Distributed SecKill Service Based on Redis

CS237 group 5

Qirui Yang
Mingyuan Yang
Jiannan Tan

Motivation & Goals

- The rapid development of e-commerce prompted the birth of seckill activity. In a seckill activity, a limited number of products will be sold at varying degrees of discount, which brings a huge temptation for customers. The discounted products are usually sold out in seconds, which can be a huge challenge for e-commerce systems. In this case, a seckill system with high concurrency and high availability has very practical significance. We want to design a seckill system to mock the scenario like Black Friday where a huge amount of customers snap up a small number of super-cheap products successfully at a specified time.

- We aim to design and implement a seckill system based on Redis. Specifically, we use the MySQL database to store the stock and order information and use Redis as the cache of the MySQL database to prevent oversold in the distributed systems.

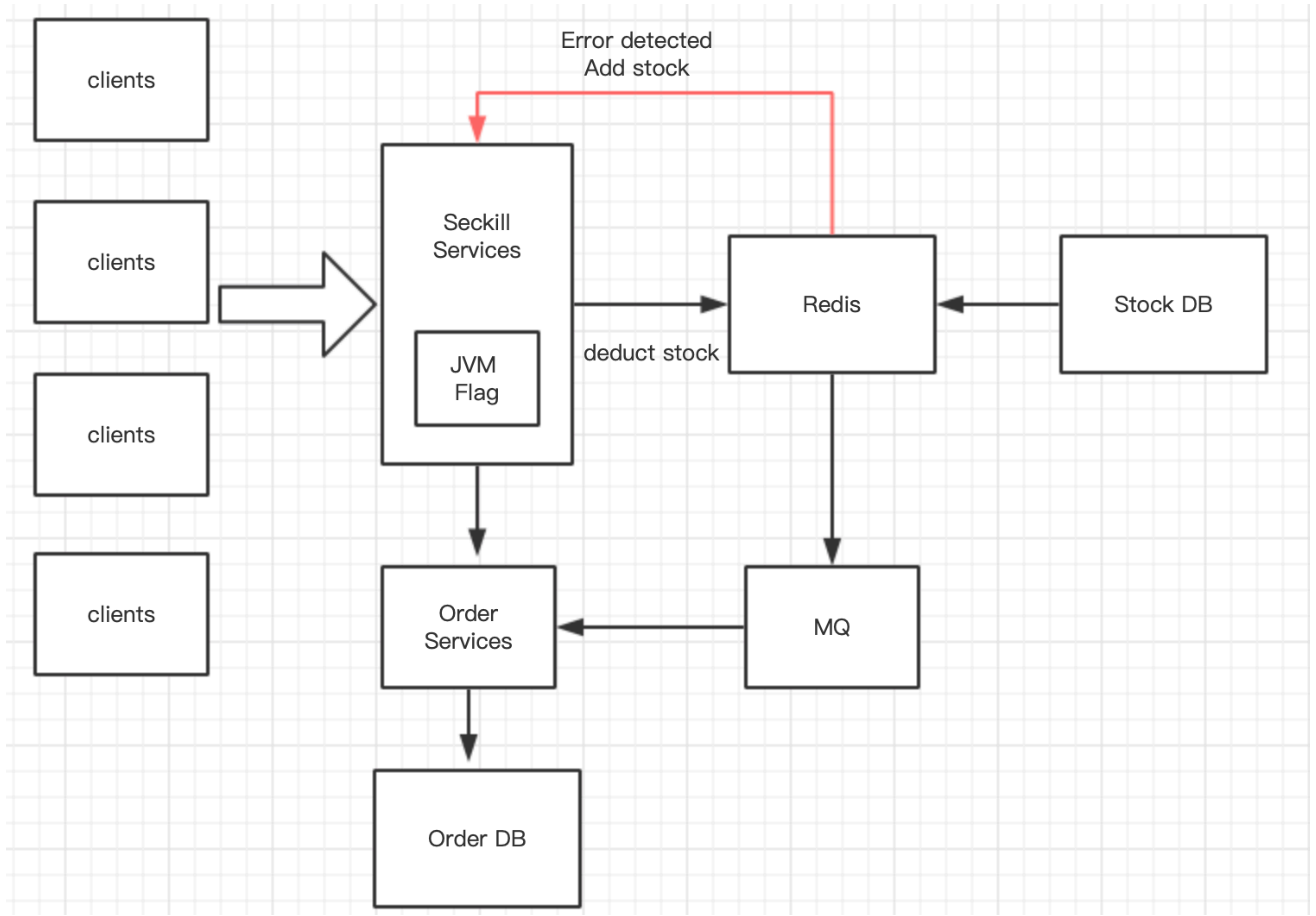
Related Work

- In this distributed seckill scenario, we use **zookeeper** to achieve the global synchronization of sold out products tags, that is, when one node is sold out, it will inform all other nodes that the status should be SOLD OUT.

- When the nodes are sold out, we use the **concureenthashmap** to update the markers to block subsequent purchase requests, which prevents the oversold situation.

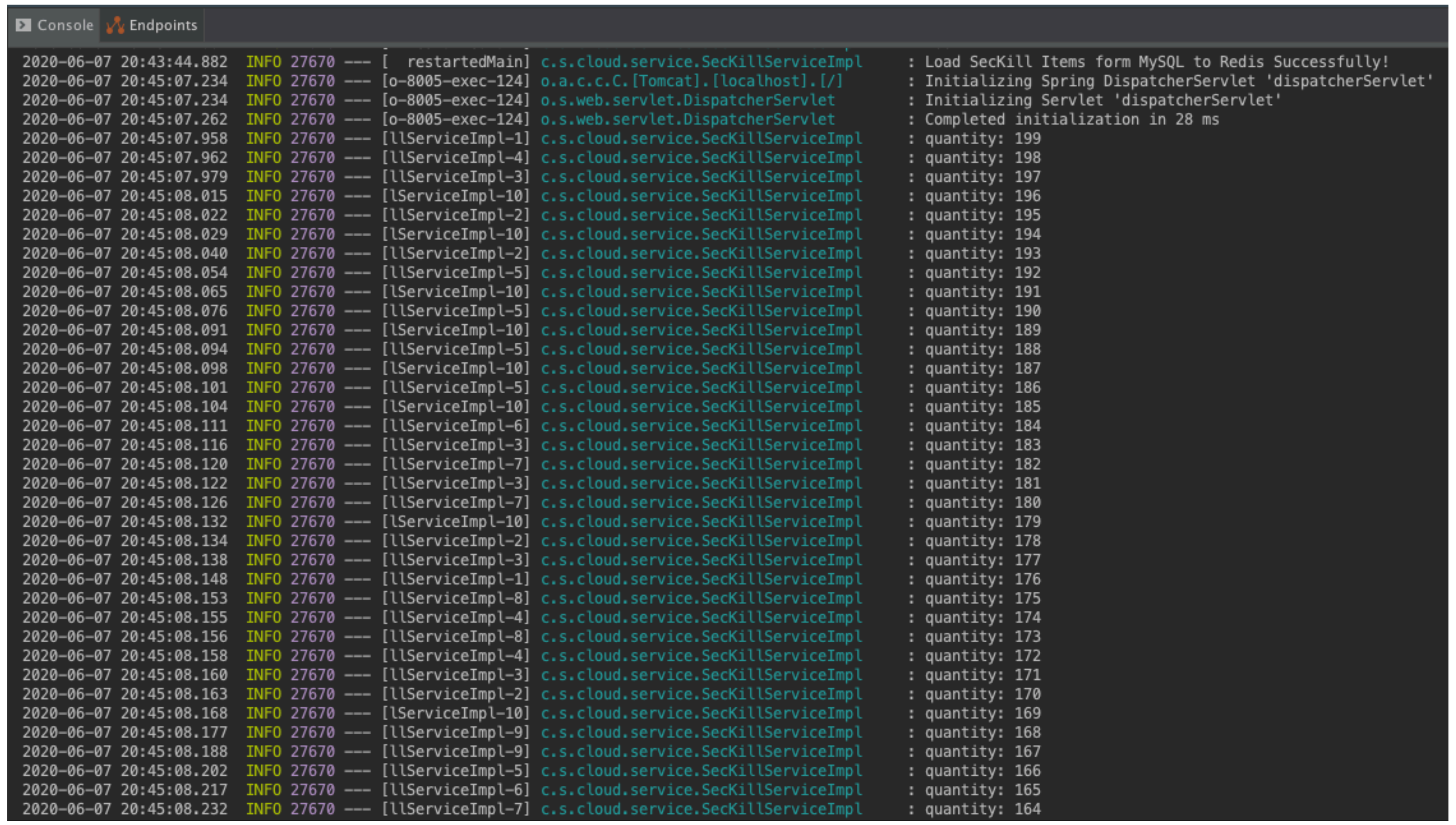
- We use **message queues** to place orders asynchronously, reducing the processing time of a single request and improving throughput.

