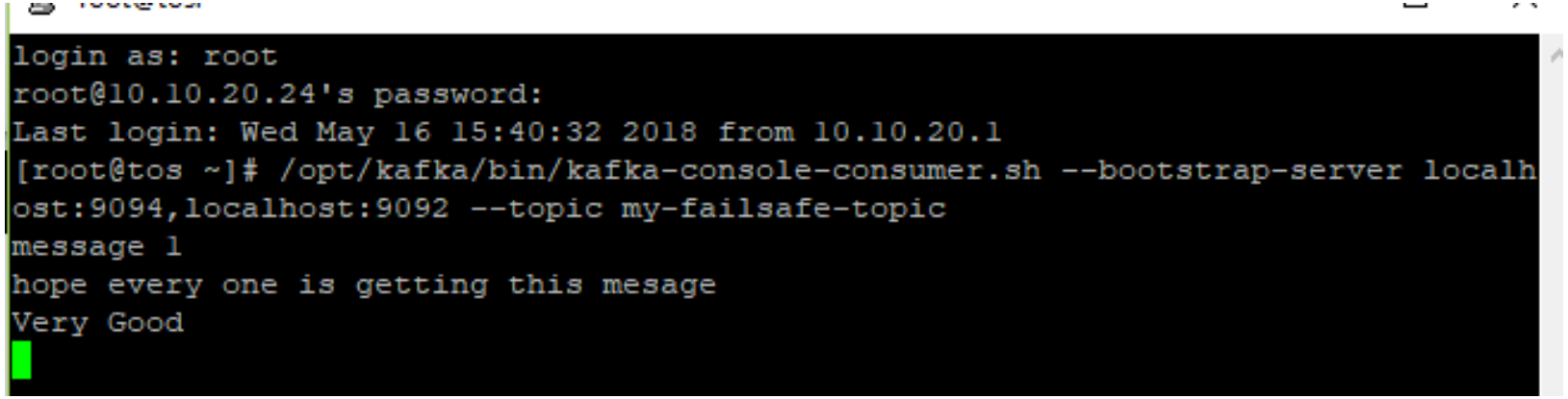
The two consumer consoles will be as shown below



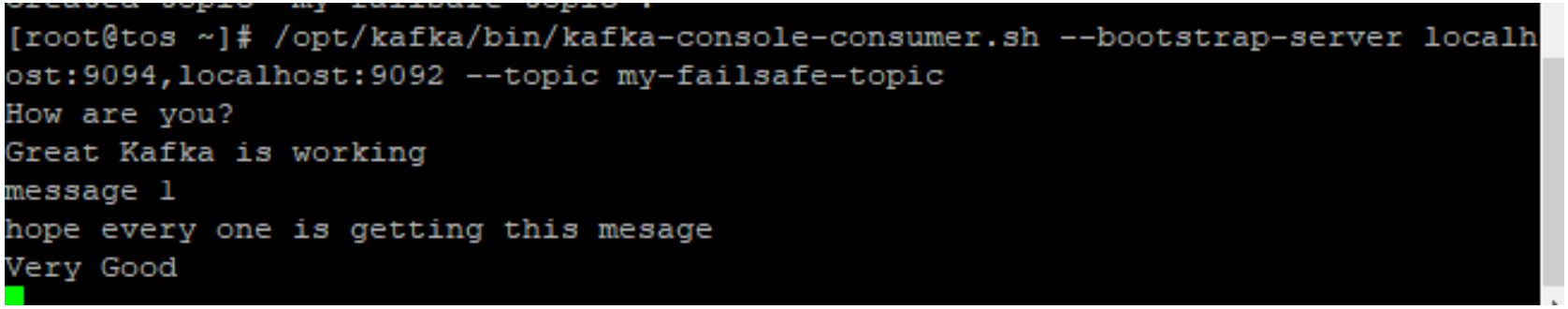
Producer Console will be as shown below:

```
login as: root
root@10.10.20.24's password:
Last login: Wed May 16 15:20:40 2018 from 10.10.20.1
[root@tos ~]# /opt/kafka/bin/kafka-console-producer.sh --broker-list localhos
092,localhost:9093 --topic my-failsafe-topic
>How are you?
>Great Kafka is working
>message 1
>hope every one is getting this mesage
>Very Good
>
```

Consumer Console 1st, you should be able to view the messages whatever you type on the producer console after the new consumer console was started.



Consumer Console 2nd in new Terminal, similarly all the messages that were type on the producer console should be also display in the second console after it was started.
Consumer Console 2nd in new Terminal



Notice that the messages are sent to all of the consumers because each consumer is in a different consumer group.

Change consumer to be in their own consumer group.

Stop the producers and the consumers before, but leave Kafka and ZooKeeper running. You can use ctrl + c.
We want to put all of the consumers in same *consumer group*. This way the consumers will share the messages as each consumer in the *consumer group* will get its share of partitions.

Run the following scripts three times – from different console.

```
#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9094,kafka0:9092
--topic my-failsafe-topic   --consumer-property group.id=mygroup
```

Notice that the script is the same as before except we added `--consumer-property group.id=mygroup` which will put every consumer that runs with this script into the `mygroup` consumer group.
Now we just run the producer and three consumers.

Run Producer Console

```
/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:9092,kafka0:9093 --topic
my-failsafe-topic
```

Now send eight messages from the Kafka producer console.
Producer Console

```
[root@tos ~]#
[root@tos ~]#
[root@tos ~]# /opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9
092,localhost:9093 --topic my-failsafe-topic
>message 1
>message 2
>message 3
>message 4
>message 5
>message 6
>message 7
>message 8
>
```

Notice that the messages are spread evenly among the consumers.

1st Kafka Consumer gets m3, m5

```
[root@tos ~]#  /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server local
host:9094,localhost:9092 --topic my-failsafe-topic    --consumer-property group.
id=mygroup
message 5
message 6
message 7
```

Notice the first consumer gets messages m3 and m5.

2nd Kafka Consumer gets m2, m6

```
[root@tos ~]#  /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server local
host:9094,localhost:9092 --topic my-failsafe-topic    --consumer-property group.
id=mygroup
message 2
message 4
message 8
```

Notice the second consumer gets messages m2 and m6.

3rd Kafka Consumer gets m1, m4, m7

```
[root@tos ~]#  /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server local
host:9094,localhost:9092 --topic my-failsafe-topic    --consumer-property group.
id=mygroup
message 1
message 3
```

Notice the third consumer gets messages m1, m4 and m7.

Notice that each consumer in the group got a share of the messages.

Kafka Consumer Failover

Next, let's demonstrate consumer failover by killing one of the consumers and sending seven more messages. Kafka should divide up the work to the consumers that are running. First, kill the third consumer (CTRL-C in the consumer terminal does the trick).

```
[root@tos ~]#  /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server local
host:9094,localhost:9092 --topic my-failsafe-topic    --consumer-property group.
id=mygroup
message 1
message 3
^CProcessed a total of 2 messages
[root@tos ~]#
```

Now send seven more messages from the Kafka console-producer.

Producer Console - send seven more messages m8 through m14

```
[root@tos ~]# /opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9
092,localhost:9093 --topic my-failsafe-topic
>message 1
>message 2
>message 3
>message 4
>message 5
>message 6
>message 7
>message 8
>
>message 9
>m 10
>m11
>m 12
>m 13
>m 14
>m 15
>
```

Notice that the messages are spread evenly among the remaining consumers.

1st Kafka Consumer gets m8, m9, m11, m14

```
[root@tos ~]#  /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server local
host:9094,localhost:9092 --topic my-failsafe-topic    --consumer-property group.
id=mygroup
message 2
message 4
message 8

message 9
m 12
m 13
m 14
```

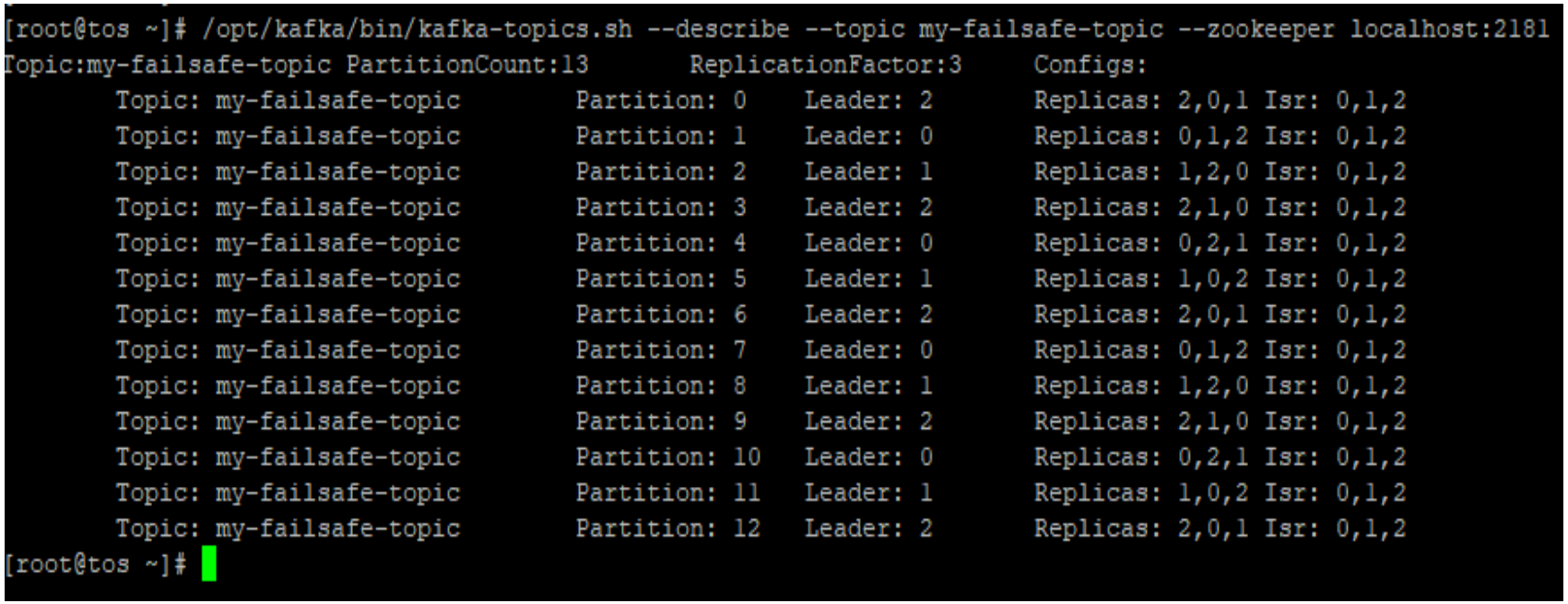
2nd Kafka Consumer gets m10, m12, m13

```
[root@tos ~]#  /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server local
host:9094,localhost:9092 --topic my-failsafe-topic    --consumer-property group.
id=mygroup
message 5
message 6
message 7
m 10
m11
m 15
```

We killed one consumer, sent seven more messages, and saw Kafka spread the load to remaining consumers. ***Kafka consumer failover works!***

Create Kafka Describe Topic Script
You can use kafka-topics.sh to see how the Kafka topic is laid out among the Kafka brokers. The ---describe will show partitions, ISRs, and broker partition leadership.

```
#/opt/kafka/bin/kafka-topics.sh --describe --topic my-failsafe-topic --bootstrap-server kaf
ka0:9092
```



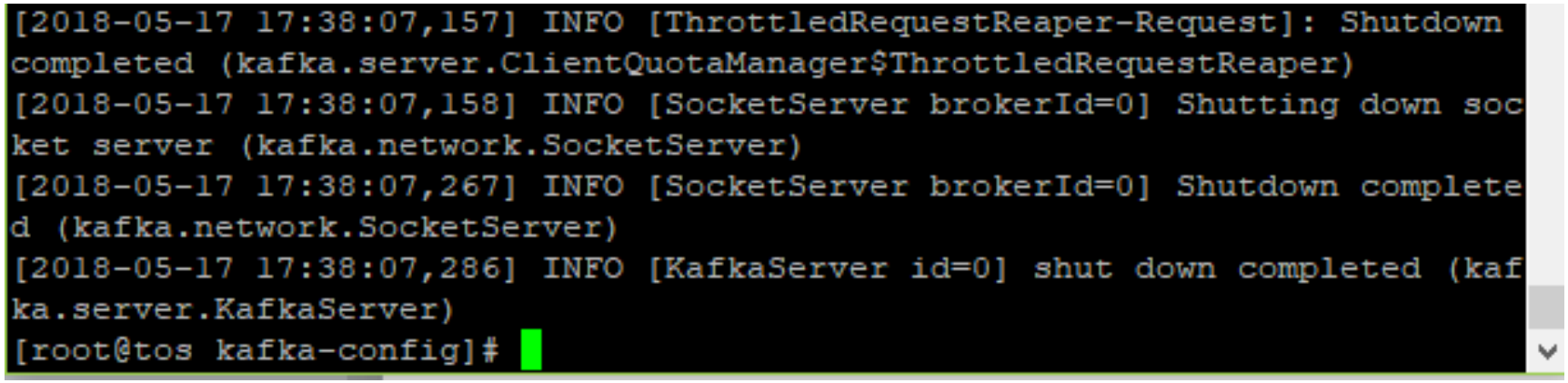
Run describe-topics
We are going to lists which broker owns (leader of) which partition, and list replicas and ISRs of each partition. ISRs are replicas that are up to date. Remember there are 13 topics.

Topology of Kafka Topic Partition Ownership
Notice how each broker gets a share of the partitions as leaders and followers. Also, see how Kafka replicates the partitions on each broker.

Test Broker Failover by killing 1st server
Let's kill the first broker, and then test the failover.

Kill the first broker

```
$ kill `ps aux | grep java | grep server-0.properties | tr -s " " | cut -d " " -f2`
```



You can stop the first broker by hitting CTRL-C in the broker terminal or by running the above command.
Now that the first Kafka broker has stopped, let's use Kafka topics describe to see that new leaders were elected!

Run describe-topics again to see leadership change

```
[root@tos ~]# /opt/kafka/bin/kafka-topics.sh --describe --topic my-failsafe-topic --zookeeper localhost:2181
Topic:my-failsafe-topic PartitionCount:13       ReplicationFactor:3     Configs:
        Topic: my-failsafe-topic        Partition: 0    Leader: 2       Replicas: 2,0,1 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 1    Leader: 1       Replicas: 0,1,2 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 2    Leader: 1       Replicas: 1,2,0 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 3    Leader: 2       Replicas: 2,1,0 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 4    Leader: 2       Replicas: 0,2,1 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 5    Leader: 1       Replicas: 1,0,2 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 6    Leader: 2       Replicas: 2,0,1 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 7    Leader: 1       Replicas: 0,1,2 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 8    Leader: 1       Replicas: 1,2,0 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 9    Leader: 2       Replicas: 2,1,0 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 10   Leader: 2       Replicas: 0,2,1 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 11   Leader: 1       Replicas: 1,0,2 Isr: 1,2
        Topic: my-failsafe-topic        Partition: 12   Leader: 2       Replicas: 2,0,1 Isr: 1,2
[root@tos ~]#
```

Notice how Kafka spreads the leadership over the 2nd and 3rd Kafka brokers.

Create consolidated scripts as mention below. It will help you to start zookeeper and kafka using a single script.
Start 3 Brokers.
#vi /opt/scripts/start3Brokers.sh
#!/usr/bin/env bash
Start Zookeeper.
/opt/zookeeper/bin/zkServer.sh start

#Start Kafka Server 0
/opt/kafka/bin/kafka-server-start.sh "/opt/kafka-config/config/server-0.properties" &

#Start Kafka Server 1
/opt/kafka/bin/kafka-server-start.sh "/opt/kafka-config/config/server-1.properties" &

```
#Start Kafka Server 2
/opt/kafka/bin/kafka-server-start.sh   "/opt/kafka-config/config/server-2.properties" &

echo "Start zookeeper & 3 Brokers Successfully"
```

to Stop All 3 Brokers.

```
# vi stop3Brokers.sh
#!/usr/bin/env bash
# Stop Zookeeper & 3 Servers.
/opt/zookeeper/bin/zkServer.sh stop
/opt/kafka/bin/kafka-server-stop.sh
echo "Stop zookeeper & 3 servers Successfully"
```

---------- Lab Ends here ----------

8. Securing Kafka SSL – 90 Minutes

Enable Encryption and Authentication using SSL.
In this lab we will configure SSL between client and the broker, then ACL will be enable accordingly later in the next lab.
Take a back up of the server.properties before making any changes. [cp server.properties server.properties_org]
Apache Kafka allows clients to connect over SSL. By default, SSL is disabled but can be turned on as needed.

You need to shut down all the brokers before going ahead with this lab.
[hints: jps and kill -9 all kafka/zookeeper processes]

You required Openssl library.

yum install openssl

Before going ahead with the SSL configuration let us verify that TLS is configured or not.
#openssl s_client -debug -connect kafka0:9092 -tls1

```
[root@hp ~]# openssl s_client -debug -connect localhost:9092 -tls1
socket: Connection refused
connect:errno=111
[root@hp ~]#
```

If you get the above output, then it's not configured.

Generate SSL key and certificate for each Kafka broker

The first step of deploying one or more brokers with the SSL support is to generate the key and the certificate for each machine in the cluster. You can use Java's keytool utility to accomplish this task. We will generate the key into a temporary keystore(**server.keystore.jks**) initially so that we can export and sign it later with CA. (Create folders appropriately if its not there)

Change the alias i.e kafka0 parameter with that of your hostname

```
#cd /opt/scripts/cer
#keytool -keystore server.keystore.jks -alias kafka0 -validity 365 -genkey -keyalg RSA
```

Enter the following parameters for Keystore repository:

```
Password Kesystore: kafka213
What is your first and last name?
  [Unknown]:  kafka0
```

This command will prompt you for a password. After entering and confirming the password, the next prompt is for the first and last name. This is actually the common name. Enter **kafka0** for our test cluster. (Alternatively, if you are accessing a cluster by a different hostname, enter that name

instead.) Leave other fields blank. At the final prompt, hit y to confirm.

```
[root@kafka0 cer]# keytool -keystore server.keystore.jks -alias kafka0 -validity 365 -genkey -keyalg RSA
Enter keystore password:
Re-enter new password:
What is your first and last name?
  [Unknown]:  kafka0
What is the name of your organizational unit?
  [Unknown]:
What is the name of your organization?
  [Unknown]:
What is the name of your City or Locality?
  [Unknown]:
What is the name of your State or Province?
  [Unknown]:
What is the two-letter country code for this unit?
  [Unknown]:
Is CN=kafka0, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct?
  [no]:  yes

[root@kafka0 cer]#
```

You need to specify two parameters in the above command:

1. keystore: the keystore file that stores the certificate. The keystore file contains the private key of the certificate; therefore, it needs to be kept safely.
2. validity: the valid time of the certificate in days.

Input all the necessary required attribute. Accept the password as same as above.

The result will be a **server.keystore.jks** file deposited into the current directory.

The following command can be run afterwards to verify the contents of the generated certificate:

```
#keytool -list -v  -keystore server.keystore.jks
```

Output:

```
[root@kafka0 cer]# keytool -list -v -keystore server.keystore.jks
Enter keystore password:
Keystore type: PKCS12
Keystore provider: SUN

Your keystore contains 1 entry

Alias name: kafka0
Creation date: Oct 24, 2022
Entry type: PrivateKeyEntry
Certificate chain length: 1
Certificate[1]:
Owner: CN=kafka0, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown
Issuer: CN=kafka0, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown
Serial number: 35efd4bc
Valid from: Mon Oct 24 11:00:39 IST 2022 until: Tue Oct 24 11:00:39 IST 2023
Certificate fingerprints:
```

```
        SHA1: D7:0E:14:58:EB:1D:21:19:C8:CA:C4:B8:35:3A:FF:E2:7B:E2:17:A8
        SHA256:
38:89:82:DF:15:7D:11:7F:80:18:AD:85:1D:C5:10:5D:34:8D:D2:74:4B:86:0F:E6:8D:88:72:2E:13:
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3

Extensions:

#1: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
0000: 71 BF 42 54 3C 48 B6 E5   70 7A 5A 67 2C 72 5F AE  q.BT<H..pzZg,r_.
0010: A2 69 62 B6                                        .ib.
]
]



*******************************************
*******************************************
```

Configure your own CA

After the first step, each machine in the cluster has a public-private key pair, and a certificate to identify the machine. The certificate, however, is unsigned, which means that an attacker can create such a certificate to pretend to be any machine.
Therefore, it is important to prevent forged certificates by signing them for each machine in the cluster. A certificate authority (CA) is responsible for signing certificates. CA works likes a government that issues passports—the government stamps (signs) each passport so that the passport becomes difficult to forge. Other governments verify the stamps to ensure the passport is authentic. Similarly, the CA signs the certificates, and the cryptography guarantees that a signed certificate is computationally difficult to forge. Thus, as long as the CA is a genuine and trusted authority, the clients have high assurance that they are connecting to the authentic machines.

Use Password: EnjoyKafka

If openssl is not found, install using - yum install openssl

```
#openssl req -new -x509 -keyout ca-key -out ca-cert -days 365

Common Name (eg, your name or your server's hostname) []:kafka0
```

The generated CA is simply a public-private key pair and certificate, and it is intended to sign other certificates. (Enter Phrase: **EnjoyKafka**)

You are required to provide a password, which may differ from the password used in the previous step. Leave all fields empty with the exception of the Common Name, which should be set to **kafka0**.

Output:

```
[root@kafka0 cer]# openssl req -new -x509 -keyout ca-key -out ca-cert -days 365
Generating a RSA private key
.....+++++
.....+++++
writing new private key to 'ca-key'
Enter PEM pass phrase:
Verifying - Enter PEM pass phrase:
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [XX]:
State or Province Name (full name) []:
Locality Name (eg, city) [Default City]:
Organization Name (eg, company) [Default Company Ltd]:
Organizational Unit Name (eg, section) []:
```

Common Name (eg, your name or your server's hostname) []:kafka0
Email Address []:

```
[root@kafka0 cer]# ls
ca-cert  ca-key  server.keystore.jks
[root@kafka0 cer]# pwd
/opt/scripts/cer
[root@kafka0 cer]#
```

It will generate : **ca-cert** –> Certificate and **ca-key** -> Key
The next step is to add the generated CA to the brokers and **clients' truststore** so that the clients can trust this CA. Once imported, the parties will implicitly trust the CA and any certificate signed by the CA.

