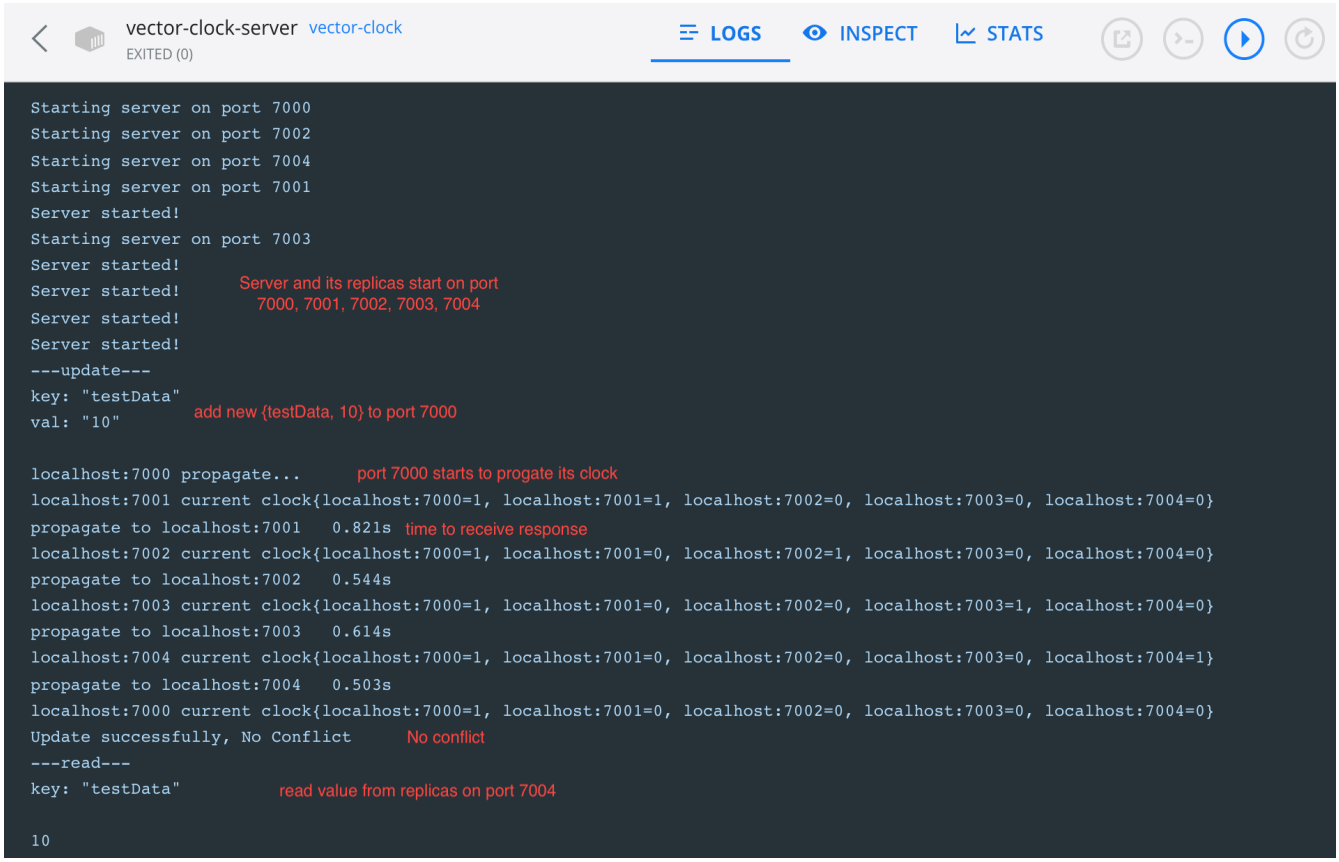
Vector Clock Report

1. Implementation

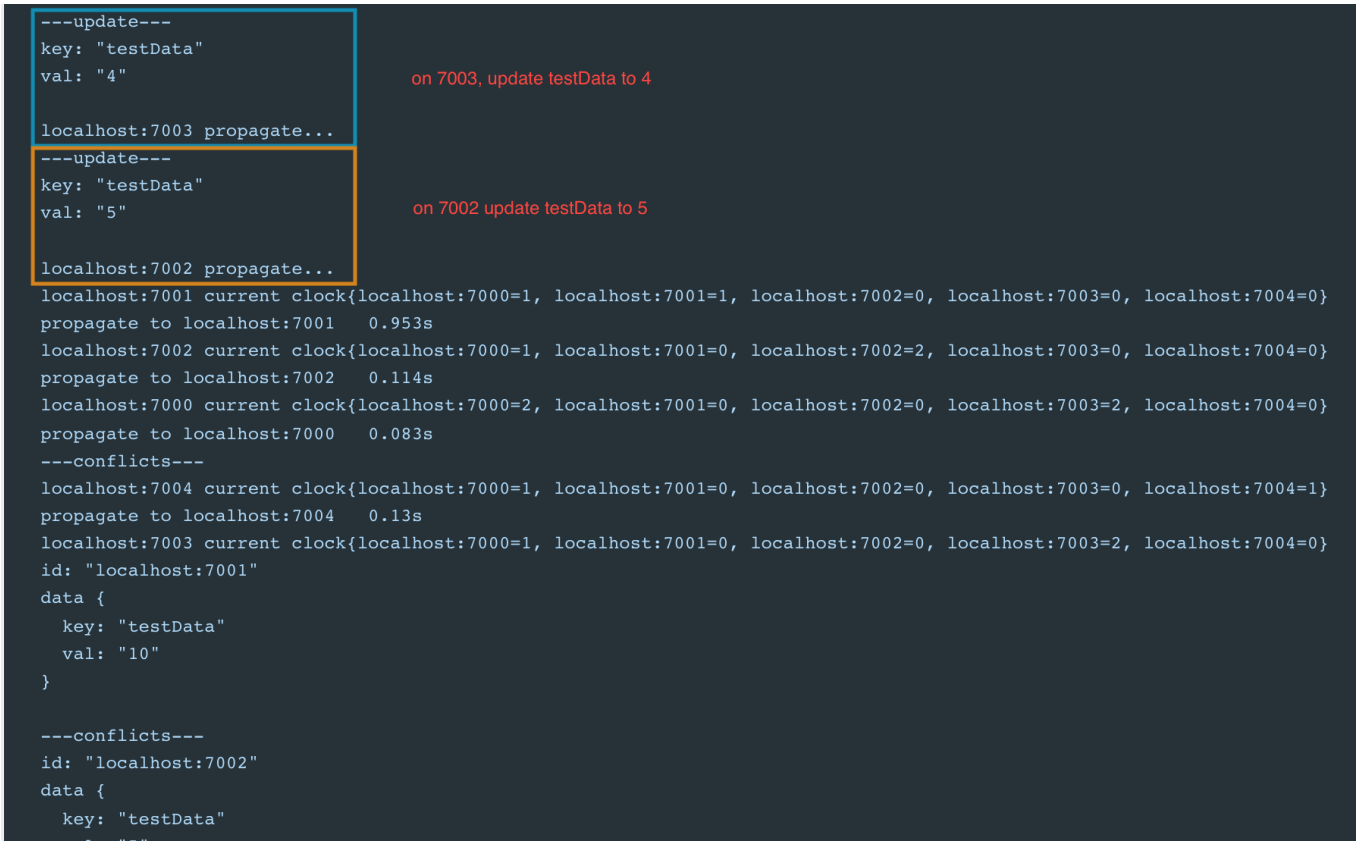
1) Entity.
    a) Data. Key-value store
    b) Server. IP:port as id, clock and update Data
    c) Vector_Clock. Servers with its clock
2) Service.
    a) read (Data) returns (Data).
    Send key return value
    b) add_update (Data) returns (stream Server).
    Send Data and increase its own clock, then propagate to all replicas
    c) Propagate (Vector_clock) returns (stream Server)
    Send clock to other servers return Server which has conflict clock
3) Test on Docker. Details in docker.log.txt

```
docker build -t vector-clock .
docker run -d -p 7000:3000 --name vector-clock-server vector-clock
```



Update simultaneously on replicas 7002 and 7003

```
java -jar Client-1.0-SNAPSHOT-jar-with-dependencies.jar -server_ip localhost -port 7002 -update testData,5
&
java -jar Client-1.0-SNAPSHOT-jar-with-dependencies.jar -server_ip localhost -port 7003 -update testData,4
```



```
id: "localhost:7001"
data {
  key: "testData"
  val: "10"
}

---conflicts---
id: "localhost:7000"
data {
  key: "testData"
  val: "4"
}

---conflicts---
id: "localhost:7003"
data {
  key: "testData"
  val: "4"
}

---conflicts---
id: "localhost:7004"
data {
  key: "testData"
  val: "10"
}

---read---
key: "testData"

10
```