System Architecture



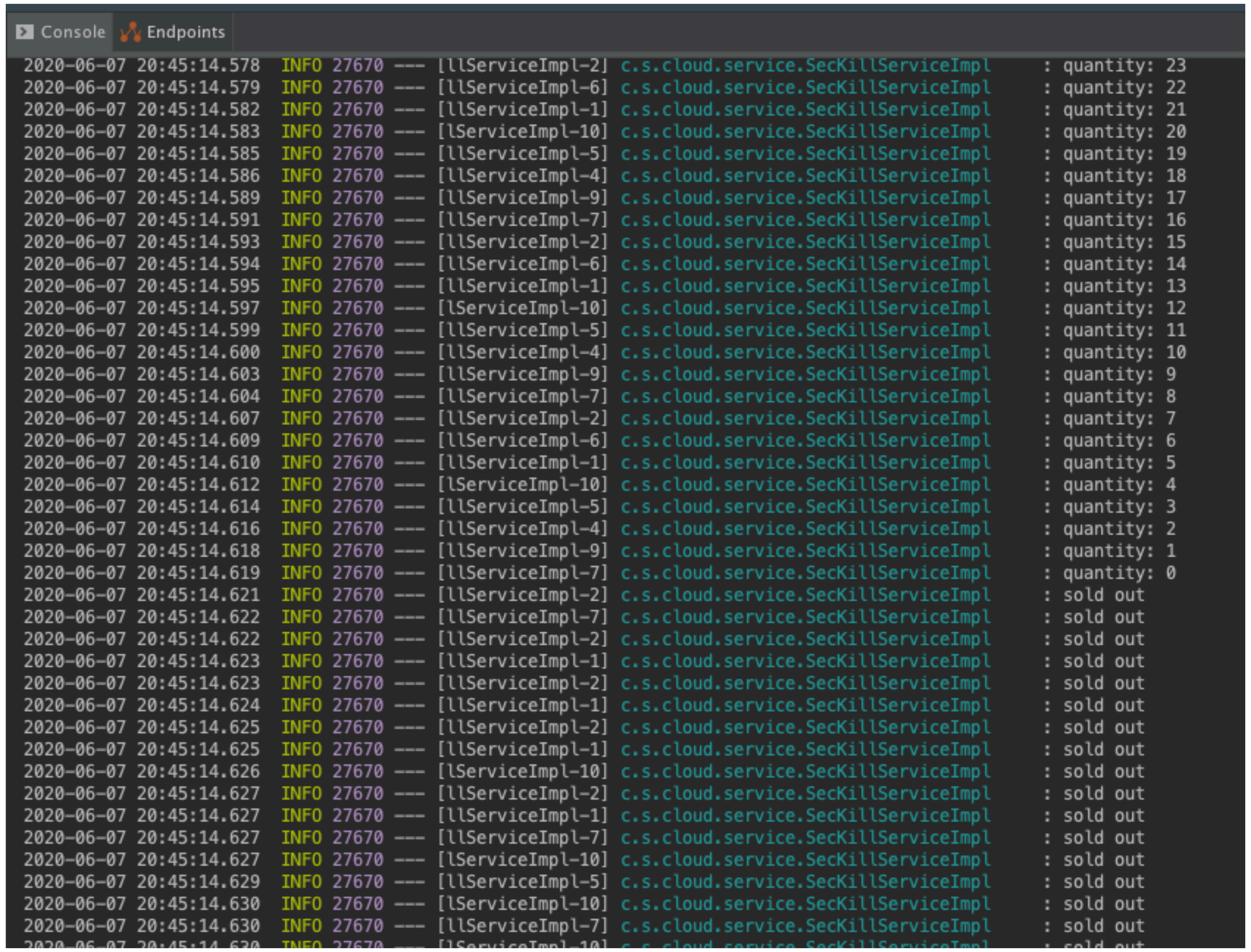
Note: JVM-Level Flag is in the back-end services, and requests check this flag firstly then Redis.