Enter. (Password – kafka213) whenever the system asks for:

#keytool -keystore client.truststore.jks -alias CARoot -import -file ca-cert

Trust this certificate? [no]: yes
Output:

[root@kafka0 cer]# keytool -keystore client.truststore.jks -alias CARoot -import -file ca-cert
Enter keystore password:
Re-enter new password:
Owner: CN=kafka0, O=Default Company Ltd, L=Default City, C=XX

```
Issuer: CN=kafka0, O=Default Company Ltd, L=Default City, C=XX
Serial number: 24cd3f803451fc94d6a851be5ca7a52ed4e7204
Valid from: Mon Oct 24 11:07:46 IST 2022 until: Tue Oct 24 11:07:46 IST 2023
Certificate fingerprints:
        SHA1: 43:AC:2A:34:BF:60:9C:9D:99:1D:C9:56:76:7B:81:56:71:04:66:E0
        SHA256:
54:A6:4B:AF:AA:E4:58:D1:5C:12:C3:07:1E:72:97:E8:AC:D1:EF:ED:21:A8:F2:FA:1A:77:8A:64:DB:94
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3

Extensions:

#1: ObjectId: 2.5.29.35 Criticality=false
AuthorityKeyIdentifier [
KeyIdentifier [
0000: CD CC 71 10 CF 2A 80 A2   67 96 A0 E1 AF 1A 9A 87  ..q..*..g.......
0010: 67 D1 62 DD                                        g.b.
]
]

#2: ObjectId: 2.5.29.19 Criticality=true
BasicConstraints:[
  CA:true
  PathLen:2147483647
```

```
]

#3: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
0000: CD CC 71 10 CF 2A 80 A2   67 96 A0 E1 AF 1A 9A 87  ..q..*..g.......
0010: 67 D1 62 DD                                        g.b.
]
]

Trust this certificate? [no]:  yes
Certificate was added to keystore
```

```
Trust this certificate? [no]:  yes
```

Enter. (Password – kafka213)

Repeat for server.truststore.jks:

> **Note:** If you configure the Kafka brokers to require client authentication by setting ssl.client.auth to be "requested" or "required" on the Kafka brokers config then you must provide a truststore for the Kafka brokers as well and it should have all the CA certificates that clients' keys were signed by.

```
# keytool -keystore server.truststore.jks -alias CARoot -import -file ca-cert
```

Password: kafka213

Output:

```
[root@kafka0 cer]# keytool -keystore server.truststore.jks -alias CARoot -import -file ca-
cert
Enter keystore password:
Re-enter new password:
Owner: CN=kafka0, O=Default Company Ltd, L=Default City, C=XX
Issuer: CN=kafka0, O=Default Company Ltd, L=Default City, C=XX
Serial number: 24cd3f803451fc94d6a851be5ca7a52ed4e7204
Valid from: Mon Oct 24 11:07:46 IST 2022 until: Tue Oct 24 11:07:46 IST 2023
Certificate fingerprints:
        SHA1: 43:AC:2A:34:BF:60:9C:9D:99:1D:C9:56:76:7B:81:56:71:04:66:E0
        SHA256:
54:A6:4B:AF:AA:E4:58:D1:5C:12:C3:07:1E:72:97:E8:AC:D1:EF:ED:21:A8:F2:FA:1A:77:8A:
64:DB:94:2E:72
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3

Extensions:

#1: ObjectId: 2.5.29.35 Criticality=false
```

```
AuthorityKeyIdentifier [
KeyIdentifier [
0000: CD CC 71 10 CF 2A 80 A2   67 96 A0 E1 AF 1A 9A 87  ..q..*..g.......
0010: 67 D1 62 DD                                        g.b.
]
]

#2: ObjectId: 2.5.29.19 Criticality=true
BasicConstraints:[
  CA:true
  PathLen:2147483647
]

#3: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
0000: CD CC 71 10 CF 2A 80 A2   67 96 A0 E1 AF 1A 9A 87  ..q..*..g.......
0010: 67 D1 62 DD                                        g.b.
]
]

Trust this certificate? [no]:  yes
Certificate was added to keystore
[root@kafka0 cer]#
```

In contrast to the keystore in step 1 that stores each machine's own identity, the truststore of a client stores all the certificates that the client should trust. Importing a certificate into one's truststore also means trusting all certificates that are signed by that certificate. As the analogy above, trusting the government (CA) also means trusting all passports (certificates) that it has issued. This attribute is called the chain of trust, and it is particularly useful when deploying SSL on a large Kafka cluster. You can sign all certificates in the cluster with a single CA, and have all machines share the same truststore that trusts the CA. That way all machines can authenticate all other machines.

```
[root@hp opt]# ls
apache-drill-1.12.0  ca-key                kafka    server.keystore.jks    zeppelin
ca-cert              client.truststore.jks scripts  server.truststore.jks
[root@hp opt]#
```

Signing the certificate

The next step is to sign all certificates generated by step 1 with the CA generated in step 2. First, you need to export the certificate from the keystore: replace **kafka0** with that of your hostname which you enter before.

```
# keytool -keystore server.keystore.jks -alias kafka0 -certreq -file cert-file
```

```
[root@hp opt]# keytool -keystore server.keystore.jks -alias hp.com -certreq -file cert-fi
le
Enter keystore password:
[root@hp opt]#
```

Password: kafka213

This produces ***cert-req***, being the signing request. To sign with the CA, run the following command.

Then sign it with the CA:

```
#openssl x509 -req -CA ca-cert -CAkey ca-key -in cert-file -out cert-signed -days 365 -CAcreateserial
#Password: EnjoyKafka
```

Output:

```
[root@kafka0 cer]# openssl x509 -req -CA ca-cert -CAkey ca-key -in cert-file -out cert-signed -days 365 -CAcreateserial
Signature ok
subject=C = Unknown, ST = Unknown, L = Unknown, O = Unknown, OU = Unknown, CN = kafka0
Getting CA Private Key
Enter pass phrase for ca-key:
```

This results in the cert-signed file.

The CA certificate must be imported into the server's keystore under the CARoot alias.

Finally, you need to import both the certificate of the CA and the signed certificate into the keystore: Accept Yes for all Queries Y/N.

All password after this should be : **kafka213**

#keytool -keystore server.keystore.jks -alias CARoot -import -file ca-cert

Accept, Yes to trust the certificate.

Output:

[root@kafka0 cer]# keytool -keystore server.keystore.jks -alias CARoot -import -file ca-cert
Enter keystore password:
Owner: CN=kafka0, O=Default Company Ltd, L=Default City, C=XX
Issuer: CN=kafka0, O=Default Company Ltd, L=Default City, C=XX
Serial number: 24cd3f803451fc94d6a851be5ca7a52ed4e7204
Valid from: Mon Oct 24 11:07:46 IST 2022 until: Tue Oct 24 11:07:46 IST 2023
Certificate fingerprints:
SHA1: 43:AC:2A:34:BF:60:9C:9D:99:1D:C9:56:76:7B:81:56:71:04:66:E0
SHA256:
54:A6:4B:AF:AA:E4:58:D1:5C:12:C3:07:1E:72:97:E8:AC:D1:EF:ED:21:A8:F2:FA:1A:77:8A:64:DB:94:
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3

Extensions:

```
#1: ObjectId: 2.5.29.35 Criticality=false
AuthorityKeyIdentifier [
KeyIdentifier [
0000: CD CC 71 10 CF 2A 80 A2   67 96 A0 E1 AF 1A 9A 87  ..q..*..g.......
0010: 67 D1 62 DD                                        g.b.
]
]

#2: ObjectId: 2.5.29.19 Criticality=true
BasicConstraints:[
  CA:true
  PathLen:2147483647
]

#3: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
0000: CD CC 71 10 CF 2A 80 A2   67 96 A0 E1 AF 1A 9A 87  ..q..*..g.......
0010: 67 D1 62 DD                                        g.b.
]
]

Trust this certificate? [no]:  yes
Certificate was added to keystore
```

[root@kafka0 cer]#

Then, import the signed certificate into the server's keystore under the **kafka0** alias.

#keytool -keystore server.keystore.jks -alias kafka0 -import -file cert-signed

Output:

[root@kafka0 cer]# keytool -keystore server.keystore.jks -alias kafka0 -import -file cert-signed
Enter keystore password:
Certificate reply was installed in keystore
[root@kafka0 cer]#

All password: kafka213

The definitions of the parameters are the following:

3. keystore: the location of the keystore
4. ca-cert: the certificate of the CA
5. ca-key: the private key of the CA
6. ca-password: the passphrase of the CA
7. cert-file: the exported, unsigned certificate of the server
8. cert-signed: the signed certificate of the server

Till now, we have configured the server key and certificate. Then we can configure the Broker to use SSL

Configuring Kafka Brokers

Kafka Brokers support listening for connections on multiple ports. We need to configure the following property in server.properties, which must have one or more comma-separated values:
Server properties is in /opt/kafka/config. [Ensure that you take a copy of the file before making any changes i.e cp server.properties server.properties_bak. We will be using the copy to roll back after this lab]

listeners

If SSL is not enabled for inter-broker communication, both PLAINTEXT and SSL ports will be necessary. Update the entry as shown below. Substitute with your hostname.

```
listeners= PLAINTEXT://kafka0:9092,SSL://kafka0:8092
```

```
# The address the socket server listens on. If not configured, the host name will be equal to the value of
# java.net.InetAddress.getCanonicalHostName(), with PLAINTEXT listener name, and port 9092.
#   FORMAT:
#     listeners = listener_name://host_name:port
#   EXAMPLE:
#     listeners = PLAINTEXT://your.host.name:9092
#listeners=PLAINTEXT://:9092
listeners= PLAINTEXT://kafka0:9092,SSL://kafka0:8092

# Listener name, hostname and port the broker will advertise to clients.
# If not set, it uses the value for "listeners".
#advertised.listeners=PLAINTEXT://your.host.name:9092

# Maps listener names to security protocols, the default is for them to be the same. See the config documentation for more
 details
#listener.security.protocol.map=PLAINTEXT:PLAINTEXT,SSL:SSL,SASL_PLAINTEXT:SASL_PLAINTEXT,SASL_SSL:SASL_SSL
```

We have enable SSL on port no 8092. This broker can be connected using plain and SSL protocol.

Comment all the following highlighted entries:

```
# Hostname and port the broker will advertise to producers and consumers. If not set,
# it uses the value for "listeners" if configured.  Otherwise, it will use the value
# returned from java.net.InetAddress.getCanonicalHostName().
#advertised.listeners=PLAINTEXT://your.host.name:9092
listeners= PLAINTEXT://kafka0:9092,SSL://kafka0:8092
#listeners=PLAINTEXT://0.0.0.0:9092,PLAINTEXT_HOST://0.0.0.0:8082
#advertised.listeners=PLAINTEXT://localhost:9092,PLAINTEXT_HOST://localhost:8082
#listener.security.protocol.map=PLAINTEXT:PLAINTEXT,PLAINTEXT_HOST:PLAINTEXT
```

Following SSL configs are needed on the broker side. Add the following in the ***server.properties. You can append at the last.***

ssl.keystore.location=/opt/scripts/cer/server.keystore.jks
ssl.keystore.password=kafka213
ssl.key.password=kafka213
ssl.truststore.location=/opt/scripts/cer/server.truststore.jks
ssl.truststore.password=kafka213
ssl.endpoint.identification.algorithm=
ssl.client.auth=required

```
 a maximum of max.poll.interval.ms.
# The default value for this is 3 seconds.
# We override this to 0 here as it makes for a better out-of-the-box experience for development and testing.
# However, in production environments the default value of 3 seconds is more suitable as this will help to avoid unnecessary,
 and potentially expensive, rebalances during application startup.
group.initial.rebalance.delay.ms=0


ssl.keystore.location=/opt/scripts/cer/server.keystore.jks
ssl.keystore.password=kafka213
ssl.key.password=kafka213
ssl.truststore.location=/opt/scripts/cer/server.truststore.jks
ssl.truststore.password=kafka213
ssl.endpoint.identification.algorithm=
ssl.client.auth=required
[root@kafka0 scripts]#
```

You need to ensure that path to the generated keys are in **/opt/scripts/cer/** folder.
Note: ssl.truststore.password is technically optional but highly recommended. If a password is not set access to the truststore is still available, but integrity checking is disabled.

Shutdown the broker if started earlier.
Start the broker now.
#cd /opt/scripts
#sh startABroker.sh

```
[root@kafka0 scripts]# pwd
/opt/scripts
[root@kafka0 scripts]# sh startABroker.sh
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
Started Successfully
[root@kafka0 scripts]#
```

Once you start broker you should be able to see in the ***server.log***.

In the log,/opt/kafka/logs/server.log, there will be an entry as shown below. i.e SSL port being configured.

```
[2022-12-23 13:48:52,166] INFO Updated connection-accept-rate max connection creation rate to 2147483647 (kafka.network.Co
nnectionQuotas)
[2022-12-23 13:48:52,169] INFO Awaiting socket connections on kafka0:9092. (kafka.network.DataPlaneAcceptor)
[2022-12-23 13:48:52,199] INFO [SocketServer listenerType=ZK_BROKER, nodeId=0] Created data-plane acceptor and processors
for endpoint : ListenerName(PLAINTEXT) (kafka.network.SocketServer)
[2022-12-23 13:48:52,200] INFO Updated connection-accept-rate max connection creation rate to 2147483647 (kafka.network.Co
nnectionQuotas)
[2022-12-23 13:48:52,200] INFO Awaiting socket connections on kafka0:8092. (kafka.network.DataPlaneAcceptor)
[2022-12-23 13:48:52,546] INFO [SocketServer listenerType=ZK_BROKER, nodeId=0] Created data-plane acceptor and processors
for endpoint : ListenerName(SSL) (kafka.network.SocketServer)
[2022-12-23 13:48:52,554] INFO [BrokerToControllerChannelManager broker=0 name=alterPartition]: Starting (kafka.server.Bro
```

Awaiting connection both in 9092(Plain) and 8092(SSL)

You can even verify using the following command to find out the listening port no.

```
#yum install lsof
#lsof -i:8092
```

```
[root@kafka0 scripts]# lsof -i:8092
COMMAND  PID USER   FD   TYPE DEVICE SIZE/OFF NODE NAME
java    3074 root  140u  IPv4  26221      0t0  TCP kafka0:8092 (LISTEN)
[root@kafka0 scripts]#
```

To check quickly if the server keystore and truststore are setup properly you can run the following command

```
#openssl s_client -debug -connect kafka0:8092
```

(Note: TLSv1 should be listed under ssl.enabled.protocols or –ts1 parameter require)
In the output of this command you should see server's certificate:

```
[root@hp logs]# openssl s_client -debug -connect hp.com:8092 -tls1
CONNECTED(00000003)
write to 0xle06950 [0xle4ed03] (155 bytes => 155 (0x9B))
0000 - 16 03 01 00 96 01 00 00-92 03 01 5b 03 f6 b9 39   ...........[...9
0010 - f7 ba 86 d0 24 7d c2 85-8e 32 c1 12 66 38 60 63   ....$}...2..f8`c
0020 - e4 5a 83 0f b6 6c ad 04-69 54 d3 00 00 4c c0 14   .Z...l..iT...L..
0030 - c0 0a 00 39 00 38 00 88-00 87 c0 0f c0 05 00 35   ...9.8.........5
0040 - 00 84 c0 13 c0 09 00 33-00 32 00 9a 00 99 00 45   .......3.2.....E
0050 - 00 44 c0 0e c0 04 00 2f-00 96 00 41 c0 12 c0 08   .D...../...A....
0060 - 00 16 00 13 c0 0d c0 03-00 0a 00 07 c0 11 c0 07   ................
0070 - c0 0c c0 02 00 05 00 04-00 ff 01 00 00 1d 00 0b   ................
0080 - 00 04 03 00 01 02 00 0a-00 08 00 06 00 19 00 18   ................
0090 - 00 17 00 23 00 00 00 0f-00 01 01                  ...#.......
read from 0xle06950 [0xle4a7b3] (5 bytes => 5 (0x5))
0000 - 16 03 01 05 5b                                    ....[
read from 0xle06950 [0xle4a7b8] (1371 bytes => 1371 (0x55B))
0000 - 02 00 00 4d 03 01 5b 03-f6 b9 b1 c1 a2 24 1a 90   ...M..[......$..
0010 - 15 5e 2e d8 63 0f e7 7b-6b 1c ae 0c 54 4c fa d9   .^..c..{k...TL..
0020 - e4 ca 8e 6d d6 83 20 5b-03 f6 b9 0f 35 70 21 8c   ...m.. [....5p!.
0030 - 39 fa b7 6f a2 ce b1 a1-de 87 9b 76 a2 80 85 22   9..o.......v..."
0040 - 6a 45 bb eb 5c a5 b4 c0-13 00 00 05 ff 01 00 01   jE..\...........
0050 - 00 0b 00 03 73 00 03 70-00 03 6d 30 82 03 69 30   ....s..p..m0..i0
0060 - 82 02 51 a0 03 02 01 02-02 04 66 63 83 b2 30 0d   ..Q.......fc..0.
0070 - 06 09 2a 86 48 86 f7 0d-01 01 0b 05 00 30 65 31   ..*.H........0e1
0080 - 0b 30 09 06 03 55 04 06-13 02 49 4e 31 14 30 12   .0...U....IN1.0.
0090 - 06 03 55 04 08 13 0b 4d-61 68 61 72 61 73 74 68   ..U....Maharasth
00a0 - 72 61 31 0f 30 0d 06 03-55 04 07 13 06 4d 75 6d   ra1.0...U....Mum
00b0 - 62 61 69 31 0c 30 0a 06-03 55 04 0a 13 03 74 6f   bai1.0...U....to
00c0 - 73 31 10 30 0e 06 03 55-04 0b 13 07 74 6f 73 2e   s1.0...U....tos.
```

```
-----END CERTIFICATE-----
subject=/C=IN/ST=Maharasthra/L=Mumbai/O=tos/OU=tos.com/CN=Apache
issuer=/C=IN/ST=Maharasthra/L=Mumbai/O=tos/OU=tos.com/CN=Apache
---
No client certificate CA names sent
Server Temp Key: ECDH, secp521r1, 521 bits
---
SSL handshake has read 1435 bytes and written 357 bytes
---
New, TLSv1/SSLv3, Cipher is ECDHE-RSA-AES128-SHA
Server public key is 2048 bit
Secure Renegotiation IS supported
Compression: NONE
Expansion: NONE
SSL-Session:
    Protocol  : TLSv1
    Cipher    : ECDHE-RSA-AES128-SHA
    Session-ID: 5B03F6B90F3570218C39FAB76FA2CEB1A1DE879B76A28085226A45BBEB5CA5B4
    Session-ID-ctx:
    Master-Key: B3C76F24E11BD5F6D66B6605606AED4342923EF46908AD2938B82CB04CE6C75D9091C5729
9462745D40C921A3B67DFDC
    Key-Arg   : None
    Krb5 Principal: None
    PSK identity: None
    PSK identity hint: None
    Start Time: 1526986425
    Timeout   : 7200 (sec)
    Verify return code: 18 (self signed certificate)
---
```

If the certificate does not show up or if there are any other error messages, then your keystore is not setup properly.

That is about configuring SSL on the server Side.

Let us configure Client to connect to the broker on SSL.

Since the client is present on the same broker, you don't need to generate different certificate. The existing broker certificate can be used for connecting to the server.

Create a file with the following content in /opt/scripts/ - **consumer_ssl.properties**

```
security.protocol=SSL
ssl.truststore.location=/opt/scripts/cer/server.truststore.jks
ssl.truststore.password=kafka213
ssl.keystore.location=/opt/scripts/cer/server.keystore.jks
ssl.keystore.password=kafka213
ssl.key.password=kafka213
ssl.client.auth=required
```

Connect to the broker using SSL.

```
#/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:8092  \
                --topic test --producer.config /opt/scripts/consumer_ssl.properties
```

Send Some Messages.

```
[root@kafka0 scripts]# vi consumer_ssl.properties
[root@kafka0 scripts]# /opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:8092  \
>                                       --topic test --producer.config /opt/scripts/consumer_ssl.properties
>hope this message gets through
>yes it does
>
```

You should be able to consume the messages with the following commands.

```
# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:8092   --topic test --consumer.config /opt/scripts/consumer_ssl.properties --from-beginning
```

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:8092   --topic test --consumer.conf
ig /opt/scripts/consumer_ssl.properties --from-beginning
Hello
How are u?
Hi
hope this message gets through
yes it does
```

Let us now configure ACL. Before going ahead with the next section, you need to roll back the server.properties.

Steps:

- Shutdown the zookeeper and kafka.
- Clean the kafka and zookeeper directories.
- Rename the server.properties back.

---------- Lab Ends Here ----------

9. Securing Kafka ACL – 60 Minutes

Kafka SASL/PLAIN without SSL

We will perform the following activity in a single node broker only. We will enable ACL in a single broker.
To run a secure broker, two steps need to be performed.

1. Configure the Kafka brokers with ACL using JAAS file
2. Kafka Clients – Pass the Credentials

First, we need to let the broker know authorized users' credentials. This will be stored in a JAAS file.

1.Configure the Kafka brokers and Kafka Clients

Add a JAAS configuration file for each Kafka broker. Create a kafka_plain_jaas.conf file as specified below:

Prepare the /opt/kafka/config/kafka_jaas.conf with below contents. Use vi editor.