4 conflicts

because of conflict, the value does not change

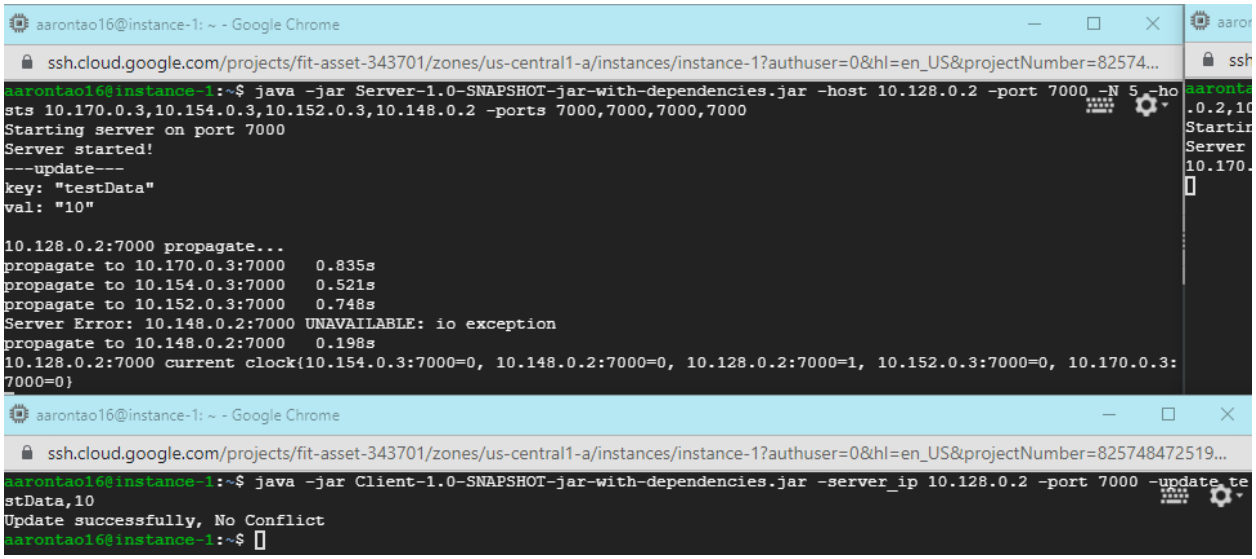
4) Test on Google Cloud.
   Five instances in us-central, Hong Kong, London, Sydney, Singapore

Filter Enter property name or value

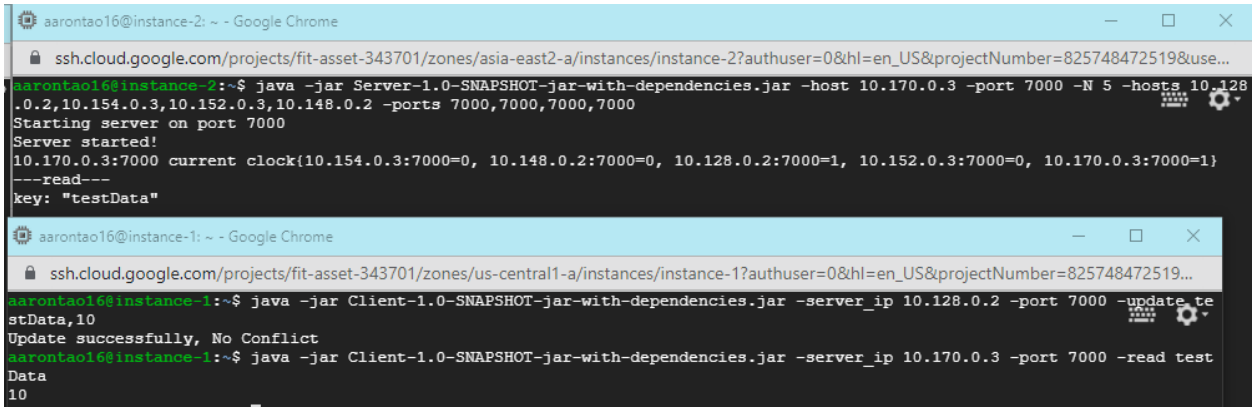
Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
✓	instance-1	us-central1-a Iowa			10.128.0.2 (nic0)	34.123.165.94	SSH
✓	instance-2	asia-east2-a Hong Kong			10.170.0.3 (nic0)	34.150.58.108	SSH
✓	instance-3	europe-west2-c London			10.154.0.3 (nic0)	35.189.121.64	SSH
✓	instance-4	australia-southeast1-b Sydney			10.152.0.3 (nic0)	34.151.69.229	SSH
✓	instance-5	asia-southeast1-b Singapore			10.148.0.2 (nic0)	34.87.0.118	SSH