Testing and Evaluation



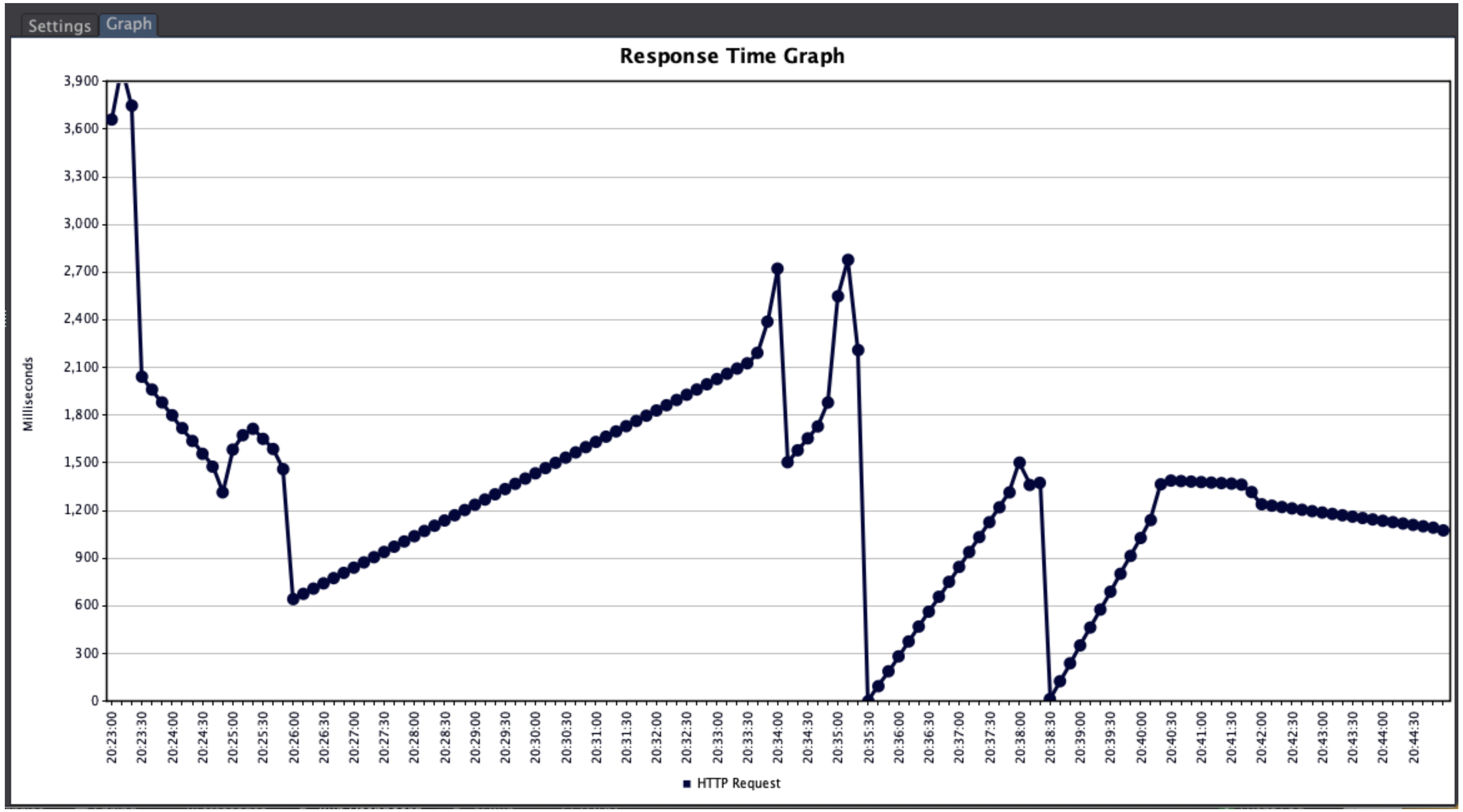
```
2020-06-07 20:43:44.882  INFO 27670 --- [  restartedMain] c.s.cloud.service.SecKillServiceImpl     : Load SecKill Items form MySQL to Redis Successfully!
2020-06-07 20:45:07.234  INFO 27670 --- [o-8005-exec-124] o.a.c.c.C.[Tomcat].[localhost].[/]       : Initializing Spring DispatcherServlet 'dispatcherServlet'
2020-06-07 20:45:07.234  INFO 27670 --- [o-8005-exec-124] o.s.web.servlet.DispatcherServlet        : Initializing Servlet 'dispatcherServlet'
2020-06-07 20:45:07.262  INFO 27670 --- [o-8005-exec-124] o.s.web.servlet.DispatcherServlet        : Completed initialization in 28 ms
2020-06-07 20:45:07.958  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : quantity: 199
2020-06-07 20:45:07.962  INFO 27670 --- [llServiceImpl-4] c.s.cloud.service.SecKillServiceImpl     : quantity: 198
2020-06-07 20:45:07.979  INFO 27670 --- [llServiceImpl-3] c.s.cloud.service.SecKillServiceImpl     : quantity: 197
2020-06-07 20:45:08.015  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 196
2020-06-07 20:45:08.022  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 195
2020-06-07 20:45:08.029  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 194
2020-06-07 20:45:08.040  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 193
2020-06-07 20:45:08.054  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 192
2020-06-07 20:45:08.065  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 191
2020-06-07 20:45:08.076  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 190
2020-06-07 20:45:08.091  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 189
2020-06-07 20:45:08.094  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 188
2020-06-07 20:45:08.098  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 187
2020-06-07 20:45:08.101  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 186
2020-06-07 20:45:08.104  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 185
2020-06-07 20:45:08.111  INFO 27670 --- [llServiceImpl-6] c.s.cloud.service.SecKillServiceImpl     : quantity: 184