```
KafkaServer {
org.apache.kafka.common.security.plain.PlainLoginModule required
   username="admin"
    password="admin"
```

```
    user_admin="admin"
    user_alice="alice"
    user_bob="bob"
    user_charlie="charlie";
};
```

Let's understand the content of ***kafka_plain_jaas.conf*** file and how Kafka Brokers and Kafka Clients use it.

KafkaServer Section:

The KafkaServer section defines four users: admin, alice, bob and charlie. The properties username and password are used by the broker to initiate connections to other brokers. In this example, admin is the user for inter-broker communication. The set of properties user_{userName} defines the passwords for all users that connect to the broker and the broker validates all client connections including those from other brokers using these properties.

This file needs to be passed in as a JVM config option when running the broker, using -Djava.security.auth.login.config=[path_to_jaas_file].

Create an initialize scripts in /opt/scripts/kafkasecurity.sh file with below contents to setup kafka_jaas.conf file location

#vi /opt/scripts/kafkasecurity.sh

Update with the following content.

```
#!/usr/bash
export KAFKA_HOME=/opt/kafka
export ZOOKEEPER_HOME=/opt/zookeeper
export KAFKA_PLAIN_PARAMS="-
Djava.security.auth.login.config=/opt/kafka/config/kafka_jaas.conf"
export KAFKA_OPTS="$KAFKA_PLAIN_PARAMS $KAFKA_OPTS"
export PATH="$PATH:$ZOOKEEPER_HOME/bin:$KAFKA_HOME/bin:$JAVA_HOME/bin"
```

Use the following interpreter in case of ***bash*** interpreter issue.

#!/bin/bash

Second, the following needs to be added to the broker properties file (e.g. server.properties) it defines the accepted protocol and also the ACL authorizer used by the broker:

Step 4: Update ***/opt/kafka/config/server.properties*** for all brokers. In our case only one broker.

```
# Use below for SASL/PLAIN only (No SSL)
# Using SASL_PLAINTEXT as we do not have SSL
authorizer.class.name=kafka.security.authorizer.AclAuthorizer

listeners=SASL_PLAINTEXT://kafka0:9092
security.inter.broker.protocol=SASL_PLAINTEXT
sasl.mechanism.inter.broker.protocol=PLAIN
sasl.enabled.mechanisms=PLAIN
advertised.listeners=SASL_PLAINTEXT://kafka0:9092
super.users=User:admin
```

```
#     listeners = PLAINTEXT://your.host.name:9092
authorizer.class.name=kafka.security.auth.SimpleAclAuthorizer
listeners=SASL_PLAINTEXT://tos.master.com:9092
security.inter.broker.protocol= SASL_PLAINTEXT
sasl.mechanism.inter.broker.protocol=PLAIN
sasl.enabled.mechanisms=PLAIN
# Hostname and port the broker will advertise to producers and consumers. If not
 set,
# it uses the value for "listeners" if configured.  Otherwise, it will use the v
alue
# returned from java.net.InetAddress.getCanonicalHostName().
advertised.listeners=SASL_PLAINTEXT://tos.master.com:9092

super.users=User:admin
```

Comment the following line.

```
# Using SASL_PLAINTEXT as we do not have SSL
#authorizer.class.name=kafka.security.auth.SimpleAclAuthorizer
authorizer.class.name=kafka.security.authorizer.AclAuthorizer
listeners=SASL_PLAINTEXT://localhost:9092
security.inter.broker.protocol=SASL_PLAINTEXT
sasl.mechanism.inter.broker.protocol=PLAIN
sasl.enabled.mechanisms=PLAIN
advertised.listeners=SASL_PLAINTEXT://localhost:9092
super.users=User:admin


#listeners=PLAINTEXT://0.0.0.0:9092,PLAINTEXT_HOST://0.0.0.0:8082
#advertised.listeners=PLAINTEXT://localhost:9092,PLAINTEXT_HOST://localhost:8082
#listener.security.protocol.map=PLAINTEXT:PLAINTEXT,PLAINTEXT_HOST:PLAINTEXT
```

This is to initialize the environment HOME.
#cd /opt/scripts
#source ./kafkasecurity.sh

Before starting the server, let us clean the zookeeper/kafka log data so that there won't be any conflict with configuration of the previous cluster ***(/opt/data/zookeeper*** and (***/opt/data/kafka-logs).***

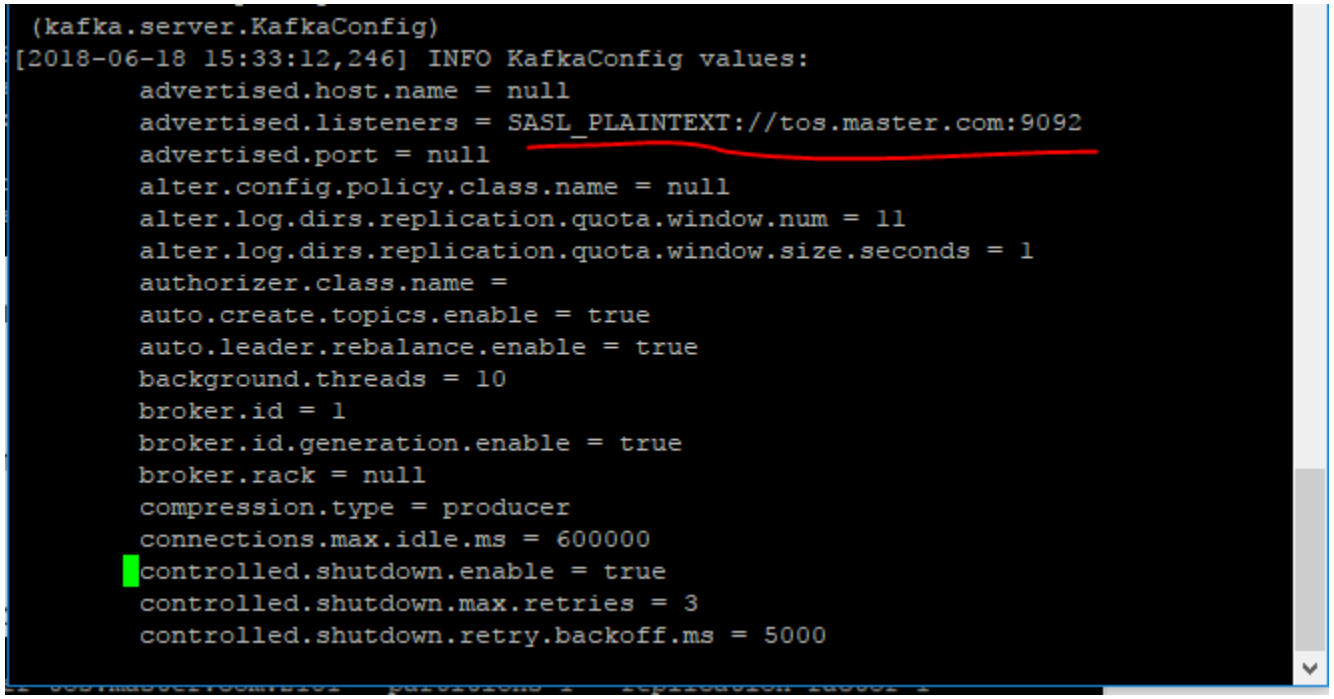
```
[root@tos zookeeper]# ls
version-2  zookeeper_server.pid
[root@tos zookeeper]# pwd
/opt/data/zookeeper
[root@tos zookeeper]# ls
version-2  zookeeper_server.pid
[root@tos zookeeper]# rm -fr *
[root@tos zookeeper]#
```

Delete the data folder of the zookeeper as shown above

Restart ZK/Kafka Services or
Start our broker (from the console that executed : source ./ kafkasecurity.sh)
sh startABroker.sh

```
[root@tos scripts]# sh startABroker.sh
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
Started Successfully
[root@tos scripts]# jps
2551 Kafka
2584 Jps
2286 QuorumPeerMain
[root@tos scripts]#
```

Validate the logs: ***/opt/kafka/logs/server.log*** in case there is any error.
Note : You can include sh startABroker.sh inside the kafkasecurity file in case the environments are not set properly in some OS.



All the commands shown below should be executed from the path */opt/scripts*.

Create a topic:

#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server kafka0:9092 --replication-factor 1 --partitions 1 --topic plain-topic

```
[root@kafka0 kafka-logs]# /opt/kafka/bin/kafka-topics.sh --create --bootstrap-server localhost:9092 --re
plication-factor 1 --partitions 1 --topic plain-topic
Error while executing topic command : Timed out waiting for a node assignment. Call: createTopics
[2022-05-17 16:42:55,686] ERROR org.apache.kafka.common.errors.TimeoutException: Timed out waiting for a
 node assignment. Call: createTopics
 (kafka.admin.TopicCommand$)
[root@kafka0 kafka-logs]#
```

It should generate an error like as shown above.

Run Kafka console producer.

Before running the Kafka console Producer configure the producer.properties file as shown:

vi producer.properties
Update with the following entries.

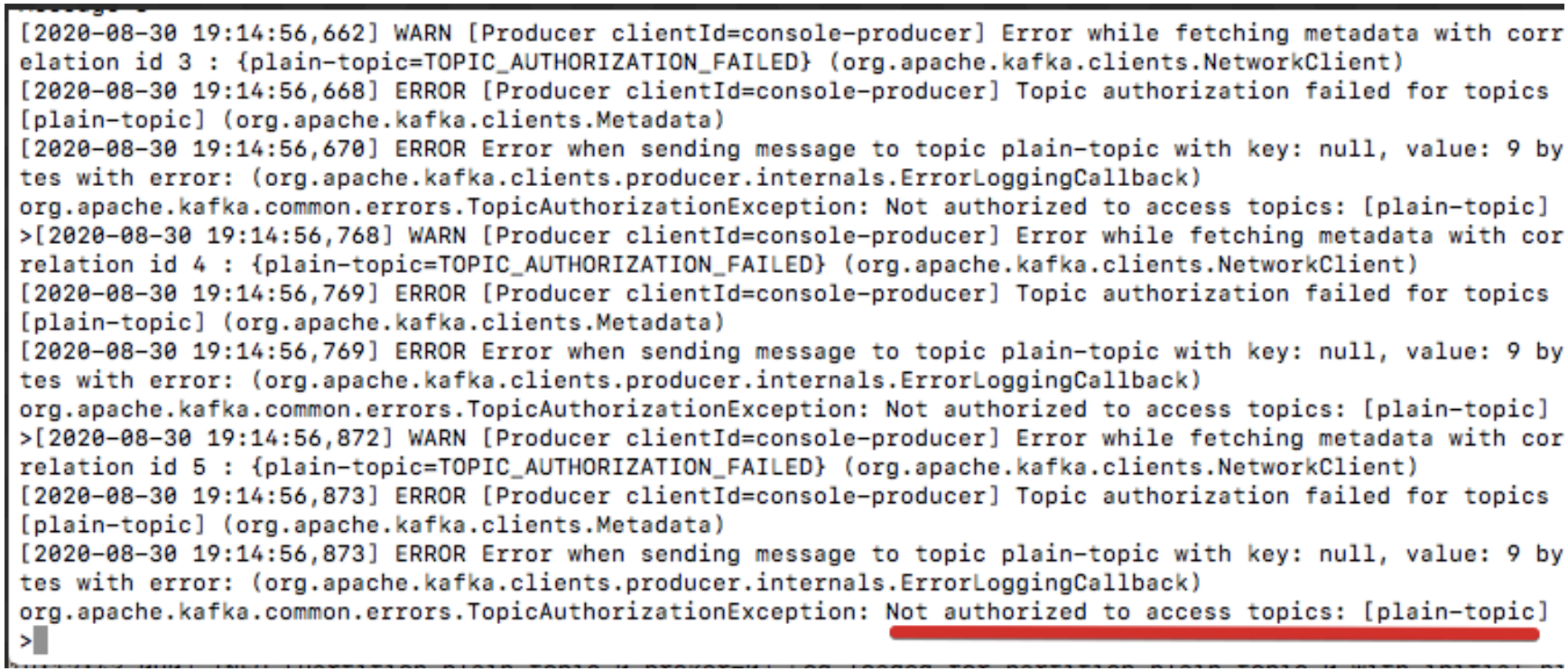
```
sasl.jaas.config=org.apache.kafka.common.security.plain.PlainLoginModule required \
 username="alice" \
 password="alice";
security.protocol=SASL_PLAINTEXT
sasl.mechanism=PLAIN
```

----- Code Ends Here // Exclude this line.

#/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:9092 --topic plain-topic --producer.config producer.properties

Send some messages in the producer console.

```
Message 1
Message 2
Message 3
```



Error since we have not authorized to access the topic.

The security configuration still does not give specific permissions to our Kafka users (except for admin who is a super user). These permissions are defined using the ACL command (bin/kafka-acls.sh). To verify existing ACLs run:

#cd /opt/scripts
#vi admin.properties

Update the following content in it.
// Begin - Exclude it

```
sasl.jaas.config=org.apache.kafka.common.security.plain.PlainLoginModule required \
 username="admin" \
 password="admin";
security.protocol=SASL_PLAINTEXT
sasl.mechanism=PLAIN
```

// Ends Here – Exclude it

Verify the ACL configure using the Admin credentials.

#/opt/kafka/bin/kafka-acls.sh --bootstrap-server kafka0:9092 --command-config admin.properties --list

This returns no ACL definitions. You have handled authentication, but have not provided any authorization rules to define the users able run specific APIs and access certain Kafka resources.

```
[root@kafka0 kafka-logs]# cd /opt/scripts/
[root@kafka0 scripts]# vi admin.properties
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh --bootstrap-server localhost:9092 --command-config admin.properties --li
st
[root@kafka0 scripts]#
```

Assign the permission:

#/opt/kafka/bin/kafka-acls.sh --bootstrap-server kafka0:9092 --command-config admin.properties --add --allow-principal User:alice --operation All --topic plain-topic

```
[root@kafka0 config]# cd /opt/scripts
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh  --bootstrap-server localhost:9092 --command-config admin.properties --
add --allow-principal User:alice --operation All --topic plain-topic
Adding ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:alice, host=*, operation=ALL, permissionType=ALLOW)

Current ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:alice, host=*, operation=WRITE, permissionType=ALLOW)
        (principal=User:alice, host=*, operation=ALL, permissionType=ALLOW)

[root@kafka0 scripts]#
```

Now you can verify the acl granted to alice user

```
#/opt/kafka/bin/kafka-acls.sh --bootstrap-server kafka0:9092 --command-config
admin.properties --list
```

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh --bootstrap-server localhost:9092 --command-config admin.properties --l
ist
Current ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:alice, host=*, operation=WRITE, permissionType=ALLOW)
        (principal=User:alice, host=*, operation=ALL, permissionType=ALLOW)

[root@kafka0 scripts]#
```

Now you can try sending message again from the producer console. Type one or two messages in the producer console.

```
# cd /opt/scripts
#/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:9092 --topic plain-
topic --producer.config producer.properties
```

Send some messages in the producer console.

```
Hello Message
```

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9092 --topic plain-topic --producer
.config producer.properties
>Hello
>Message
>
```

Now, it should be able to sent message to the topic as shown above.
Now we can try consuming these messages further from the consumer console, open a separate terminal for this.

Run Kafka console consumer

Consuming from Topic using bob user, hence grant ACL to bob.
Next, you need to let user bob consume (or fetch) from topic plain-topic using the Fetch API, as a member of the bob-group consumer group. Bob's ACL for fetching from topic test is:
Principal bob is Allowed Operation Read From Host * On Topic plain-topic .
or

```
# /opt/kafka/bin/kafka-acls.sh  --bootstrap-server=kafka0:9092 -command-config
admin.properties --add --allow-principal User:bob --operation Read --topic plain-topic
```

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh  --bootstrap-server=localhost:9092 -command-config admin.properties --a
dd --allow-principal User:bob --operation Read --topic plain-topic
Adding ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)

Current ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)
        (principal=User:alice, host=*, operation=WRITE, permissionType=ALLOW)
        (principal=User:alice, host=*, operation=ALL, permissionType=ALLOW)

[root@kafka0 scripts]#
```

Bob needs a second ACL for committing offsets to group bob-group (using the OffsetCommit API):

Principal bob is Allowed Operation Read From Host * On Group bob-group.
or

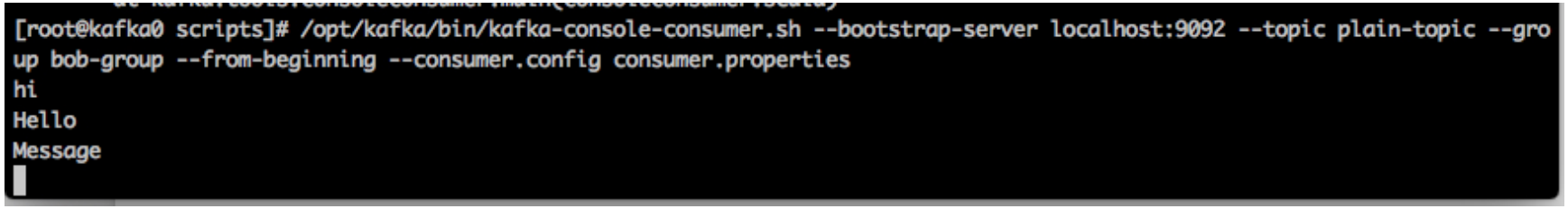
```
$ /opt/kafka/bin/kafka-acls.sh  --bootstrap-server=kafka0:9092 -command-config
admin.properties --add --allow-principal User:bob --operation Read --group bob-group
```

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh  --bootstrap-server=localhost:9092 -command-config admin.properties --a
dd --allow-principal User:bob --operation Read --group bob-group
Adding ACLs for resource `ResourcePattern(resourceType=GROUP, name=bob-group, patternType=LITERAL)`:
        (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)

Current ACLs for resource `ResourcePattern(resourceType=GROUP, name=bob-group, patternType=LITERAL)`:
        (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)

[root@kafka0 scripts]#
```

By granting these permissions to Bob, he can now consume messages from topic test as a member of bob-group.
Before running Kafka console consumer configure the consumer.properties file as shown:

```
# vi consumer.properties

sasl.jaas.config=org.apache.kafka.common.security.plain.PlainLoginModule required \
 username="bob" \
 password="bob";
security.protocol=SASL_PLAINTEXT
sasl.mechanism=PLAIN
```

$ /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9092 --topic plain-topic --group bob-group --from-beginning --consumer.config consumer.properties



Sent a few messages from the producer console, and you will see that messages are being consume on the console...

Describing consumer groups

Open a new console for the Charlie user.
Lastly, user charlie needs permission to retrieve committed offsets from group bob-group (using the OffsetFetch API). According to the table above, Charlie's first ACL for fetching offsets from this consumer group is:

Principal charlie is Allowed Operation Describe From Host * On Group bob-group.

or

$ /opt/kafka/bin/kafka-acls.sh --bootstrap-server=kafka0:9092 -command-config admin.properties --add --allow-principal User:charlie --operation Describe --group bob-group

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh --bootstrap-server=localhost:9092 -command-config admin.properties --ad
d --allow-principal User:charlie --operation Describe --group bob-group
Adding ACLs for resource `ResourcePattern(resourceType=GROUP, name=bob-group, patternType=LITERAL)`:
        (principal=User:charlie, host=*, operation=DESCRIBE, permissionType=ALLOW)

Current ACLs for resource `ResourcePattern(resourceType=GROUP, name=bob-group, patternType=LITERAL)`:
        (principal=User:charlie, host=*, operation=DESCRIBE, permissionType=ALLOW)
        (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)

[root@kafka0 scripts]#
```

Principal charlie is Allowed Operation Describe From Host * On Topic test.

or

$ /opt/kafka/bin/kafka-acls.sh --bootstrap-server=kafka0:9092 -command-config admin.properties --add --allow-principal User:charlie --operation Describe --topic plain-topic

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh --bootstrap-server=localhost:9092 -command-config admin.properties --ad
d --allow-principal User:charlie --operation Describe --topic plain-topic
Adding ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:charlie, host=*, operation=DESCRIBE, permissionType=ALLOW)

Current ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
        (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)
        (principal=User:charlie, host=*, operation=DESCRIBE, permissionType=ALLOW)
        (principal=User:alice, host=*, operation=WRITE, permissionType=ALLOW)
        (principal=User:alice, host=*, operation=ALL, permissionType=ALLOW)

[root@kafka0 scripts]#
```

The following file contains the client configuration for group.

vi group.properties

```
sasl.jaas.config=org.apache.kafka.common.security.plain.PlainLoginModule required \
 username="charlie" \
 password="charlie";
security.protocol=SASL_PLAINTEXT
sasl.mechanism=PLAIN
```

Now Charlie is able to get the proper listing of offsets in the group:

```
$ /opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server kafka0:9092 --describe --
group bob-group --command-config group.properties
```

```
[root@tos scripts]# vi group.properties
[root@tos scripts]# /opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server tos.master.
com:9092 --describe --group bob-group --command-config group.properties
Note: This will not show information about old Zookeeper-based consumers.

TOPIC           PARTITION  CURRENT-OFFSET  LOG-END-OFFSET  LAG             CONSUMER-ID
                                HOST            CLIENT-ID
plain-topic     0          5               5               0               consumer-1-6450
d497-85b1-4113-80bc-985c4045b185 /10.10.20.24    consumer-1
[root@tos scripts]#
```

or

```
[root@kafka0 scripts]# vi group.properties
[root@kafka0 scripts]# /opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server localhost:9092 --describe --group bob-grou
p --command-config group.properties

Consumer group 'bob-group' has no active members.