Start the main server instance-1, and all replicas except instance-5

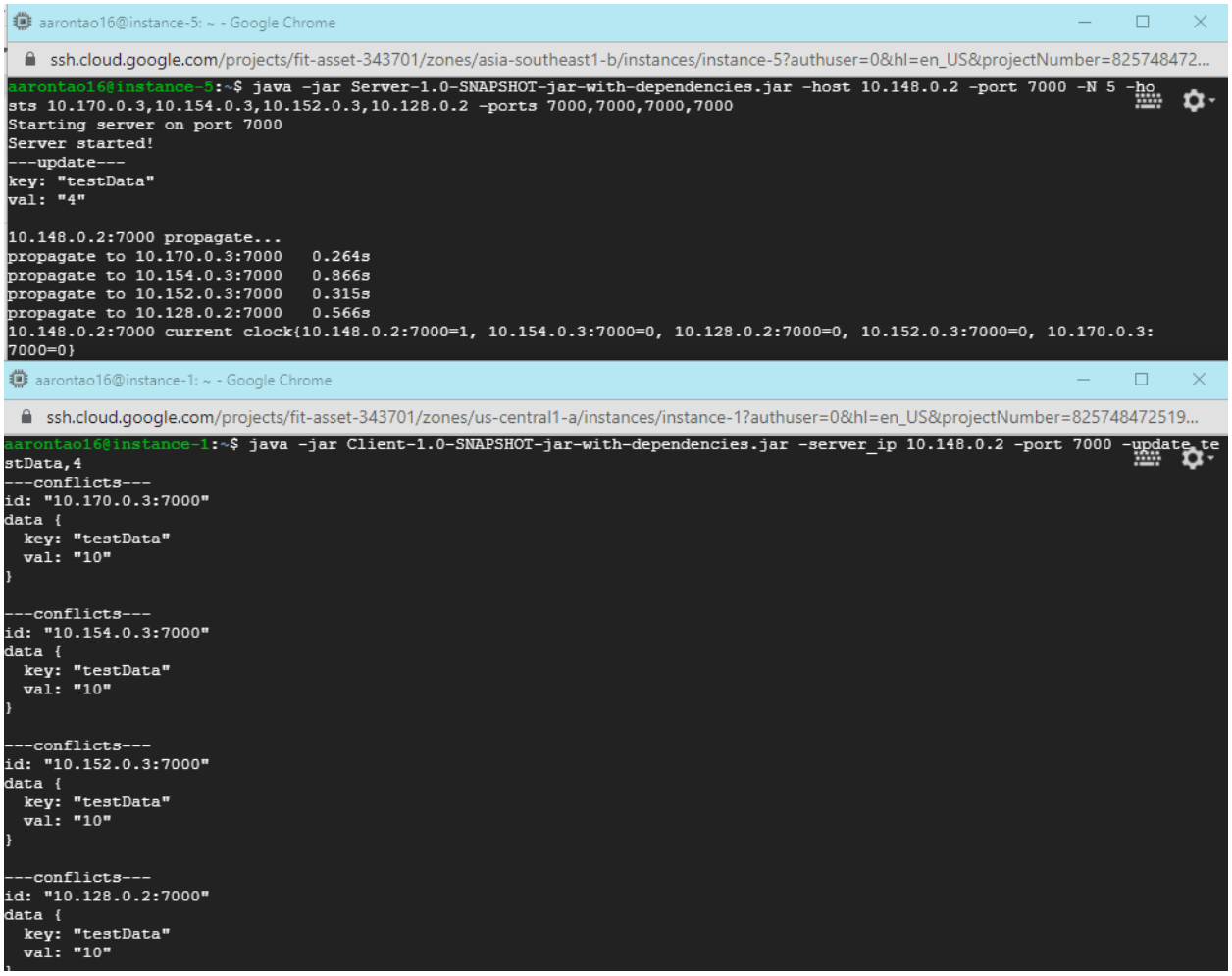
Add {testData, 10} to the main server — No conflict



Read testData from instance-2 — result: 10



Instance-5 is back, the send update {testData, 5} to it —conflict!



Latency (server in US to other replicas)

US	Hong Kong	London	Sydney	Singapore
Propagate (round)	0.53s	0.30s	0.53s	0.63s
distance	12,719 km	6,848 km	12013.75 km	15289.17 km