2020-06-07 20:45:08.116  INFO 27670 --- [llServiceImpl-3] c.s.cloud.service.SecKillServiceImpl     : quantity: 183
2020-06-07 20:45:08.120  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : quantity: 182
2020-06-07 20:45:08.122  INFO 27670 --- [llServiceImpl-3] c.s.cloud.service.SecKillServiceImpl     : quantity: 181
2020-06-07 20:45:08.126  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : quantity: 180
2020-06-07 20:45:08.132  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 179
2020-06-07 20:45:08.134  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 178
2020-06-07 20:45:08.138  INFO 27670 --- [llServiceImpl-3] c.s.cloud.service.SecKillServiceImpl     : quantity: 177
2020-06-07 20:45:08.148  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : quantity: 176
2020-06-07 20:45:08.153  INFO 27670 --- [llServiceImpl-8] c.s.cloud.service.SecKillServiceImpl     : quantity: 175
2020-06-07 20:45:08.155  INFO 27670 --- [llServiceImpl-4] c.s.cloud.service.SecKillServiceImpl     : quantity: 174
2020-06-07 20:45:08.156  INFO 27670 --- [llServiceImpl-8] c.s.cloud.service.SecKillServiceImpl     : quantity: 173
2020-06-07 20:45:08.158  INFO 27670 --- [llServiceImpl-4] c.s.cloud.service.SecKillServiceImpl     : quantity: 172
2020-06-07 20:45:08.160  INFO 27670 --- [llServiceImpl-3] c.s.cloud.service.SecKillServiceImpl     : quantity: 171
2020-06-07 20:45:08.163  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 170
2020-06-07 20:45:08.168  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 169
2020-06-07 20:45:08.177  INFO 27670 --- [llServiceImpl-9] c.s.cloud.service.SecKillServiceImpl     : quantity: 168
2020-06-07 20:45:08.188  INFO 27670 --- [llServiceImpl-9] c.s.cloud.service.SecKillServiceImpl     : quantity: 167
2020-06-07 20:45:08.202  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 166
2020-06-07 20:45:08.217  INFO 27670 --- [llServiceImpl-6] c.s.cloud.service.SecKillServiceImpl     : quantity: 165
2020-06-07 20:45:08.232  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : quantity: 164
```