GROUP           TOPIC           PARTITION  CURRENT-OFFSET  LOG-END-OFFSET  LAG             CONSUMER-ID     HOST            C
LIENT-ID
bob-group       plain-topic     0          4               4               0               -               -               -
[root@kafka0 scripts]#
```

As you can see above the details of the consumer group, Here the log end offset is showing as 3/5 that is the current offset are same with that of the end offset. This is an ideal cluster, where there is no lagging in the production and consumption.

The above ACLs grants enough permissions for this use case to run.
To summarize, configured ACLs execute the following command.

$ /opt/kafka/bin/kafka-acls.sh --bootstrap-server=kafka0:9092 --command-config admin.properties --list

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-acls.sh --bootstrap-server=localhost:9092  --command-config admin.properties --list
Current ACLs for resource `ResourcePattern(resourceType=GROUP, name=bob-group, patternType=LITERAL)`:
       (principal=User:charlie, host=*, operation=DESCRIBE, permissionType=ALLOW)
       (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)

Current ACLs for resource `ResourcePattern(resourceType=TOPIC, name=plain-topic, patternType=LITERAL)`:
       (principal=User:bob, host=*, operation=READ, permissionType=ALLOW)
       (principal=User:charlie, host=*, operation=DESCRIBE, permissionType=ALLOW)
       (principal=User:alice, host=*, operation=WRITE, permissionType=ALLOW)
       (principal=User:alice, host=*, operation=ALL, permissionType=ALLOW)

[root@kafka0 scripts]#
```

Errors:

```
[root@tos scripts]# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server
tos.master.com:9092 --topic plain-topic --from-beginning --consumer.config consu
mer.properties
[2018-06-27 21:37:46,223] WARN [Consumer clientId=consumer-1, groupId=console-co
nsumer-47559] Error while fetching metadata with correlation id 2 : {plain-topic
=TOPIC_AUTHORIZATION_FAILED} (org.apache.kafka.clients.NetworkClient)
[2018-06-27 21:37:46,232] ERROR Unknown error when running consumer:  (kafka.too
ls.ConsoleConsumer$)
org.apache.kafka.common.errors.GroupAuthorizationException: Not authorized to ac
cess group: console-consumer-47559
```

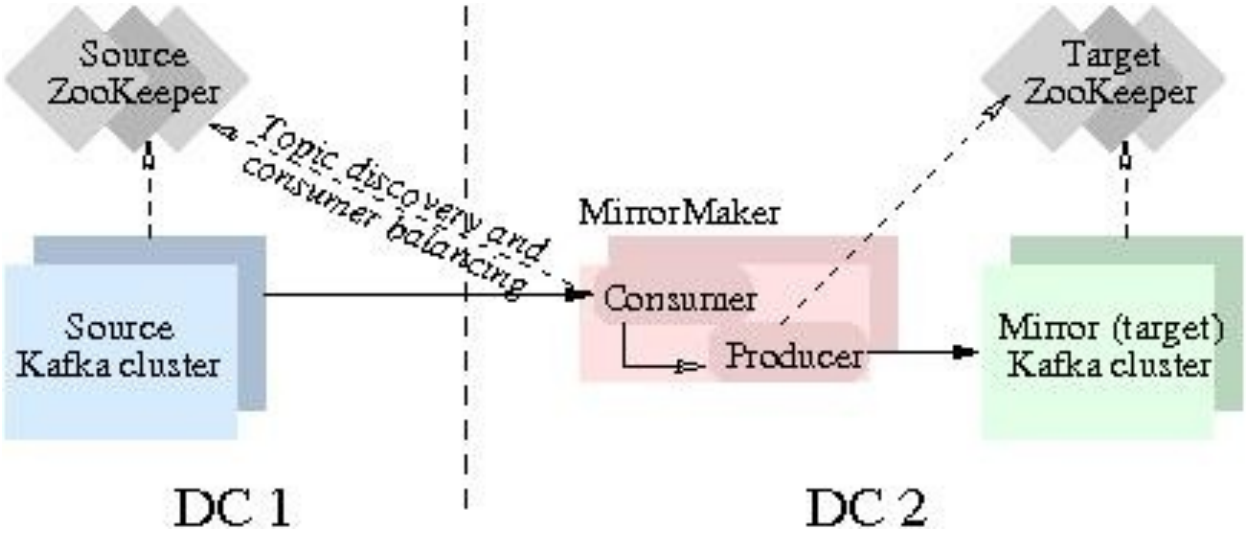
Grant proper authorization.
Ensure that kafkasecurity.sh is only executed for the server start up scripts not in any of the other console.

---- ---------- ----------

Lab Ends Here

10. Mirroring data between clusters – MirrorMaker V 1 – 90 Minutes

In this lab we will demonstrate the replication of message across the cluster for DR.



As shown in the above picture, there are two cluster; a kafka cluster in (kafka0:9092)DC1 and another kafka cluster in DC2(kafka0:9093)

How to set up a mirror
Setting up a mirror is easy - simply start up the mirror-maker processes after bringing up the target cluster. At minimum, the mirror maker takes one or more consumer configurations, a producer configuration and either a whitelist or a blacklist. You need to

point the consumer to the source cluster's ZooKeeper, and the producer to the mirror cluster's ZooKeeper (or use the broker.list parameter).

Create Two instances of kafka Nodes which will act as seperate DC.

- DC 1 (kafka0:9092) : zookeeper : /source
- DC 2 (kafka0:9093) : zookeeper : /dest

Replication will happen from DC 1 to DC 2.

Start a common zookeeper for DC1 and DC2 with different znode.

Follow the following steps to Start a New Zookeeper for the Mirror Maker

Create a config file and update the following in the /opt/zookeeper/conf/zoom.cfg

```
dataDir=/opt/data/zookeeper-km/
clientPort=2181
initLimit=5
syncLimit=2
```

Use the above zookeeper config file to start the zookeeper instance

```
#cd /opt/zookeeper
#bin/zkServer.sh start conf/zoom.cfg
```

Create two properties file for kafka instances

$ cd /opt
$ mkdir -p kafka-config/config

Copy two servers config for Source and Destination cluster.
$ cp kafka/config/server.properties kafka-config/config/server-p.properties
$ cp kafka/config/server.properties kafka-config/config/server-s.properties

Make the necessary data directories.
#mkdir -p /opt/data/kafka-logs/kafka-p
#mkdir -p /opt/data/kafka-logs/kafka-s

DC 1 – Zookeeper and Kafka Instances

Start the 1st zookeeper and source kafka node.

Update the following properties.
#vi /opt/kafka-config/config/server-p.properties

broker.id=0
listeners=PLAINTEXT://kafka0:9092
advertised.listeners=PLAINTEXT://kafka0:9092
log.dirs=/opt/data/kafka-logs/kafka-p
zookeeper.connect=localhost:2181/source

Open a separate terminal and execute the following:
/opt/kafka/bin/kafka-server-start.sh "/opt/kafka-config/config/server-p.properties"

DC2 VM – Zookeeper and Kafka Instances

Start the 2nd zookeeper and a kafka node

Update the following properties.

#vi /opt/kafka-config/config/server-s.properties
broker.id=0
listeners=PLAINTEXT://kafka0:9093
advertised.listeners=PLAINTEXT://kafka0:9093
log.dirs=/opt/data/kafka-logs/kafka-s
zookeeper.connect=localhost:2181/dest

Start the destination cluster in a separate node.

/opt/kafka/bin/kafka-server-start.sh "/opt/kafka-config/config/server-s.properties"

Let us create the following configuration in the data center, DC2 . Change the directory to /opt/scripts

#cd /opt/scripts

Create consumer.props

Update the above file with the following entries:

In this example, the file that lists the properties and values for the consumers that will read messages from the topics in Apache Kafka is named consumer.props. It contains this list:

```
group.id=cg.1
bootstrap.servers=kafka0:9092
shallow.iterator.enable=false
```

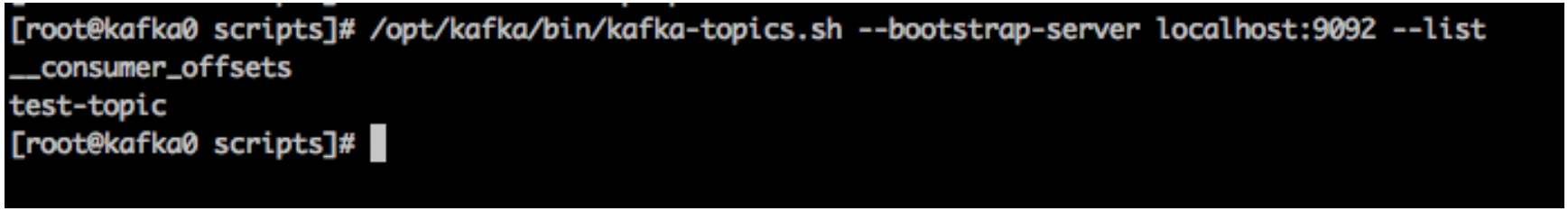
The file that lists the properties and values for the producers that will publish messages to topics in Kafka DC2 is named producer.props. It contains this list: (Destination Brokers)

#vi producer.props

bootstrap.servers=kafka0:9093

Verify the topic on DC1

#/opt/kafka/bin/kafka-topics.sh --bootstrap-server kafka0:9092 --list



Here is an example showing how to mirror a single topic (named test-topic) from an input cluster:
If the test-topic is not present, ensure that you have created on the DC1:

#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server kafka0:9092 --replication-factor 1 --partitions 8 --topic test-topic

Create the topic on the second node.
#/opt/kafka/bin/kafka-topics.sh --bootstrap-server kafka0:9093 --create --topic test-topic

Let us configure replication across the DC using Mirror maker. You need to execute the following on the DC2. It can be executed from any of the DC, however we have created configuration files in the DC2 hence we will be executing this from the /opt/scripts folder of DC2 vm

#cd /opt/scripts
#/opt/kafka/bin/kafka-mirror-maker.sh --consumer.config consumer.props --producer.config producer.props --whitelist test-topic

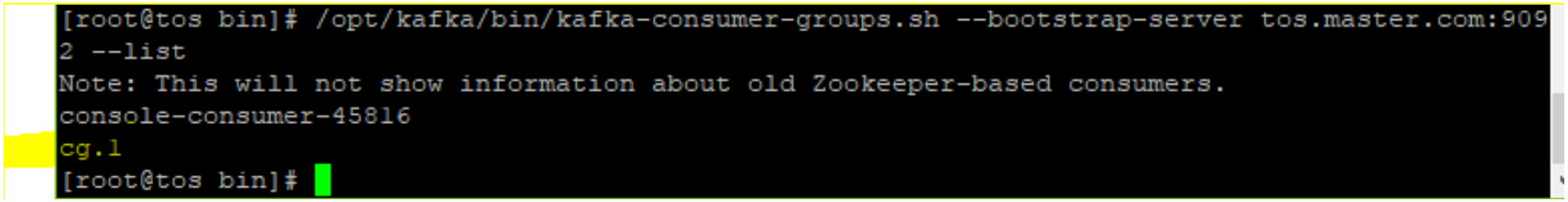
```
[root@tos kafka]# bin/kafka-mirror-maker.sh --consumer.config consumer.props --p
roducer.config producer.props --whitelist test-topic
WARNING: The default partition assignment strategy of the new-consumer-based mir
ror maker will change from 'range' to 'roundrobin' in an upcoming release (so th
at better load balancing can be achieved). If you prefer to make this switch in
advance of that release add the following to the corresponding new-consumer conf
ig: 'partition.assignment.strategy=org.apache.kafka.clients.consumer.RoundRobinA
ssignor'
[2018-06-13 23:59:17,883] WARN The configuration 'auto.create.topics.enable' was
 supplied but isn't a known config. (org.apache.kafka.clients.producer.ProducerC
onfig)
[2018-06-13 23:59:17,884] WARN The configuration 'compression.codec' was supplie
d but isn't a known config. (org.apache.kafka.clients.producer.ProducerConfig)
[2018-06-13 23:59:17,884] WARN The configuration 'metadata.broker.list' was supp
lied but isn't a known config. (org.apache.kafka.clients.producer.ProducerConfig
)
[2018-06-13 23:59:18,108] WARN The configuration 'shallow.iterator.enable' was s
upplied but isn't a known config. (org.apache.kafka.clients.consumer.ConsumerCon
fig)
```

Note that we specify the list of topics with the `--whitelist` option. This option allows any regular expression using Java-style regular expressions. So you could mirror two topics named *A* and *B* using `--whitelist 'A|B'`. Or you could mirror *all* topics using `--whitelist '*'`. Make sure to quote any regular expression to ensure the shell doesn't try to expand it as a file path. For convenience we allow the use of ',' instead of '|' to specify a list of topics. Combining mirroring with the configuration `auto.create.topics.enable=true` makes it possible to have a replica cluster that will automatically create and replicate all data in a source cluster even as new topics are added.

How to check whether a mirror is keeping up

List the consumer on the DC1

#/opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server kafka0:9092 --list



Note: cg.1 is the consumer group of the MirrorMaker.

The consumer groups tool is useful to gauge how well your mirror is keeping up with the source cluster. Note that the *–bootstrap-server* argument should point to the source cluster's broker (DC1 in this scenario). For example:

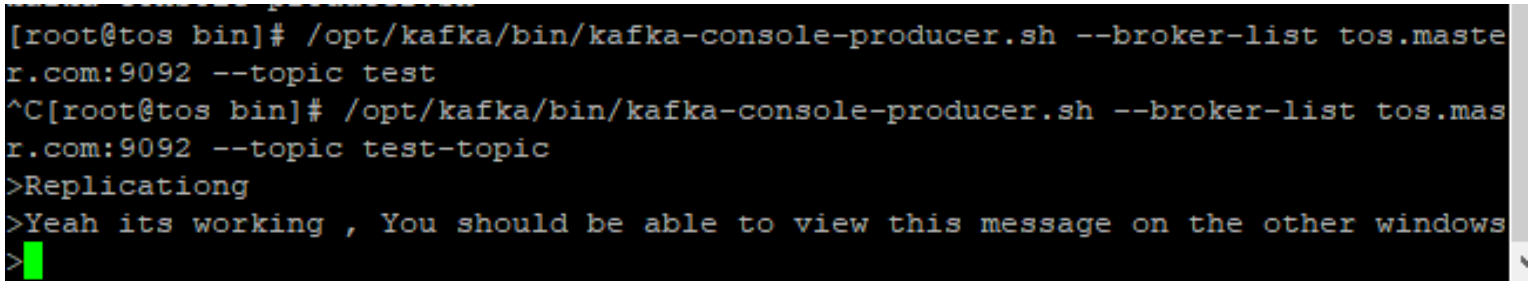
#/opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server kafka0:9092 --describe --group cg.1

```
(base) Henrys-MacBook-Air:~ henrypotsangbam$ /opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server localhost:9092 --describe --group cg.1

GROUP           TOPIC           PARTITION  CURRENT-OFFSET  LOG-END-OFFSET  LAG             CONSUMER-ID                                     HOST
    CLIENT-ID
cg.1            test-topic      4          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      5          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      2          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      6          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      3          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      1          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      7          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
cg.1            test-topic      0          -               0               -               cg.1 -0-882629a6-a099-4093-a97e-6fec17e0790c /192.168.29.
132 cg.1 -0
(base) Henrys-MacBook-Air:~ henrypotsangbam$
```

Let us send messages on DC1 and verify it on DC2

Send messages from DC1. Ensure that you open a separate terminal for each of the console.

Type few message from the producer console.
#/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:9092 --topic test-topic



Consume messages from a test topic: DC2

/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9093 --topic test-topic --from-beginning

```
Last login: Wed Jun 13 23:20:13 2018 from 10.10.20.1
[root@tos ~]# /opt/kafka/bin/kafka-console-consumer.sh -zookeeper tos.slave.com:
2181 --topic test-topic --from-beginning
Using the ConsoleConsumer with old consumer is deprecated and will be removed in
 a future major release. Consider using the new consumer by passing [bootstrap-s
erver] instead of [zookeeper].
Replicationg
Yeah its working , You should be able to view this message on the other windows
```

You are able to receive message from the DC1 to DC2

Verify the messages lagging again: (Connect on the Source Custer)
#/opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server kafka0:9092 --describe --group cg.1

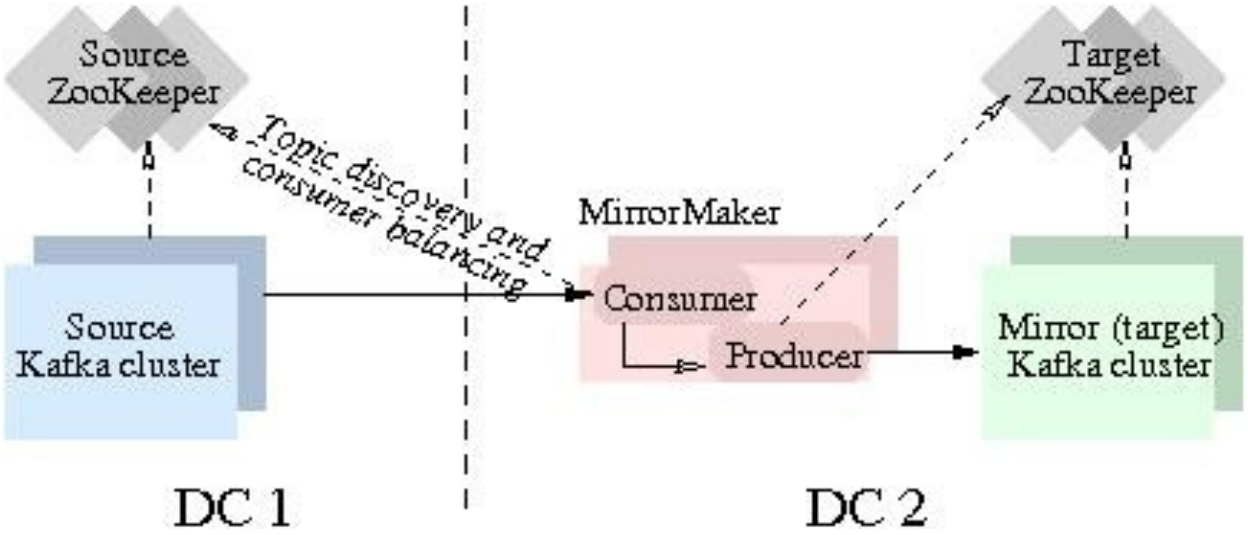
```
[root@tos bin]# /opt/kafka/bin/kafka-consumer-groups.sh --bootstrap-server tos.master.com:9092 --describe --group cg.1
Note: This will not show information about old Zookeeper-based consumers.

TOPIC           PARTITION  CURRENT-OFFSET  LOG-END-OFFSET  LAG             CONSUMER-ID                                     HOST
       CLIENT-ID
test-topic      4          -               0               -               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      5          -               0               -               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      2          -               0               -               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      6          -               0               -               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      3          1               1               0               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      1          1               1               0               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      7          -               0               -               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
test-topic      0          -               0               -               cg.1 -0-c7960852-b3ad-429d-a8f5-33e2779cba6e /10.10.20
.26    cg.1 -0
[root@tos bin]#
```

As you can verify that the messages are being replicated. The lag is showing as 0.

---------- ---------- Labs End Here ----------

11. Mirroring data between clusters – MirrorMaker V2 – 90 Minutes

In this lab we will demonstrate the replication of message across the cluster for DR.



As shown in the above picture, there are two cluster; a kafka cluster in (kafka0:9092)DC1 and another kafka cluster in DC2(kafka0:9093)

How to set up a mirror
Setting up a mirror is easy - simply start up the mirror-maker processes after bringing up the target cluster. At minimum, the mirror maker takes one or more consumer configurations, a producer configuration and either a whitelist or a blacklist. You need to

point the consumer to the source cluster's ZooKeeper, and the producer to the mirror cluster's ZooKeeper (or use the broker.list parameter).

Create Two instances of kafka Nodes which will act as seperate DC.

- DC 1 (kafka0:9092) : zookeeper : /source
- DC 2 (kafka0:9093) : zookeeper : /dest

Replication will happen from DC 1 to DC 2.

Start a common zookeeper for DC1 and DC2 with different znode.

Follow the following steps to Start a New Zookeeper for the Mirror Maker

Create a config file and update the following in the: /opt/zookeeper/conf/zoom.cfg

```
dataDir=/opt/data/zookeeper-km/
clientPort=2181
initLimit=5
syncLimit=2
```

Use the above zookeeper config file to start the zookeeper instance

```
#cd /opt/zookeeper
#bin/zkServer.sh start conf/zoom.cfg
```

Create two properties file for kafka instances

```
$ cd /opt
$ mkdir -p kafka-config/config
```

Copy two servers config for Source and Destination cluster.

```
$ cp kafka/config/server.properties kafka-config/config/server-p.properties
$ cp kafka/config/server.properties kafka-config/config/server-s.properties
```

Make the necessary data directories.

```
#mkdir -p /opt/data/kafka-logs/kafka-p
#mkdir -p /opt/data/kafka-logs/kafka-s
```

DC 1 – Zookeeper and Kafka Instances

Start the 1st zookeeper and source kafka node.

Update the following properties.

```
#vi /opt/kafka-config/config/server-p.properties

broker.id=0
listeners=PLAINTEXT://kafka0:9092
advertised.listeners=PLAINTEXT://kafka0:9092
```

```
log.dirs=/opt/data/kafka-logs/kafka-p
zookeeper.connect=localhost:2181/source
```

Open a separate terminal and execute the following:

```
#/opt/kafka/bin/kafka-server-start.sh   "/opt/kafka-config/config/server-p.properties"
```

DC2 VM – Zookeeper and Kafka Instances

Start the same zookeeper with separate znode:dest and a kafka node

Update the following properties for the secondary Node broker.

```
#vi /opt/kafka-config/config/server-s.properties

broker.id=0
listeners=PLAINTEXT://kafka0:9093
advertised.listeners=PLAINTEXT://kafka0:9093
log.dirs=/opt/data/kafka-logs/kafka-s
zookeeper.connect=localhost:2181/dest
```

Start the destination cluster in a separate terminal.

```
#/opt/kafka/bin/kafka-server-start.sh  "/opt/kafka-config/config/server-
s.properties"
```

Let us create the following configuration in the data center, DC2 . Change the directory to /opt/scripts

```
#cd /opt/scripts
#vi mirror-maker.properties
```

Create mirror-maker.properties

Update the above file with the following entries:

```
# File begins here
clusters = primary, secondary
# Unidirectional flow (one-way) from primary to secondary cluster
primary.bootstrap.servers = kafka0:9092
secondary.bootstrap.servers = kafka0:9093

primary->secondary.enabled = true
secondary->primary.enabled = false
```

```
topics = .*
groups = .*
replication.factor = 1
refresh.topics.enabled = true
refresh.topics.interval.seconds = 30

#primary->secondary.topics = test-topic   # only replicate mention topic
offset-syncs.topic.replication.factor = 1
checkpoints.topic.replication.factor = 1
heartbeats.topic.replication.factor = 1
offset-syncs.topic.replication.factor = 1
offset.storage.replication.factor=1
status.storage.replication.factor=1
config.storage.replication.factor=1
#producer.override.bootstrap.servers = kafka0:9093
topics.blacklist = .*[\-\.]internal, .*\.replica, __consumer_offsets
groups.blacklist = console-consumer-.*, connect-.*, __.*

key.converter=org.apache.kafka.connect.converters.ByteArrayConverter
value.converter=org.apache.kafka.connect.converters.ByteArrayConverter
#File Ends here.
```

Verify the topic on DC1

```
#/opt/kafka/bin/kafka-topics.sh --bootstrap-server kafka0:9092 --list
```

```
[root@kafka0 scripts]# /opt/kafka/bin/kafka-topics.sh --bootstrap-server localhost:9092 --list
__consumer_offsets
test-topic
[root@kafka0 scripts]#
```

Here is an example showing how to mirror a single topic (named test-topic) from an input cluster:
If the test-topic is not present, ensure that you have created on the DC1:

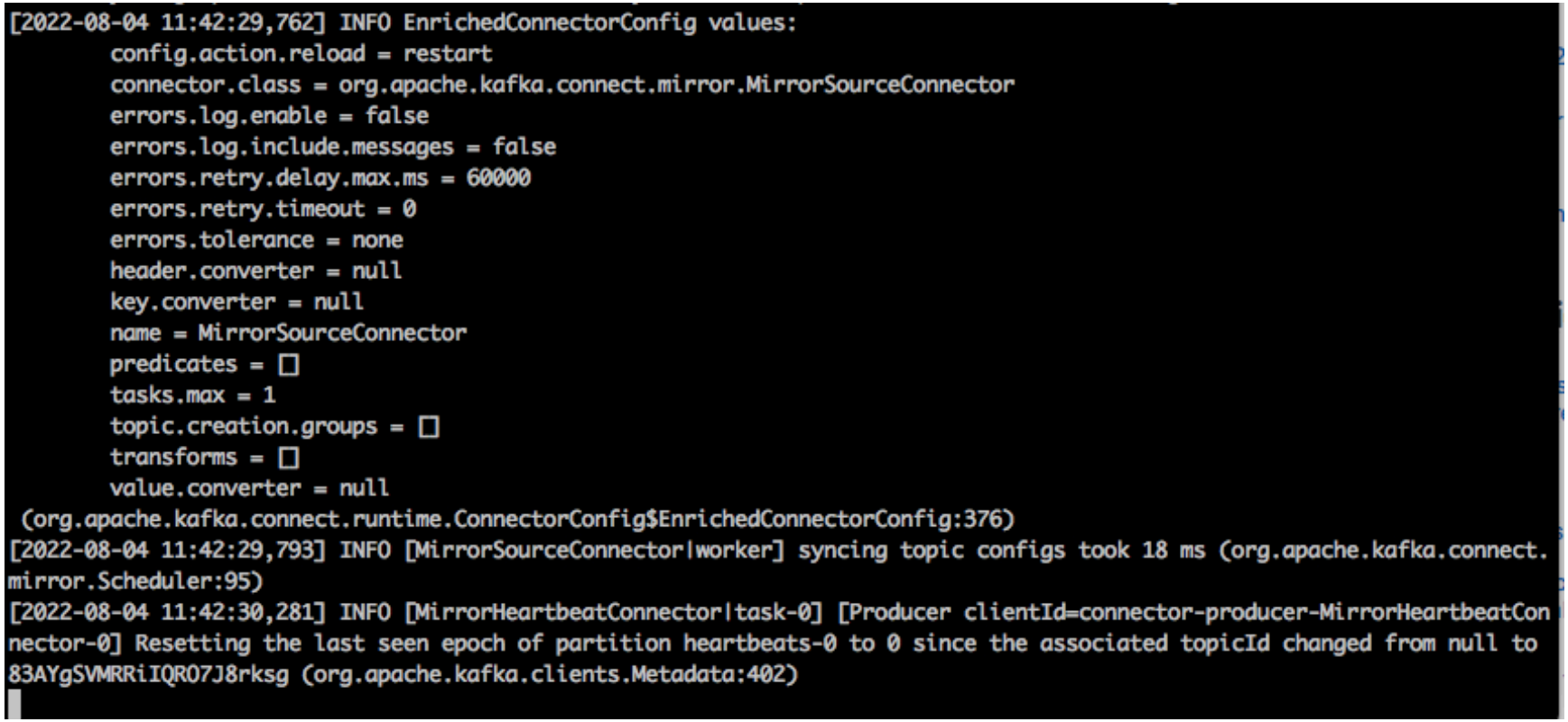
```
#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server kafka0:9092 --
replication-factor 1 --partitions 8 --topic test-topic
```

```
#/opt/kafka/bin/kafka-topics.sh --create --bootstrap-server kafka0:9092 --
replication-factor 1 --partitions 8 --topic henry
```

Let us configure replication across the DC using Mirror maker. You need to execute the following on the DC2. It can be executed from any of the DC, however we have created configuration files in the DC2 hence we will be executing this from the /opt/scripts folder of DC2 vm

Run in secondary's data center, reading from the remote `primary` cluster
$ /opt/kafka/bin/connect-mirror-maker.sh mirror-maker.properties

The --clusters secondary tells the MirrorMaker process that the given cluster(s) are nearby, and prevents it from replicating data or sending configuration to clusters at other, remote locations.

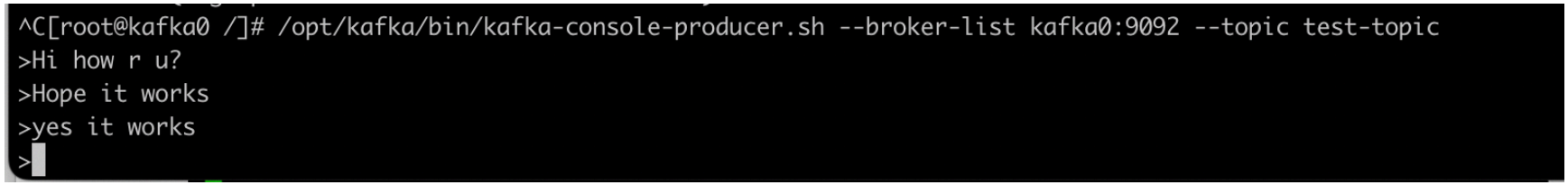


Let us send messages on DC1 and verify it on DC2

Send messages from DC1. Ensure that you open a separate terminal for each of the console.

Type few message from the producer console.

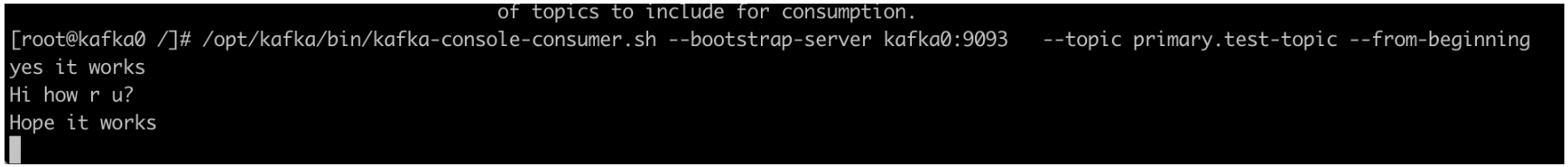
```
#/opt/kafka/bin/kafka-console-producer.sh --broker-list kafka0:9092 --topic test-topic
```



Consume messages from a test topic: DC2

```
# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server kafka0:9093 --topic primary.test-topic --from-beginning
```

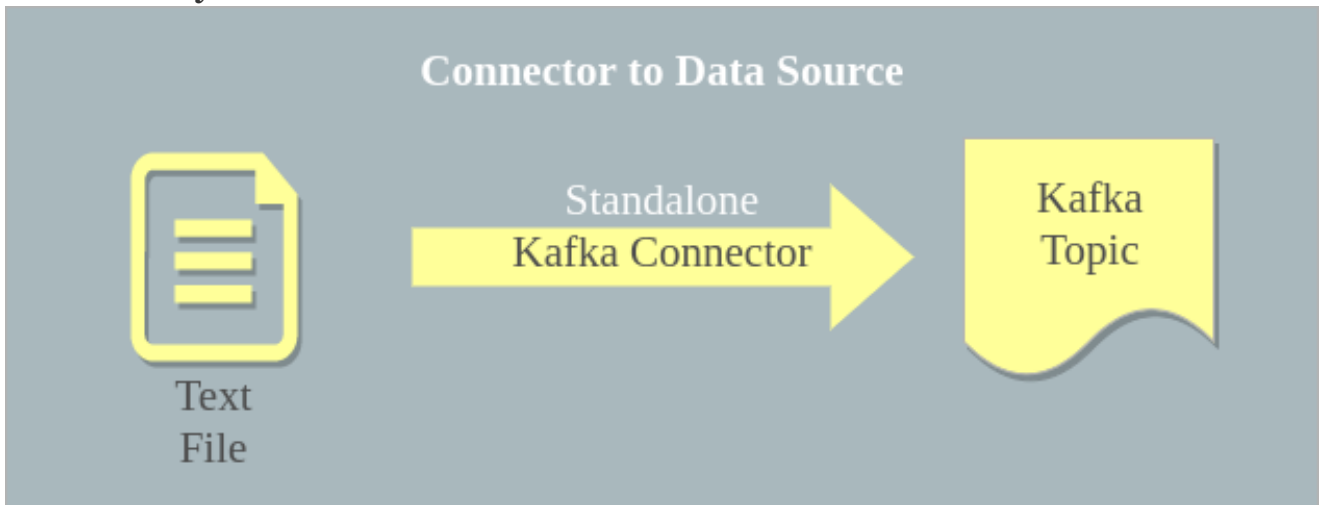
You are able to receive message from the DC1 to DC2



https://fossies.org/linux/kafka/config/connect-mirror-maker.properties
https://access.redhat.com/documentation/en-us/red_hat_amq/7.7/html/using_amq_streams_on_rhel/assembly-mirrormaker-str
---------- ---------- Labs End Here ----------

12. Kafka Connector (File & JDBC) - 150 Minutes

Apache Kafka Connector – Connectors are the components of Kafka that could be setup to listen the changes that happen to a data source like a file or database, and pull in those changes automatically.



When working with Kafka you might need to write data from a local file to a Kafka topic. This is actually very easy to do with Kafka Connect. Kafka Connect is a framework that provides scalable and reliable streaming of data to and from Apache Kafka. With Kafka Connect, writing a file's content to a topic requires only a few simple steps

Starting Kafka and Zookeeper
We will use the standalone Broker this example.
#cd /opt/scripts
#sh startABroker.sh

```
[root@tos scripts]# ls
custom-reassignment.json  server2.log       stopZookeeper.sh
old.jso                   start3Brokers.sh  topics-to-move.json
server0.log               startABroker.sh   zookeeper.out
server1.log               stop3Brokers.sh
[root@tos scripts]# sh startABroker.sh
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
Started Successfully
[root@tos scripts]# jps
2209 QuorumPeerMain
2474 Kafka
2493 Jps
[root@tos scripts]#
```

Creating a Topic to Write to, the message will be fetch from the file and publish to the topic.

```
#cd /opt/scripts
#/opt/kafka/bin/kafka-topics.sh \
 --create \
 --bootstrap-server kafka0:9092 \
 --replication-factor 1 \
 --partitions 1 \
 --topic my-kafka-connect
```

```
[root@tos bin]#
[root@tos bin]# cd /opt/scripts
[root@tos scripts]# /opt/kafka/bin/kafka-topics.sh \
>    --create \
>    --zookeeper tos.master.com:2181 \
>    --replication-factor 1 \
>    --partitions 1 \
>    --topic my-kafka-connect
Created topic "my-kafka-connect".
[root@tos scripts]#
```

Creating a Source Config File

Since we are reading the contents of a local file and writing to Kafka, this file is considered our “source”. Therefore, we will use the FileSource connector. We must create a configuration file to use with this connector. For this most part you can copy the example available in $KAFKA_HOME/config/connect-file-source.properties. Below is an example of our my-file-source.properties file.

Open a new file.
#vi my-file-source.properties

Paste the following instruction in the above file.

```
#my-file-source.properties config file
name=local-file-source
connector.class=com.github.mmolimar.kafka.connect.fs.FsSourceConnector
policy.class=com.github.mmolimar.kafka.connect.fs.policy.SimplePolicy
tasks.max=1
fs.uris=file:///tmp/my-test.txt
topic=my-kafka-connect
file_reader.class=com.github.mmolimar.kafka.connect.fs.file.reader.TextFileReader
file_reader.batch_size=0
```

This file indicates that we will use the FileStreamSource connector class, read data from the /tmp/my-test.txt file, and publish records to the my-kafka-connect Kafka topic. We are also only using 1 task to push this data to Kafka, since we are reading/publishing a single file.

Creating a Worker Config File.

Processes that execute Kafka Connect connectors and tasks are called workers. Since we are reading data from a single machine and publishing to Kafka, we can use the simpler of the two types, standalone workers (as opposed to distributed workers). You can find a sample config file for standalone workers in $KAFKA_HOME/config/connect-standalone.properties. We will call our file my-standalone.properties.

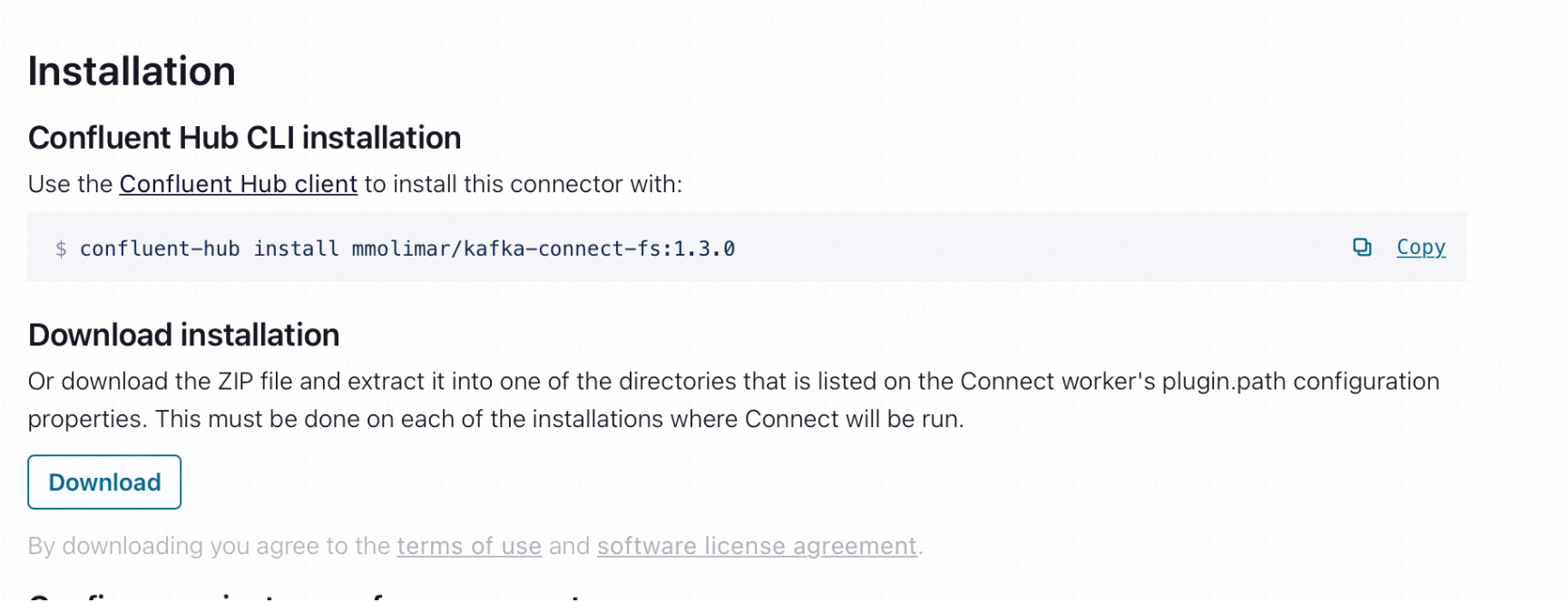
Create a file.
#vi my-standalone.properties

Update with the following contents.

```
#bootstrap kafka servers
bootstrap.servers=kafka0:9092

# specify input data format
key.converter=org.apache.kafka.connect.storage.StringConverter
value.converter=org.apache.kafka.connect.storage.StringConverter

# local file storing offsets and config data
offset.storage.file.filename=/tmp/connect.offsets
plugin.path=/software/plugins
```

The main change in this example in comparison to the default is the key.converter and value.converter settings. Since our file contains simple text, we use the StringConverter types.

Download the file connector.
https://www.confluent.io/hub/mmolimar/kafka-connect-fs



Installation

Confluent Hub CLI installation

Use the Confluent Hub client to install this connector with:

```
$ confluent-hub install mmolimar/kafka-connect-fs:1.3.0
```

Copy

Download installation

Or download the ZIP file and extract it into one of the directories that is listed on the Connect worker's plugin.path configuration properties. This must be done on each of the installations where Connect will be run.

Download

By downloading you agree to the terms of use and software license agreement.

Download the above file.
#mkdir -p /software/plugins/

Rename the folder:
#mv mmolimar-kafka-connect-fs-1.3.0/ /software/plugins/kafka-file

Open a terminal.

Our input file /tmp/my-test.txt will be read in a single process to the Kafka my-kafka-connect topic. Here is a look at the file contents:

Create a file and paste the following text.
#vi /tmp/my-test.txt
This Message is from Test File.
It will be consumed by the Kafka Connector.

Running Kafka Connect.

Now it is time to run Kafka Connect with our worker and source configuration files. As mentioned before we will be running Kafka Connect in standalone mode. Here is an example of doing this with our custom config files:

#/opt/kafka/bin/connect-standalone.sh my-standalone.properties my-file-source.properties

```
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:35,218] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:36,226] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:37,241] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:38,250] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:39,256] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:40,258] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:55:41,272] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
```

```
[2018-06-17 12:56:53,991] WARN Couldn't find file /tmp/my-test.txt for FileStrea
mSourceTask, sleeping to wait for it to be created (org.apache.kafka.connect.fil
e.FileStreamSourceTask:108)
[2018-06-17 12:56:55,535] INFO Cluster ID: rwk6R3n9TYSCArCsSs8V4w (org.apache.ka
fka.clients.Metadata:265)
[2018-06-17 12:57:53,852] INFO WorkerSourceTask{id=local-file-source-0} Committi
ng offsets (org.apache.kafka.connect.runtime.WorkerSourceTask:328)
[2018-06-17 12:57:53,854] INFO WorkerSourceTask{id=local-file-source-0} flushing
 0 outstanding messages for offset commit (org.apache.kafka.connect.runtime.Work
erSourceTask:345)
[2018-06-17 12:57:54,062] INFO WorkerSourceTask{id=local-file-source-0} Finished
 commitOffsets successfully in 208 ms (org.apache.kafka.connect.runtime.WorkerSo
urceTask:427)
```

Open another terminal and execute the following consumer to consume the message.

Reading from the Kafka Topic
If we read from the Kafka topic that we created earlier, we should see the 2 lines in the source file that were written to Kafka:

#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic my-kafka-connect --from-beginning

```
[root@tos ~]# /opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server tos.ma
ster.com:9092 --topic my-kafka-connect --from-beginning
This Message is from Test File.
It will be consumed by the Kafka Connector.
```

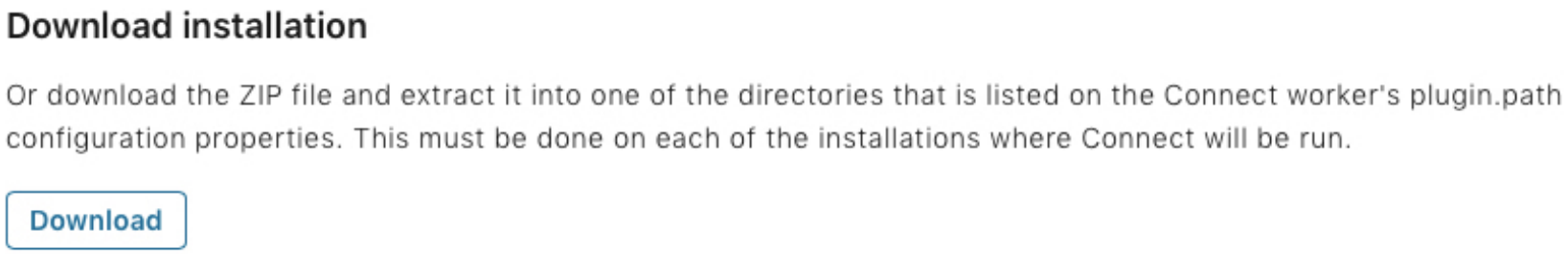
We have successfully configured, file connector in standalone mode.

Next, let us configure JDBC in a distributed mode.

Kafka Connect – JDBC Connector.

Download the connector from the following url.

Tools - https://www.confluent.io/hub/confluentinc/kafka-connect-jdbc



Extract the file:
yum install unzip
unzip confluent*zip

```
[root@4f5607f478bd software]# pwd
/software
[root@4f5607f478bd software]# ls
README.md  confluentinc-kafka-connect-jdbc-10.0.0  hbase-2.3.2-bin.tar  log.txt  master.txt
[root@4f5607f478bd software]# ls confluentinc-kafka-connect-jdbc-10.0.0/
assets  doc  etc  lib  manifest.json
[root@4f5607f478bd software]#
```

Rename the folder:
#mv confluentinc-kafka-connect-jdbc-10.0.0/ /software/plugins/kafka-jdbc

Add this to the plugin path in your Connect properties file.
For example, `plugin.path=/software/plugins`. Kafka Connect finds the plugins using its plugin path.

Start the Connect workers with that configuration. Connect will discover all connectors defined within those plugins.