We use Jmeter to test this seckill system.
We simulate 30000 customers snap up 200 items in stock.



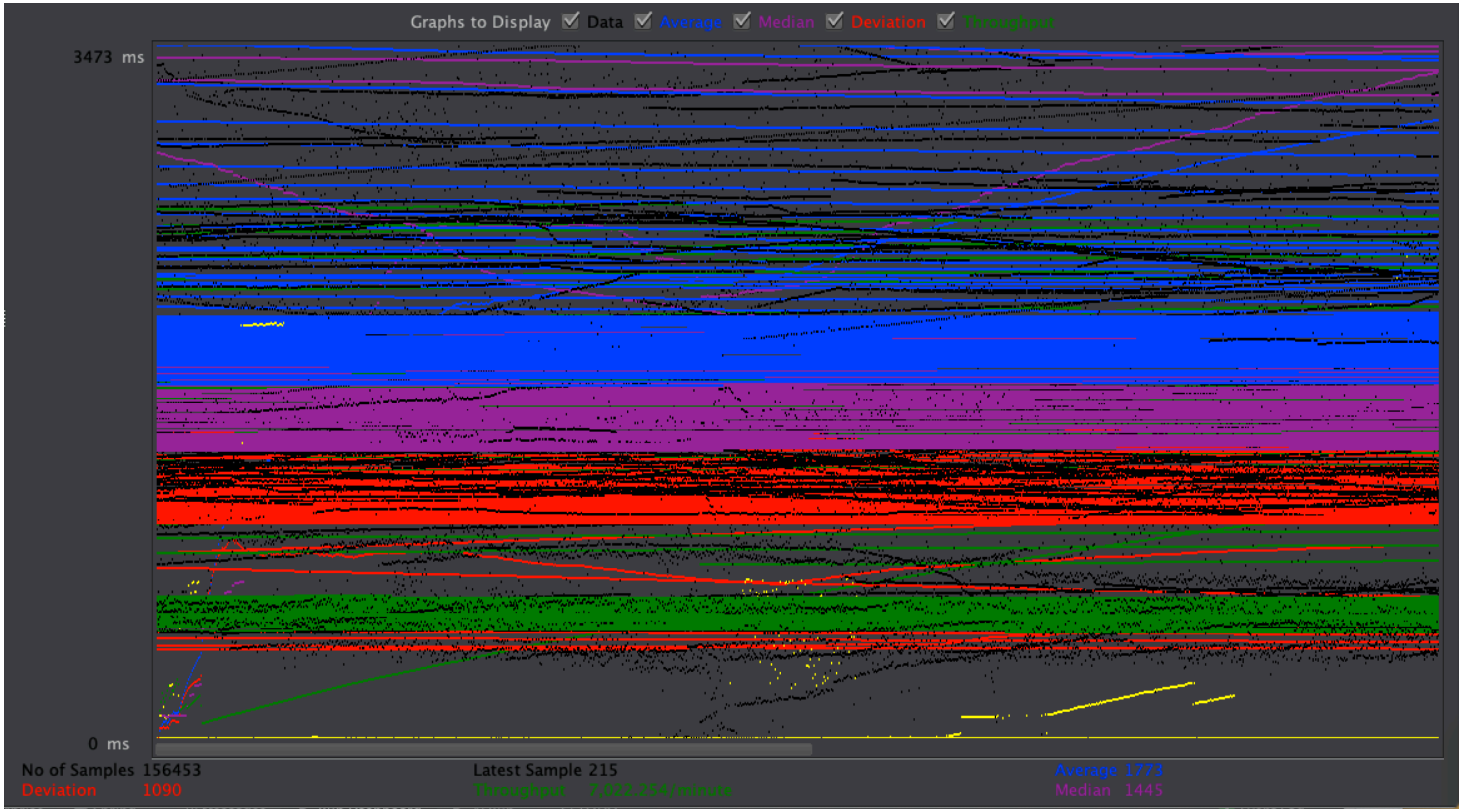
```
2020-06-07 20:45:14.578  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 23
2020-06-07 20:45:14.579  INFO 27670 --- [llServiceImpl-6] c.s.cloud.service.SecKillServiceImpl     : quantity: 22
2020-06-07 20:45:14.582  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : quantity: 21
2020-06-07 20:45:14.583  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 20
2020-06-07 20:45:14.585  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 19
2020-06-07 20:45:14.586  INFO 27670 --- [llServiceImpl-4] c.s.cloud.service.SecKillServiceImpl     : quantity: 18
2020-06-07 20:45:14.589  INFO 27670 --- [llServiceImpl-9] c.s.cloud.service.SecKillServiceImpl     : quantity: 17
2020-06-07 20:45:14.591  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : quantity: 16
2020-06-07 20:45:14.593  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 15
2020-06-07 20:45:14.594  INFO 27670 --- [llServiceImpl-6] c.s.cloud.service.SecKillServiceImpl     : quantity: 14
2020-06-07 20:45:14.595  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : quantity: 13
2020-06-07 20:45:14.597  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 12
2020-06-07 20:45:14.599  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 11
2020-06-07 20:45:14.600  INFO 27670 --- [llServiceImpl-4] c.s.cloud.service.SecKillServiceImpl     : quantity: 10
2020-06-07 20:45:14.603  INFO 27670 --- [llServiceImpl-9] c.s.cloud.service.SecKillServiceImpl     : quantity: 9
2020-06-07 20:45:14.604  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : quantity: 8
2020-06-07 20:45:14.607  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : quantity: 7
2020-06-07 20:45:14.609  INFO 27670 --- [llServiceImpl-6] c.s.cloud.service.SecKillServiceImpl     : quantity: 6
2020-06-07 20:45:14.610  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : quantity: 5