We can create create /software/connect-distributed.properties file to specify the worker properties as follows:

Note that the `plugin.path` is the path that we need to place the library that we downloaded.
#vi /software/connect-distributed.properties

Update the following content in the above file.

```
# A list of host/port pairs to use for establishing the initial connection to the Kafka
cluster.
bootstrap.servers=localhost:9092

# unique name for the cluster, used in forming the Connect cluster group. Note that this
must not conflict with consumer group IDs
group.id=connect-cluster

# The converters specify the format of data in Kafka and how to translate it into Connect
data.
key.converter=org.apache.kafka.connect.json.JsonConverter
value.converter=org.apache.kafka.connect.json.JsonConverter
key.converter.schemas.enable=true
value.converter.schemas.enable=true

# Topic to use for storing offsets. This topic should have many partitions and be replicated
and compacted.
offset.storage.topic=connect-offsets
offset.storage.replication.factor=1

# Topic to use for storing connector and task configurations; note that this should be a
single partition, highly replicated,
config.storage.topic=connect-configs
config.storage.replication.factor=1

# Topic to use for storing statuses. This topic can have multiple partitions and should be
replicated and compacted.
status.storage.topic=connect-status
status.storage.replication.factor=1

# Flush much faster than normal, which is useful for testing/debugging
offset.flush.interval.ms=10000

plugin.path=/software/plugins
```

Note that the `plugin.path` is the path that we need to place the library that we downloaded.

Start the kafka connector

Go to the bin folder of the kafka installation or specify the full path.

#/opt/kafka/bin/connect-distributed.sh /software/connect-distributed.properties

```
nnectorIds=[], taskIds=[], revokedConnectorIds=[], revokedTaskIds=[], delay=0} with rebalance delay: 0 (org.apache.kafka.connect.runtime.distr
ibuted.DistributedHerder:1681)
[2020-11-15 12:59:43,196] INFO [Worker clientId=connect-1, groupId=connect-cluster] Starting connectors and tasks using config offset -1 (org.
apache.kafka.connect.runtime.distributed.DistributedHerder:1208)
[2020-11-15 12:59:43,196] INFO [Worker clientId=connect-1, groupId=connect-cluster] Finished starting connectors and tasks (org.apache.kafka.c
onnect.runtime.distributed.DistributedHerder:1236)
Nov 15, 2020 12:59:43 PM org.glassfish.jersey.internal.Errors logErrors
WARNING: The following warnings have been detected: WARNING: The (sub)resource method listLoggers in org.apache.kafka.connect.runtime.rest.res
ources.LoggingResource contains empty path annotation.
WARNING: The (sub)resource method createConnector in org.apache.kafka.connect.runtime.rest.resources.ConnectorsResource contains empty path an
notation.
WARNING: The (sub)resource method listConnectors in org.apache.kafka.connect.runtime.rest.resources.ConnectorsResource contains empty path ann
otation.
WARNING: The (sub)resource method listConnectorPlugins in org.apache.kafka.connect.runtime.rest.resources.ConnectorPluginsResource contains em
pty path annotation.
WARNING: The (sub)resource method serverInfo in org.apache.kafka.connect.runtime.rest.resources.RootResource contains empty path annotation.

[2020-11-15 12:59:43,307] INFO Started o.e.j.s.ServletContextHandler@c6da8bb{/,null,AVAILABLE} (org.eclipse.jetty.server.handler.ContextHandle
r:825)
[2020-11-15 12:59:43,307] INFO REST resources initialized; server is started and ready to handle requests (org.apache.kafka.connect.runtime.re
st.RestServer:319)
[2020-11-15 12:59:43,308] INFO Kafka Connect started (org.apache.kafka.connect.runtime.Connect:57)
[2020-11-15 12:59:43,419] INFO [Worker clientId=connect-1, groupId=connect-cluster] Session key updated (org.apache.kafka.connect.runtime.dist
ributed.DistributedHerder:1570)
```

After running the connector we can confirm that connector's REST endpoint is accessible, and we can confirm that JDBC connector is in the plugin list by calling http://localhost:8083/connector-plugins

curl http://localhost:8083/connector-plugins

```
[root@4f5607f478bd software]# curl http://localhost:8083/connector-plugins
[{"class":"io.confluent.connect.jdbc.JdbcSinkConnector","type":"sink","version":"10.0.0"},{"class":"io.confluent.connect.jdbc.JdbcSourceConnec
tor","type":"source","version":"10.0.0"},{"class":"org.apache.kafka.connect.file.FileStreamSinkConnector","type":"sink","version":"2.6.0"},{"c
lass":"org.apache.kafka.connect.file.FileStreamSourceConnector","type":"source","version":"2.6.0"},{"class":"org.apache.kafka.connect.mirror.M
irrorCheckpointConnector","type":"source","version":"1"},{"class":"org.apache.kafka.connect.mirror.MirrorHeartbeatConnector","type":"source","
version":"1"},{"class":"org.apache.kafka.connect.mirror.MirrorSourceConnector","type":"source","version":"1"}][root@4f5607f478bd software]#
[root@4f5607f478bd software]#
```

Install the postgress db. We will configure postgressdb to store some data which will be transfer by connect to kafka topic.

Refer url for downloading the postgresdb software : https://www.postgresql.org/download/.

For Centos 7:

[If you are using docker, initiate a container for PostgressDB:
#docker run -it --name postgresdb --privileged -p 5432:5432 centos:7 /usr/sbin/init
docker exec -it postgresdb bash
Add both the container in same network.
#docker network connect spark-net postgresdb
]

The following command will install and initialize the postgres DB
#yum install -y https://download.postgresql.org/pub/repos/yum/reporpms/EL-7-x86_64/pgdg-redhat-repo-latest.noarch.rpm

Or

yum install -y https://download.postgresql.org/pub/repos/yum/reporpms/EL-8-aarch64/pgdg-redhat-repo-latest.noarch.rpm

#yum install -y postgresql13-server
#/usr/pgsql-13/bin/postgresql-13-setup initdb

Enable and start the service:

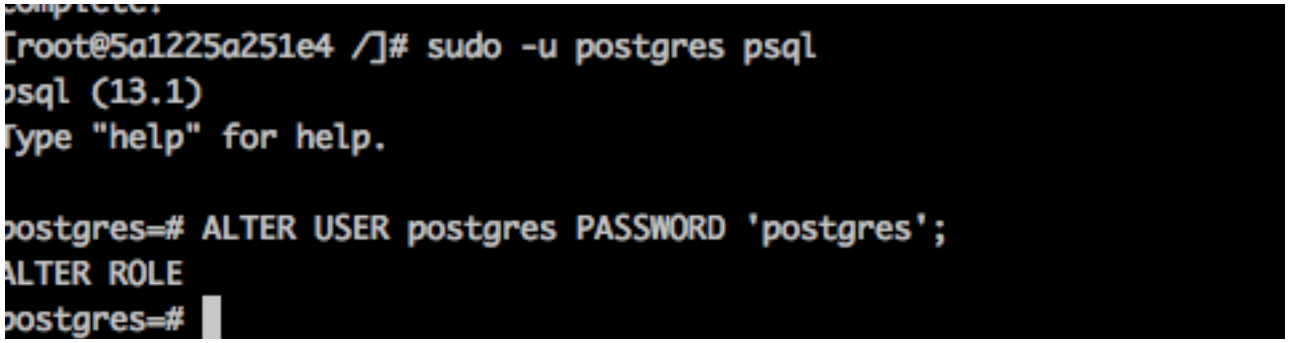
systemctl enable postgresql-13
systemctl start postgresql-13

The configuration for the plugin is stored in /software/jdbc-source.json file on kafka broker server.
It contents is as follows: (replace localhost with container IP of postgress DB if you are using docker)

```
{
    "name": "jdbc_source_connector_postgresql_01",
    "config": {
        "connector.class": "io.confluent.connect.jdbc.JdbcSourceConnector",
        "connection.url": "jdbc:postgresql://localhost:5432/postgres",
        "connection.user": "postgres",
        "connection.password": "postgres",
        "topic.prefix": "postgres-01-",
        "poll.interval.ms" : 3600000,
        "mode":"bulk"
    }
}
```

Start Postgress DB CLI: On the postgres DB server.

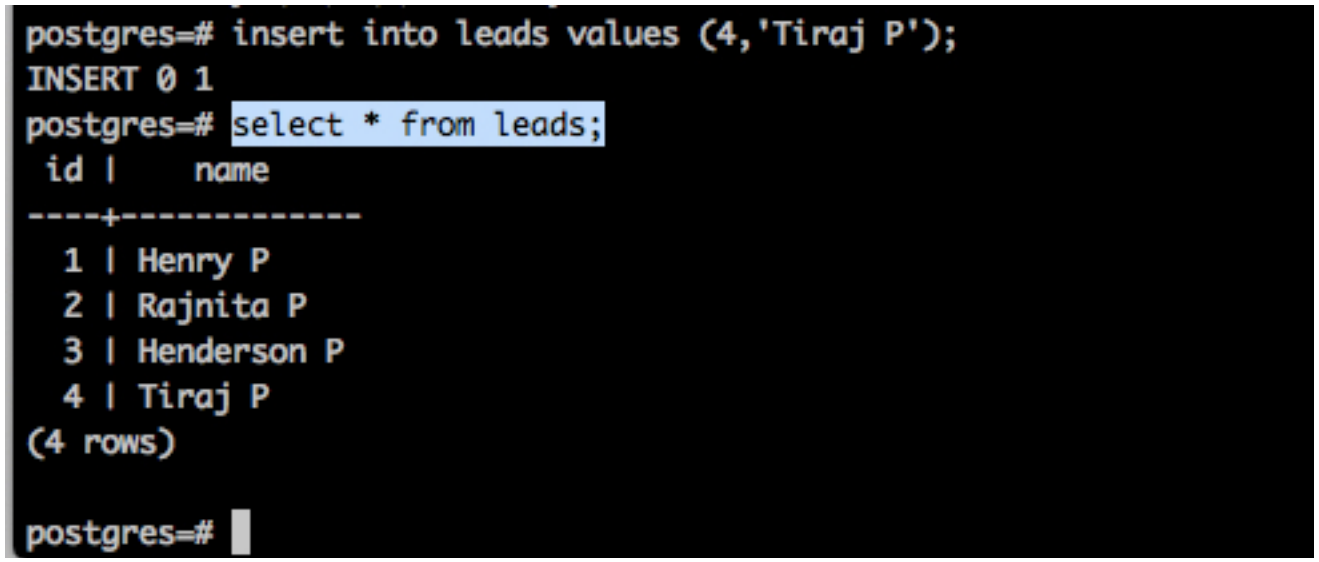
sudo -u postgres psql
ALTER USER postgres PASSWORD 'postgres';



if sudo doesn't exists in your system, install (yum install sudo)

Create a table and insert few records: Execute all the bellows SQL commands from the Postgresdb CLI.

#**CREATE TABLE** leads (id INTEGER **PRIMARY KEY**, name VARCHAR);
insert into leads values (1,'Henry P');
insert into leads values (2,'Rajnita P');
insert into leads values (3,'Henderson P');
insert into leads values (4,'Tiraj P');
select * from leads;



To exit : \q

Allow all to connect to postgresDB from remote server by updating the following contents:

#vi /var/lib/pgsql/13/data/**postgresql.conf**

listen_addresses = '*'

Append in the last line of the following file.

vi /var/lib/pgsql/13/data/pg_hba.conf

host all all all trust

#systemctl restart postgresql-13

Starting the JDBC Connector – On the Kafka Node.

As we operate on distributed mode we run the connectors by calling REST endpoints with the configuration JSON. We can specify the configuration payload from a file for curl command. The following command starts the connector. Execute the following command from the directory you have store the configuration json file.

curl -d @**"jdbc-source.json"** \
-H **"Content-Type: application/json"** \
-X POST http://localhost:8083/connectors

```
        timestamp.column.name = □
        timestamp.delay.interval.ms = 0
        timestamp.initial = null
        topic.prefix = postgres-02-
        validate.non.null = true
 (io.confluent.connect.jdbc.source.JdbcSourceTaskConfig:354)
[2020-11-15 16:05:29,313] INFO Using JDBC dialect PostgreSql (io.confluent.connect.jdbc.source.JdbcSourceTask:98)
[2020-11-15 16:05:29,317] INFO Attempting to open connection #1 to PostgreSql (io.confluent.connect.jdbc.util.CachedConnectionProvider:82)
[2020-11-15 16:05:29,383] INFO Started JDBC source task (io.confluent.connect.jdbc.source.JdbcSourceTask:257)
[2020-11-15 16:05:29,384] INFO WorkerSourceTask{id=jdbc_source_connector_postgresql_04-0} Source task finished initialization and start (org.a
pache.kafka.connect.runtime.WorkerSourceTask:233)
[2020-11-15 16:05:29,388] INFO Begin using SQL query: SELECT * FROM "public"."leads" (io.confluent.connect.jdbc.source.TableQuerier:164)
[2020-11-15 16:05:29,503] WARN [Producer clientId=connector-producer-jdbc_source_connector_postgresql_04-0] Error while fetching metadata with
 correlation id 3 : {postgres-02-leads=LEADER_NOT_AVAILABLE} (org.apache.kafka.clients.NetworkClient:1073)
[2020-11-15 16:05:39,266] INFO WorkerSourceTask{id=jdbc_source_connector_postgresql_04-0} Committing offsets (org.apache.kafka.connect.runtime
.WorkerSourceTask:478)
[2020-11-15 16:05:39,268] INFO WorkerSourceTask{id=jdbc_source_connector_postgresql_04-0} flushing 0 outstanding messages for offset commit (o
rg.apache.kafka.connect.runtime.WorkerSourceTask:495)
[2020-11-15 16:05:39,295] INFO WorkerSourceTask{id=jdbc_source_connector_postgresql_04-0} Finished commitOffsets successfully in 28 ms (org.ap
ache.kafka.connect.runtime.WorkerSourceTask:574)
[2020-11-15 16:05:49,264] INFO WorkerSourceTask{id=jdbc_source_connector_postgresql_04-0} Committing offsets (org.apache.kafka.connect.runtime
.WorkerSourceTask:478)
[2020-11-15 16:05:49,265] INFO WorkerSourceTask{id=jdbc_source_connector_postgresql_04-0} flushing 0 outstanding messages for offset commit (o
rg.apache.kafka.connect.runtime.WorkerSourceTask:495)
```

We can see that in postgres database table leads is loaded to kafka topic- postgres-02-leads:

#/opt/kafka/bin/kafka-topics.sh --list --bootstrap-server localhost:9092

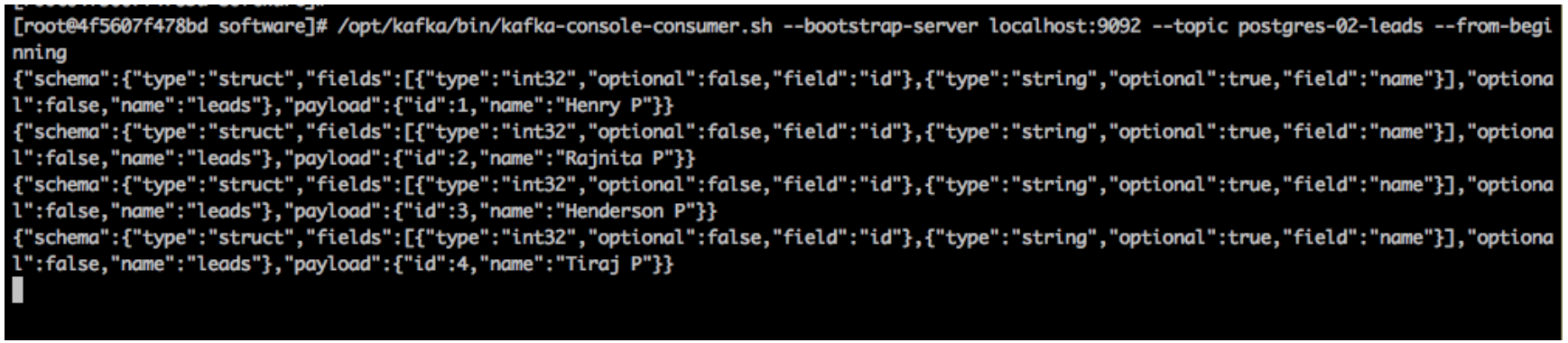
```
[root@4f5607f478bd software]# /opt/kafka/bin/kafka-topics.sh --list --zookeeper localhost:2181
__consumer_offsets
connect-configs
connect-offsets
connect-status
postgres-02-leads
test
[root@4f5607f478bd software]#
```

#/opt/kafka/bin/kafka-topics.sh --describe --bootstrap-server localhost:9092 --topic postgres-01-leads

```
        Topic: connect-status   Partition: 4    Leader: 0       Replicas: 0     Isr: 0
Topic: postgres-02-leads        PartitionCount: 1       ReplicationFactor: 1    Configs:
        Topic: postgres-02-leads        Partition: 0    Leader: 0       Replicas: 0     Isr: 0
Topic: test     PartitionCount: 1       ReplicationFactor: 1    Configs:
        Topic: test     Partition: 0    Leader: 0       Replicas: 0     Isr: 0
[root@4f5607f478bd software]#
```

And each row in the tables are loaded as a message. You can verify using the consumer console.

#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic postgres-01-leads --from-beginning



Let us perform a Single Message Transformation.

Scenario: **Name** field should be changed to **FullName**

Solution: We will use the ReplaceField to perform the above activity.

Add another instance of connector.

Define the Single Message Tranformation parameters.

The configuration for the plugin is stored in /software/jdbc-source_smt.json file on kafka broker server. It contents is as follows: (replace localhost with container IP of postgress DB if you are using docker)

```
{
    "name": "jdbc_source_connector_postgresql_02",
    "config": {
        "connector.class": "io.confluent.connect.jdbc.JdbcSourceConnector",
        "connection.url": "jdbc:postgresql://localhost:5432/postgres",
        "connection.user": "postgres",
        "connection.password": "postgres",
        "topic.prefix": "postgres-02-",
        "poll.interval.ms" : 3600000,
        "mode":"bulk",
       "transforms": "RenameField",
       "transforms.RenameField.type": "org.apache.kafka.connect.transforms.ReplaceField$Value",
       "transforms.RenameField.renames": "name:fullname"
    }
}
```

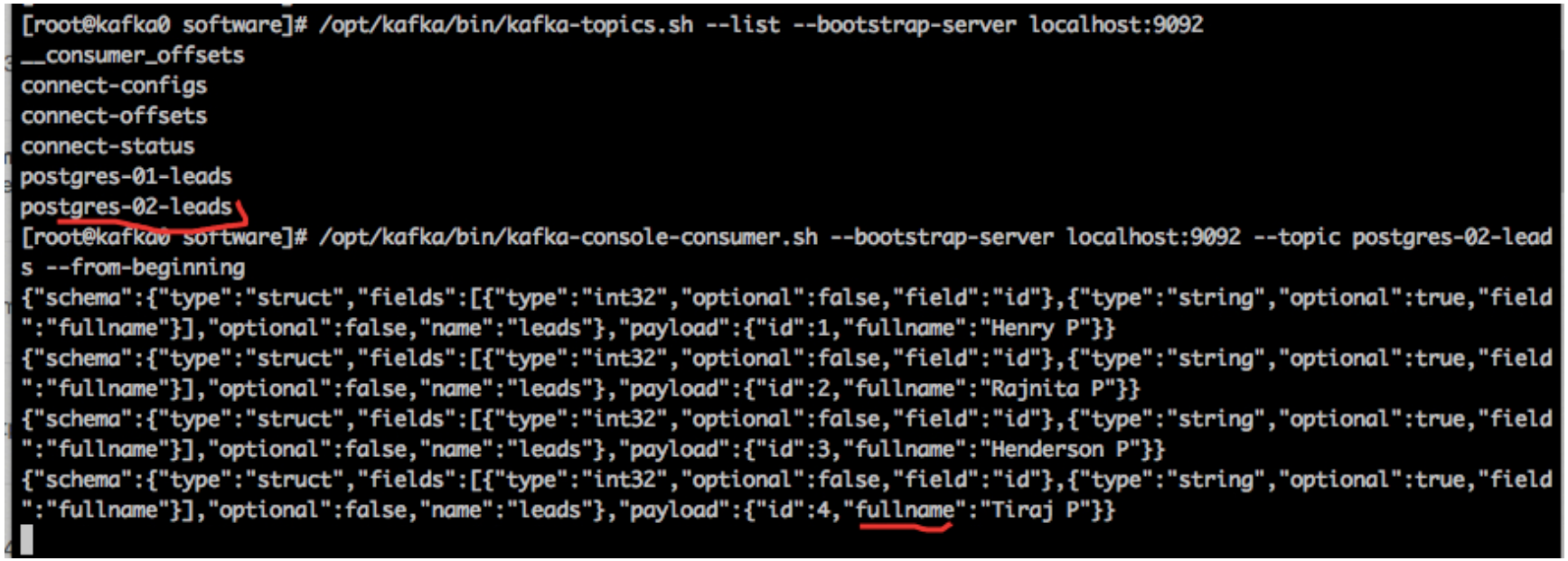
In the above configuration, the field , name is replace with fullname attribute.

Start the instance

```
#curl -d @"jdbc-source_smt1.json" \
-H "Content-Type: application/json" \
-X POST http://localhost:8083/connectors
```

Verify the topic and check the message inside that topic.

#/opt/kafka/bin/kafka-topics.sh --list --bootstrap-server localhost:9092
#/opt/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic postgres-02-leads --from-beginning



As shown above the message field has been transform from Name to fullname.

Execute some Queries to get information about connectors:

Get a list of active connectors.

#curl http://localhost:8083/connectors

Get configuration info for a connector.

#curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/config

```
[root@kafka0 /]# curl http://localhost:8083/connectors
["jdbc_source_connector_postgresql_01","jdbc_source_connector_postgresql_02"][root@kafka0 /]#
[root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/config
{"connector.class":"io.confluent.connect.jdbc.JdbcSourceConnector","mode":"bulk","topic.prefix":"postgres-01-","connection.
password":"postgres","connection.user":"postgres","poll.interval.ms":"3600000","name":"jdbc_source_connector_postgresql_01"
,"connection.url":"jdbc:postgresql://localhost:5432/postgres"}[root@kafka0 /]#
[root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_02/config
{"connector.class":"io.confluent.connect.jdbc.JdbcSourceConnector","mode":"bulk","transforms.RenameField.renames":"name:ful
lname","topic.prefix":"postgres-02-","connection.password":"postgres","connection.user":"postgres","poll.interval.ms":"3600
000","transforms.RenameField.type":"org.apache.kafka.connect.transforms.ReplaceField$Value","transforms":"RenameField","nam
e":"jdbc_source_connector_postgresql_02","connection.url":"jdbc:postgresql://localhost:5432/postgres"}[root@kafka0 /]#
[root@kafka0 /]#
[root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_02/tasks
[{"id":{"connector":"jdbc_source_connector_postgresql_02","task":0},"config":{"connector.class":"io.confluent.connect.jdbc.
JdbcSourceConnector","transforms.RenameField.renames":"name:fullname","connection.password":"postgres","transforms":"Rename
Field","mode":"bulk","topic.prefix":"postgres-02-","tables":"\"public\".\"leads\"","task.class":"io.confluent.connect.jdbc.
source.JdbcSourceTask","connection.user":"postgres","poll.interval.ms":"3600000","transforms.RenameField.type":"org.apache.
kafka.connect.transforms.ReplaceField$Value","name":"jdbc_source_connector_postgresql_02","connection.url":"jdbc:postgresql
[root@kafka0 /]#
```

Retrieve details for specific tasks (JDBC Tasks) - Get a list of tasks currently running for the connector.

#curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_02/tasks

```
[root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_02/tasks
[{"id":{"connector":"jdbc_source_connector_postgresql_02","task":0},"config":{"connector.class":"io.confluent.connect.jdbc.
JdbcSourceConnector","transforms.RenameField.renames":"name:fullname","connection.password":"postgres","transforms":"Rename
Field","mode":"bulk","topic.prefix":"postgres-02-","tables":"\"public\".\"leads\"","task.class":"io.confluent.connect.jdbc.
source.JdbcSourceTask","connection.user":"postgres","poll.interval.ms":"3600000","transforms.RenameField.type":"org.apache.
kafka.connect.transforms.ReplaceField$Value","name":"jdbc_source_connector_postgresql_02","connection.url":"jdbc:postgresql
://localhost:5432/postgres"}}][root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/ta
[{"id":{"connector":"jdbc_source_connector_postgresql_01","task":0},"config":{"connector.class":"io.confluent.connect.jdbc.
JdbcSourceConnector","mode":"bulk","topic.prefix":"postgres-01-","tables":"\"public\".\"leads\"","connection.password":"pos
tgres","task.class":"io.confluent.connect.jdbc.source.JdbcSourceTask","connection.user":"postgres","poll.interval.ms":"3600
000","name":"jdbc_source_connector_postgresql_01","connection.url":"jdbc:postgresql://localhost:5432/postgres"}}][root@kafk
a0 /]#
```

The current status of the connector
#curl http://localhost:8083/connectors/?expand=status

```
[root@kafka0 /]# curl http://localhost:8083/connectors/?expand=status
{"jdbc_source_connector_postgresql_01":{"status":{"name":"jdbc_source_connector_postgresql_01","connector":{"state":"RUNNIN
G","worker_id":"172.18.0.2:8083"},"tasks":[{"id":0,"state":"RUNNING","worker_id":"172.18.0.2:8083"}],"type":"source"}},"jdb
c_source_connector_postgresql_02":{"status":{"name":"jdbc_source_connector_postgresql_02","connector":{"state":"RUNNING","w
orker_id":"172.18.0.2:8083"},"tasks":[{"id":0,"state":"RUNNING","worker_id":"172.18.0.2:8083"}],"type":"source"}}}[root@kaf
ka0 /]#
```

Gets the current status of the connector, including:

- Whether it is running or restarting, or if it has failed or paused
- Which worker it is assigned to
- Error information if it has failed
- The state of all its tasks

#curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/status

```
root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/status
"name":"jdbc_source_connector_postgresql_01","connector":{"state":"RUNNING","worker_id":"172.18.0.2:8083"},"tasks":[{"id":
),"state":"RUNNING","worker_id":"172.18.0.2:8083"}],"type":"source"}[root@kafka0 /]#
root@kafka0 /]#
```

Retrieve details for specific tasks

curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/tasks/0/status

```
[root@kafka0 /]# curl http://localhost:8083/connectors/jdbc_source_connector_postgresql_01/tasks/0/status
{"id":0,"state":"RUNNING","worker_id":"172.18.0.2:8083"}[root@kafka0 /]#
```

---------- Labs End Here ----------

13. Schema Registry - Manage Schemas for Topics – 30 Minutes

Pre-requisite: Install kafka server.

Download and install confluent kafka : Schema Registry only. (Refer the Confluent Installation.)

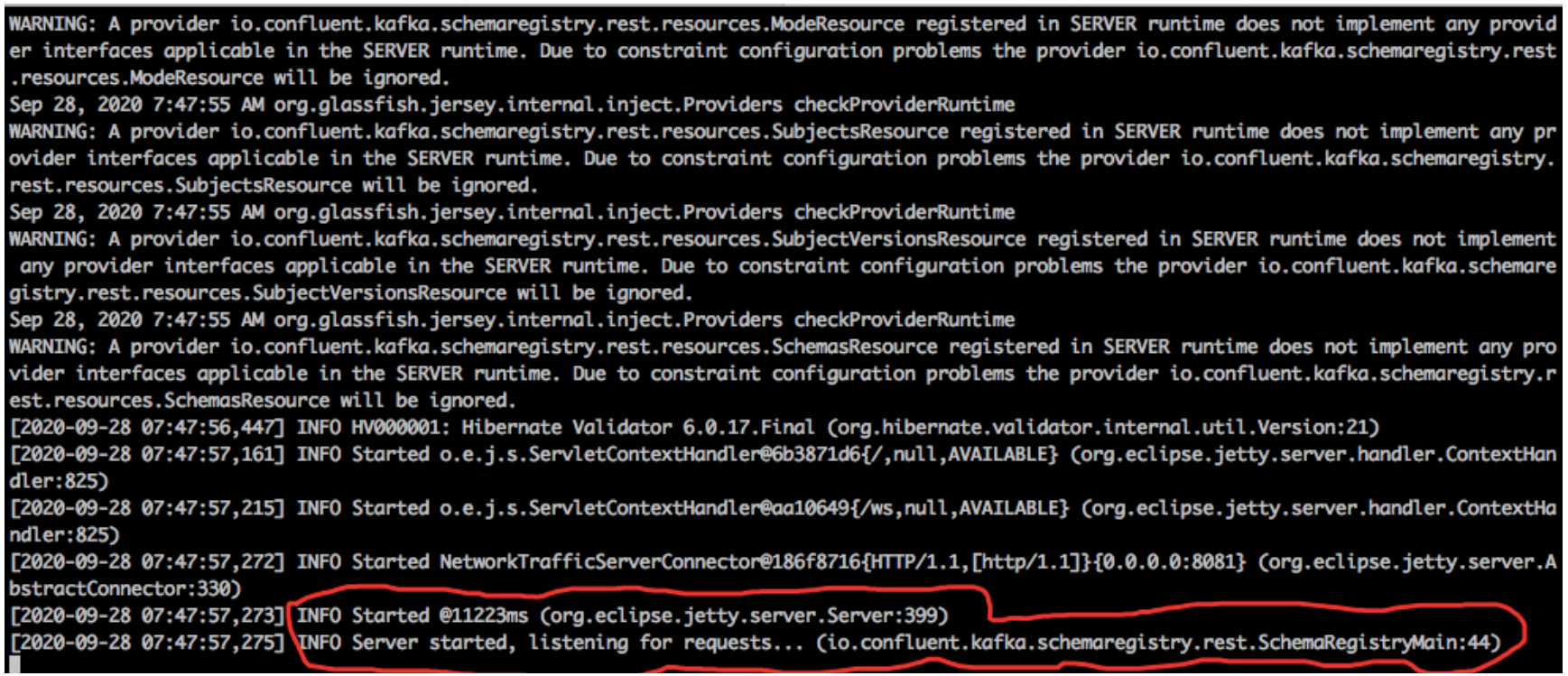
Start the Zookeeper and Broker.

Update the following in /opt/confluent/etc/schema-registry/schema-registry.properties

kafkastore.bootstrap.servers=PLAINTEXT://kafka0:9092

Start the Registry:

#cd /opt/confluent/
#schema-registry-start /opt/confluent/etc/schema-registry/schema-registry.properties



Create a topic and let us bind schema to this.

kafka-topics.sh --create --bootstrap-server kafka0:9092 --partitions 1 --replication-factor 1 --topic my-kafka
#kafka-topics.sh --list --bootstrap-server kafka0:9092

Use the Schema Registry API to add a schema for the topic my-kafka.

#curl -X POST -H "Content-Type: application/vnd.schemaregistry.v1+json" --data '{"schema": "{\"type\":\"record\",\"name\":\"Payment\",\"namespace\":\"com.tos\",\"fields\":[{\"name\":\"id\",\"type\":\"string\"},{\"name\":\"amount\",\"type\":\"double\"}]}"}' http://localhost:8081/subjects/my-kafka-value/versions

```
[root@kafka0 code]# kafka-topics.sh --list --bootstrap-server kafka0:9092
__consumer_offsets
_schemas
my-kafka
[root@kafka0 code]# curl -X POST -H "Content-Type: application/vnd.schemaregistry.v1+json" --data '{"schema": "{\"type\":\"record\",\"
name\":\"Payment\",\"namespace\":\"com.tos\",\"fields\":[{\"name\":\"id\",\"type\":\"string\"},{\"name\":\"amount\",\"type\":\"double\
"}]}"}' http://localhost:8081/subjects/my-kafka-value/versions
{"id":1}[root@kafka0 code]#
```

#curl -X GET http://localhost:8081/schemas/ids/1

```
[root@kafka0 code]# curl -X GET http://localhost:8081/schemas/ids/1
{"schema":"{\"type\":\"record\",\"name\":\"Payment\",\"namespace\":\"com.tos\",\"fields\":[{\"name\":\"id\",\"type\":\"string\"},{\"na
me\":\"amount\",\"type\":\"double\"}]}"}[root@kafka0 code]#
```

You can verify the topic which maintains the schema details in the broker.
kafka-topics.sh --list --bootstrap-server kafka0:9092

```
[root@kafka0 /]# kafka-topics.sh --list --bootstrap-server kafka0:9092
__consumer_offsets
_schemas
my-kafka
transactions
[root@kafka0 /]#
```

List all subjects associated with a given ID

Use this two-step process to find subjects associated with a given ID:

List all the subjects.

#curl -X GET http://localhost:8081/subjects
Iterate through the output from the subject list as follows, and check for the ID in the results:

#curl -X GET http://localhost:8081/subjects/<INSERT SUBJECT NAME>/versions/latest

E.x
#curl -X GET http://localhost:8081/subjects/my-kafka-value/versions/latest

```
[root@kafka0 code]# curl -X GET http://localhost:8081/subjects
["my-kafka-value"][root@kafka0 code]#
[root@kafka0 code]# curl -X GET http://localhost:8081/subjects/my-kafka-value/versions/latest
{"subject":"my-kafka-value","version":2,"id":1,"schema":"{\"type\":\"record\",\"name\":\"Payment\",\"namespace\":\"com.tos\",\"fields\
":[{\"name\":\"id\",\"type\":\"string\"},{\"name\":\"amount\",\"type\":\"double\"}]}"}[root@kafka0 code]#
```

#curl -X GET http://localhost:8081/subjects

Delete all schema versions registered under the subject “my-kafka-value”
curl -X DELETE http://localhost:8081/subjects/my-kafka-value

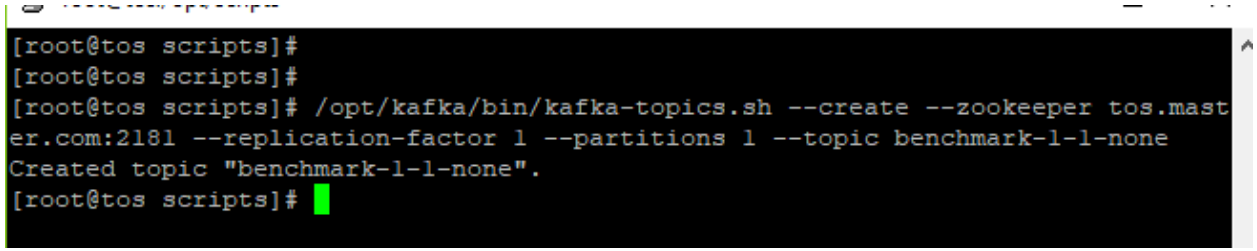
https://docs.confluent.io/platform/current/schema-registry/develop/using.html

---------- Lab Ends Here ----------

14. Performance & Tuning – 60 Minutes (ND)

We are working on a single broker for this lab.
Producer Throughput: Single producer thread, no replication, no compression

```
/opt/kafka/bin/kafka-topics.sh --create \
--bootstrap-server localhost:9092 \
--replication-factor 1 \
--partitions 1 \
--topic benchmark-1-1-none
```

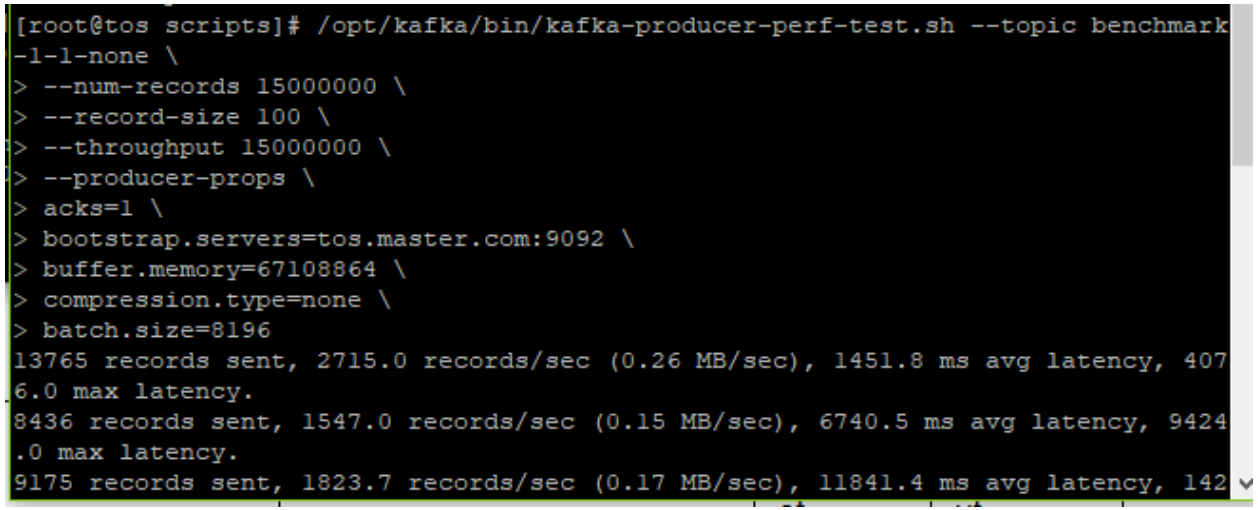


The above topic will be used for creating bench mark.

Let us execute the below benchmark that will simulate the pushing of 150000000 records.

```
/opt/kafka/bin/kafka-producer-perf-test.sh --topic benchmark-1-1-none \
--num-records 15000000 \
--record-size 100 \
--throughput 15000000 \
```

--producer-props \
acks=1 \
bootstrap.servers=tos.master.com:9092 \
buffer.memory=67108864 \
compression.type=none \
batch.size=8196

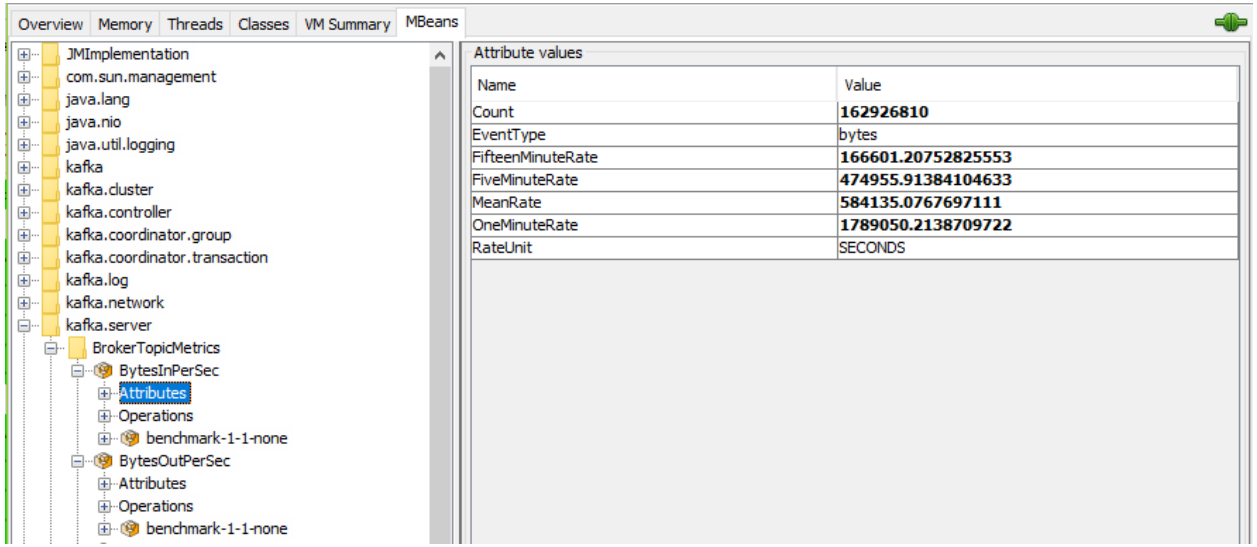


This is because in an effort to increase availability and durability, version 0.8 introduced intra-cluster replication support, and by default a producer waits for an acknowledgement response from the broker on every message (or batch of messages if async mode is used). It is possible to mimic the old behavior, but we were not very interested in that given that we intend to use replication in production.

Performance degraded further once we started using a sample of real ~1KB sized log messages rather than the synthetic messages produced by the Kafka tool, resulting in a throughput of about 10 MB/sec.

All throughput numbers refer to uncompressed data.

Verify using the Jconsole:

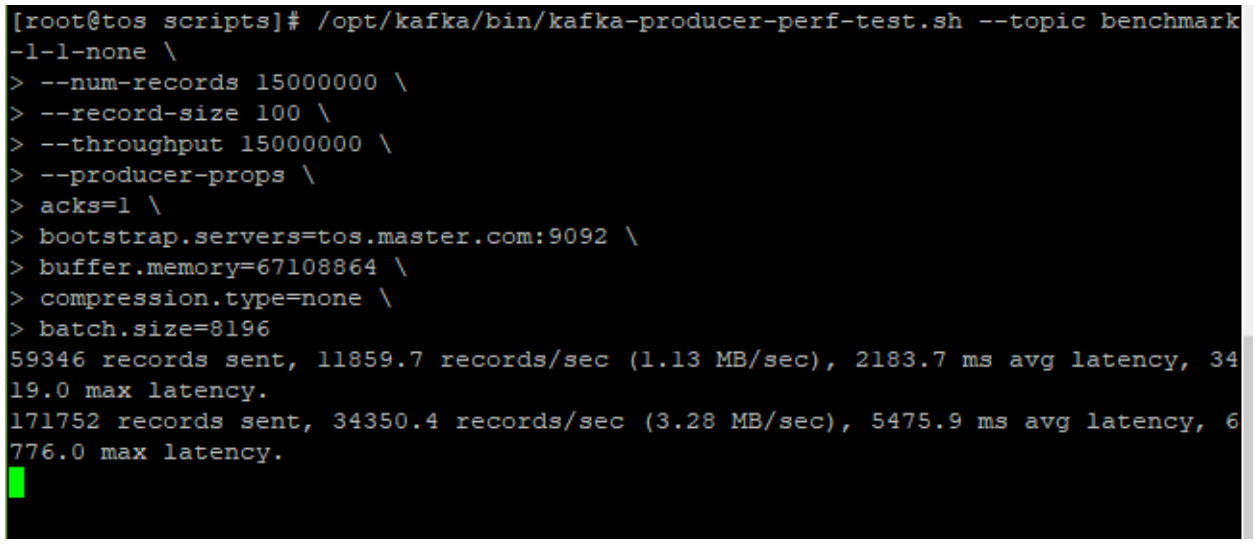


Producer Throughput: 3 producer thread, no replication, no compression

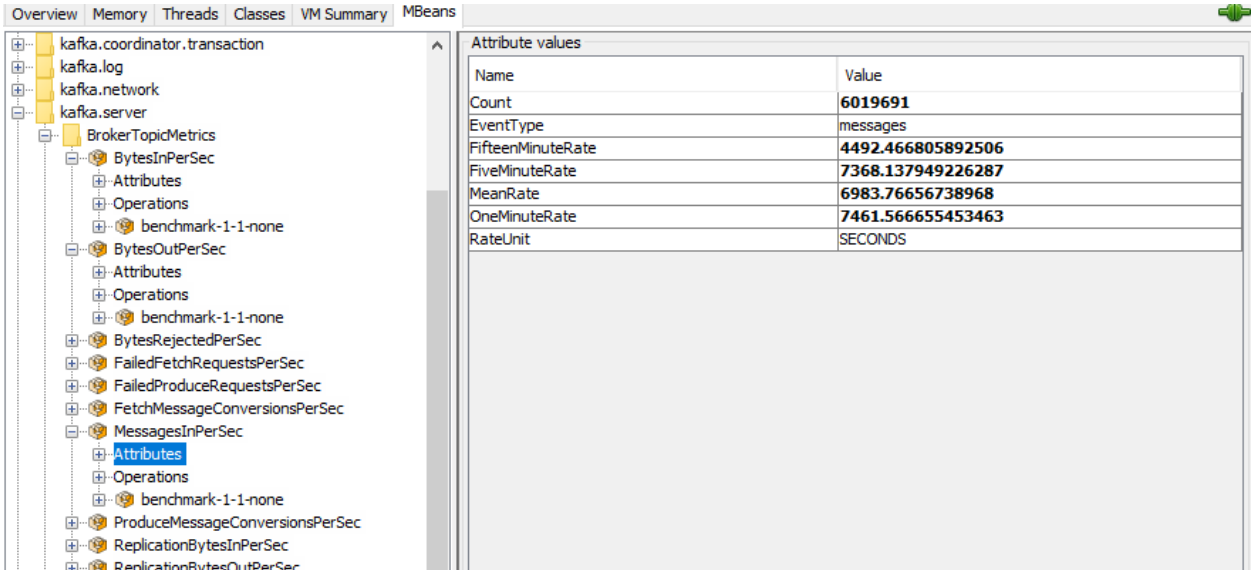
```
/opt/kafka/bin/kafka-topics.sh --create \
--bootstrap-server localhost:9020 \
```

--partitions 1 \
--topic benchmark-3-0-none

/opt/kafka/bin/kafka-producer-perf-test.sh --topic benchmark-1-1-none \
--num-records 15000000 \
--record-size 100 \
--throughput 15000000 \
--producer-props \
acks=1 \
bootstrap.servers=tos.master.com:9092 \
buffer.memory=67108864 \
compression.type=none \
batch.size=8196



```
19.0 max latency.
171752 records sent, 34350.4 records/sec (3.28 MB/sec), 5475.9 ms avg latency, 6
776.0 max latency.
104858 records sent, 20959.0 records/sec (2.00 MB/sec), 8550.3 ms avg latency, 1
1153.0 max latency.
175602 records sent, 30312.8 records/sec (2.89 MB/sec), 13427.1 ms avg latency,
15975.0 max latency.
147926 records sent, 29514.4 records/sec (2.81 MB/sec), 18332.1 ms avg latency,
20395.0 max latency.
170938 records sent, 34167.1 records/sec (3.26 MB/sec), 20456.3 ms avg latency,
20922.0 max latency.
112176 records sent, 22435.2 records/sec (2.14 MB/sec), 21444.9 ms avg latency,
22348.0 max latency.
151989 records sent, 30391.7 records/sec (2.90 MB/sec), 20898.0 ms avg latency,
21820.0 max latency.
145851 records sent, 28326.1 records/sec (2.70 MB/sec), 20725.3 ms avg latency,
21662.0 max latency.
114107 records sent, 22803.2 records/sec (2.17 MB/sec), 21857.6 ms avg latency,
22880.0 max latency.
150657 records sent, 30131.4 records/sec (2.87 MB/sec), 22220.4 ms avg latency,
22757.0 max latency.
120324 records sent, 23751.3 records/sec (2.27 MB/sec), 22182.4 ms avg latency,
22591.0 max latency.
```



In this way you can perform benchmark of your broker.