2020-06-07 20:45:14.612  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : quantity: 4
2020-06-07 20:45:14.614  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : quantity: 3
2020-06-07 20:45:14.616  INFO 27670 --- [llServiceImpl-4] c.s.cloud.service.SecKillServiceImpl     : quantity: 2
2020-06-07 20:45:14.618  INFO 27670 --- [llServiceImpl-9] c.s.cloud.service.SecKillServiceImpl     : quantity: 1
2020-06-07 20:45:14.619  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : quantity: 0
2020-06-07 20:45:14.621  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.622  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.622  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.623  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.623  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.624  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.625  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.625  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.626  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.627  INFO 27670 --- [llServiceImpl-2] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.627  INFO 27670 --- [llServiceImpl-1] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.627  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.627  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.629  INFO 27670 --- [llServiceImpl-5] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.630  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.630  INFO 27670 --- [llServiceImpl-7] c.s.cloud.service.SecKillServiceImpl     : sold out
2020-06-07 20:45:14.630  INFO 27670 --- [lServiceImpl-10] c.s.cloud.service.SecKillServiceImpl     : sold out
```

Testing and Evaluation



For the response time of requests, the high one is narrow, which means most response time is short

Testing and Evaluation



```
No of Samples 156453          Latest Sample 215                         Average 1773
Deviation     1090            Throughput    7,022.254/minute            Median  1445
```