Demo:

First let's create a topic for the test data. The following example will result in a topic named **my-perf-test** with 2 partitions, a replication factor of 1 and retention time of 24 hours. Replace broker0 as needed for the Kafka cluster in your environment:

#kafka-topics.sh --create --topic my-perf-test \ --partitions 2 --config retention.ms=86400000 \ --config min.insync.replicas=2 --bootstrap-server kafka0:9092

Then run the producer performance test script with different configuration settings. The following example will use the topic created above to store 1 lakh messages with a size of 1 KiB each. The -1 value for *--throughput* means that messages are produced as quickly as possible, with no throttling limit. Kafka producer related configuration properties like *acks* and *bootstrap.servers* are mentioned as part of *--producer-props* argument:

```
# kafka-producer-perf-test.sh --topic my-perf-test \
--num-records 100000 \
--record-size 1024 \
--throughput -1 \
--producer-props acks=1 \
bootstrap.servers=localhost:9092
```

```
[root@kafka0 code]# kafka-producer-perf-test.sh --topic my-perf-test \
> --num-records 100000 \
> --record-size 1024 \
> --throughput -1 \
> --producer-props acks=1 \
> bootstrap.servers=localhost:9092
7666 records sent, 1531.4 records/sec (1.50 MB/sec), 1013.3 ms avg latency, 1876.0 ms max latency.
12750 records sent, 2545.4 records/sec (2.49 MB/sec), 3116.2 ms avg latency, 5239.0 ms max latency.
8175 records sent, 1632.4 records/sec (1.59 MB/sec), 6957.0 ms avg latency, 9480.0 ms max latency.
8775 records sent, 1754.6 records/sec (1.71 MB/sec), 11696.2 ms avg latency, 13566.0 ms max latency.
14655 records sent, 2931.0 records/sec (2.86 MB/sec), 14802.3 ms avg latency, 15516.0 ms max latency.
14670 records sent, 2927.6 records/sec (2.86 MB/sec), 12559.2 ms avg latency, 14597.0 ms max latency.
17295 records sent, 3456.9 records/sec (3.38 MB/sec), 10034.4 ms avg latency, 10787.0 ms max latency.
12270 records sent, 2412.0 records/sec (2.36 MB/sec), 9613.4 ms avg latency, 10595.0 ms max latency.
100000 records sent, 2386.179250 records/sec (2.33 MB/sec), 9400.79 ms avg latency, 15516.00 ms max latency, 10062 ms 50th, 15252 ms
 95th, 15469 ms 99th, 15502 ms 99.9th.
[root@kafka0 code]#
```

In this example, roughly 2.3k messages are produced per second on average, with a maximum latency of approx. 15 seconds.

To run the consumer performance test script as an example, will read 1 lakh messages from our same topic *my-perf-test.*
#kafka-consumer-perf-test.sh --topic my-perf-test --broker-list kafka0:9092 --messages 100000

```
--version                                 Display Kafka version.
[root@kafka0 code]# kafka-consumer-perf-test.sh --topic my-perf-test --broker-list kafka0:9092 --messages 100000
start.time, end.time, data.consumed.in.MB, MB.sec, data.consumed.in.nMsg, nMsg.sec, rebalance.time.ms, fetch.time.ms, fetch.MB.sec,
fetch.nMsg.sec
2022-02-28 15:43:59:610, 2022-02-28 15:44:06:745, 98.1396, 13.7547, 100495, 14084.7933, 1933, 5202, 18.8658, 19318.5313
[root@kafka0 code]#
```

The throughput (MB.sec and nMsg.sec) which are of interest : 13.75 and 14084.

Increase the no of partitions:
#kafka-topics.sh --create --topic my-perf-test4 \ --partitions 12 --config retention.ms=86400000 \ --config min.insync.replicas=2 --bootstrap-server kafka0:9092

```
# kafka-producer-perf-test.sh --topic my-perf-test4 \
--num-records 100000 \
--record-size 1024 \
--throughput -1 \
--producer-props acks=1 \
bootstrap.servers=kafka0:9092
```

```
[root@kafka0 code]# kafka-producer-perf-test.sh --topic my-perf-test4 --num-records 100000 --record-size 1024 --throughput -1 --prod
ucer-props acks=1 bootstrap.servers=kafka0:9092
11946 records sent, 2373.1 records/sec (2.32 MB/sec), 521.9 ms avg latency, 1748.0 ms max latency.
19260 records sent, 3843.5 records/sec (3.75 MB/sec), 2231.3 ms avg latency, 4188.0 ms max latency.
20556 records sent, 4111.2 records/sec (4.01 MB/sec), 5283.8 ms avg latency, 6877.0 ms max latency.
24264 records sent, 4848.9 records/sec (4.74 MB/sec), 6761.5 ms avg latency, 8210.0 ms max latency.
100000 records sent, 4004.324671 records/sec (3.91 MB/sec), 4737.75 ms avg latency, 8210.00 ms max latency, 5609 ms 50th, 7438 ms 95
th, 7888 ms 99th, 8152 ms 99.9th.
[root@kafka0 code]#
```

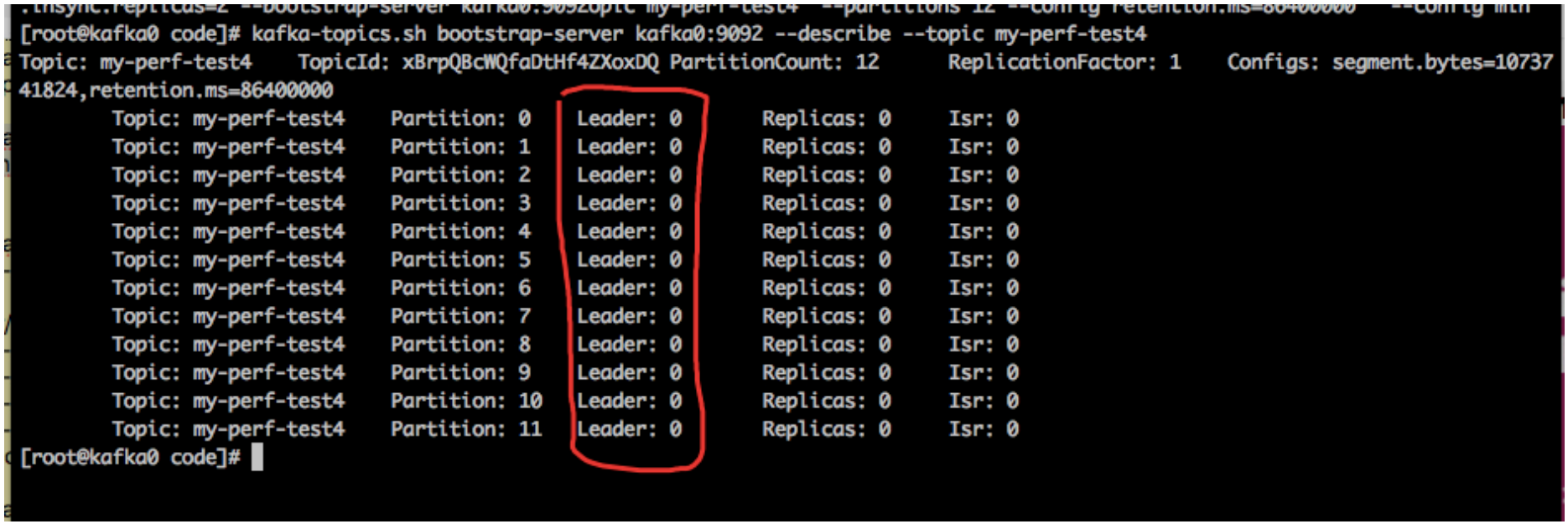
Verify the nos. after increasing the partition. The differences will be observed if you have multiple nodes.

Tuning Brokers

Topics are divided into partitions. Each partition has a leader. Topics that are properly configured for reliability will consist of a leader partition and 2 or more follower partitions. When the leaders are not balanced properly, one might be overworked, compared to others.

Depending on your system and how critical your data is, you want to be sure that you have sufficient replication sets to preserve your data. For each topic, It is recommends starting with one partition per physical storage disk and one consumer per partition.

#kafka-topics.sh --bootstrap-server kafka0:9092 --describe --topic *my-perf-test4*

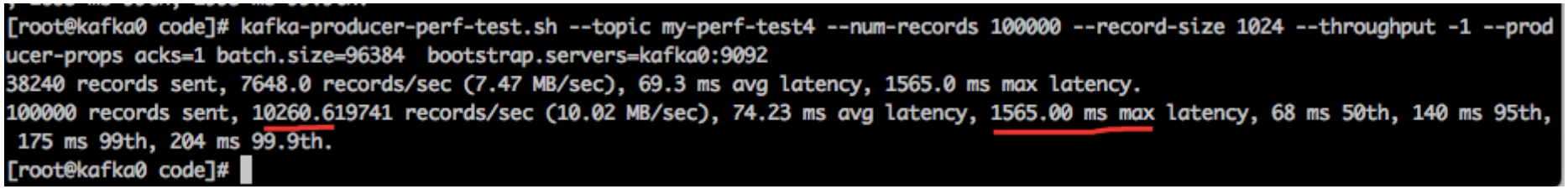


Tuning Producers

When you use Producer.send(), you fill up buffers on the producer. When a buffer is full, the producer sends the buffer to the Kafka broker and begins to refill the buffer.

batch.size measures batch size in total bytes instead of the number of messages.

#kafka-producer-perf-test.sh --topic my-perf-test4 --num-records 100000 --record-size 1024 --throughput -1 --producer-props acks=1 batch.size=86384 bootstrap.servers=kafka0:9092



No of throughput increases and latency max is about 1.5 seconds only.

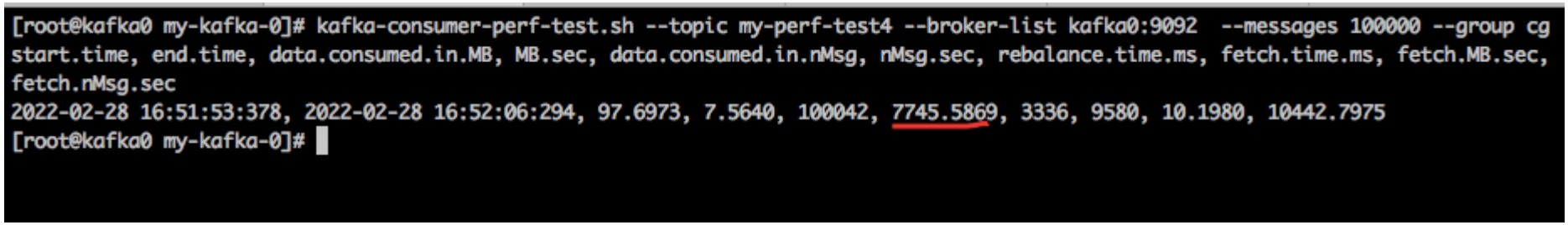
Tuning Consumers

Consumers can create throughput issues on the other side of the pipeline. The maximum number of consumers in a consumer group for a topic is equal to the number of partitions. You need enough partitions to handle all the consumers needed to keep up with the producers.

Consumers in the same consumer group split the partitions among them. Adding more consumers to a group can enhance performance (up to the number of partitions). Adding

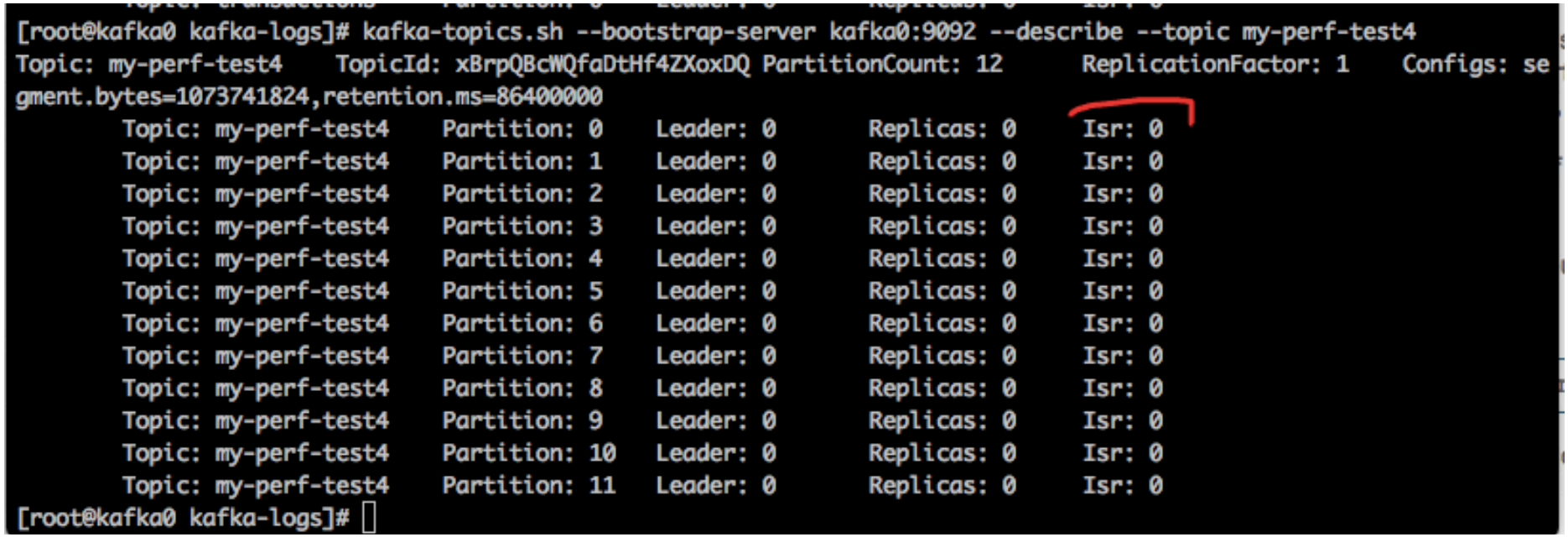
more consumer groups does not affect performance. Execute the following command from 2 terminals.

#kafka-consumer-perf-test.sh --topic my-perf-test4 --broker-list kafka0:9092 --messages 100000 --group cg



- To check the ISR set for topic partitions, run the following command:

```
kafka-topics.sh --bootstrap-server kafka0:9092 --describe --topic my-perf-test4
```



- If a partition leader dies, new leader is selected from the ISR set. There will be no data loss. If there is no ISR, unclean leader election can be used with the risk of data-loss.
- Unclean leader election occurs if `unclean.leader.election.enable` is set to true. By default, this is set to `false`.

---------- Lab Ends Here ----------

15. Errors

I. {test=LEADER_NOT_AVAILABLE} (org.apache.kafka.clients.NetworkClient)

```
[2018-05-15 23:46:40,132] WARN [Producer clientId=console-producer] Error while
fetching metadata with correlation id 14 : {test=LEADER_NOT_AVAILABLE} (org.apac
he.kafka.clients.NetworkClient)
[2018-05-15 23:46:40,266] WARN [Producer clientId=console-producer] Error while
fetching metadata with correlation id 15 : {test=LEADER_NOT_AVAILABLE} (org.apac
he.kafka.clients.NetworkClient)
^C[2018-05-15 23:46:40,394] WARN [Producer clientId=console-producer] Error whil
e fetching metadata with correlation id 16 : {test=LEADER_NOT_AVAILABLE} (org.ap
ache.kafka.clients.NetworkClient)
[root@tos opt]#  {test=LEADER_NOT_AVAILABLE} (org.apache.kafka.clients.NetworkCl
ient)
bash: syntax error near unexpected token `org.apache.kafka.clients.NetworkClient
```

Solutions: /opt/kafka/config/server.properties
Update the following information.

```
# it uses the value for "listeners" if configured.  Otherwise, it will use the v
alue
# returned from java.net.InetAddress.getCanonicalHostName().
advertised.listeners=PLAINTEXT://localhost:9092
```

II Unable to connect to the server / `Topic my-example-topic not present in metadata after 60000 ms.`

```
############################# Socket Server Settings #############################

# The address the socket server listens on. It will get the value returned from
# java.net.InetAddress.getCanonicalHostName() if not configured.
#   FORMAT:
#     listeners = listener_name://host_name:port
#   EXAMPLE:
#     listeners = PLAINTEXT://your.host.name:9092
#listeners=PLAINTEXT://:9092

# Hostname and port the broker will advertise to producers and consumers. If not set,
# it uses the value for "listeners" if configured.  Otherwise, it will use the value
# returned from java.net.InetAddress.getCanonicalHostName().
advertised.listeners=PLAINTEXT://localhost:9092

# Maps listener names to security protocols, the default is for them to be the same. See the config documentation for more d
ls
#listener.security.protocol.map=PLAINTEXT:PLAINTEXT,SSL:SSL,SASL_PLAINTEXT:SASL_PLAINTEXT,SASL_SSL:SASL_SSL

"server.properties" 136L, 6848C written
```

16. LOG verification + segment Sizing

17. Annexure Code:

II. DumplogSegment

/opt/kafka/bin/kafka-run-class.sh kafka.tools.DumpLogSegments --deep-iteration --print-data-log --files \
/tmp/kafka-logs/my-kafka-connect-0/oooooooooooooooooooo.log | head -n 4

```
[root@tos test-topic-0]# more 00000000000000000000.log
[root@tos test-topic-0]# cd ../
[root@tos kafka-logs]# cd my-kafka-connect-0/
[root@tos my-kafka-connect-0]# ls
00000000000000000000.index      00000000000000000011.snapshot
00000000000000000000.log        leader-epoch-checkpoint
00000000000000000000.timeindex
[root@tos my-kafka-connect-0]# more *log
\▒▒▒▒▒▒▒▒afka Connector.--More--(53%)

[root@tos my-kafka-connect-0]# pwd
/tmp/kafka-logs/my-kafka-connect-0
[root@tos my-kafka-connect-0]# /opt/kafka/bin/kafka-run-class.sh kafka.tools.Dum
pLogSegments --deep-iteration --print-data-log --files \
> /tmp/kafka-logs/my-kafka-connect-0/00000000000000000000.log | head -n 4
Dumping /tmp/kafka-logs/my-kafka-connect-0/00000000000000000000.log
Starting offset: 0
offset: 0 position: 0 CreateTime: 1530552634675 isvalid: true keysize: -1 values
ize: 31 magic: 2 compresscodec: NONE producerId: -1 producerEpoch: -1 sequence:
-1 isTransactional: false headerKeys: [] payload: This Message is from Test File
.
offset: 1 position: 0 CreateTime: 1530552634677 isvalid: true keysize: -1 values
ize: 43 magic: 2 compresscodec: NONE producerId: -1 producerEpoch: -1 sequence:
-1 isTransactional: false headerKeys: [] payload: It will be consumed by the Kaf
ka Connector.
[root@tos my-kafka-connect-0]#
```

CLI to list offset number.

#/opt/kafka/bin/kafka-run-class.sh kafka.tools.GetOffsetShell --broker-list localhost:9092 --topic IBM

Sending Message with Key and Value

#/opt/kafka/bin/kafka-console-producer.sh --broker-list localhost:9092 --topic IBM --property "parse.key=true" --property "key.separator=:"

#/opt/kafka/bin/Kafka-console-consumer.sh --topic IBM --bootstrap-server localhost:9092 --from-beginning \
 --property print.key=true \
 --property key.separator=":" \
 --partition 4 \
 --offset 3

```
kafka-console-consumer --topic example-topic --bootstrap-server broker:9092 \
 --from-beginning \
 --property print.key=true \
 --property key.separator="-" \
 --partition 0
```

III. Resources

https://developer.ibm.com/hadoop/2017/04/10/kafka-security-mechanism-saslplain/

https://sharebigdata.wordpress.com/2018/01/21/implementing-sasl-plain/
https://developer.ibm.com/code/howtos/kafka-authn-authz
https://jaceklaskowski.gitbooks.io/apache-kafka/content/kafka-tools-GetOffsetShell.html