ChainSQLV3.0 性能测试报告

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1.概况

1.1 测试背景

ChainSQLV3.0 版本更新了最新的 Ripple 代码，新增加了多链，共识可插拔功能以及将软国密功能合并到产品中。基于上述改动需要进行性能测试，了解当前 chainsql 版本性能如何，是否能满足日后项目业务的客户场景。

1.2 测试目的

本文档为 ChainSQLV3.0 的性能测试报告，目的是在大用户量、数据量的超负荷下，测试 ChainSQL 链在 POP 和 HOTSTUFF 算法下 Payment 和 Insertment 的共识 TPS 和交易的响应时间 ,获得 ChainSQL 链运行时的相关数据，从而进行分析。

2. 指标参考

指标	建议值
➢ CPU 占用对比	➢ 服务器 CPU 占用率: 70%以内 优秀 70% ~85% 一般 85%以上 差
➢ 内存占用对比	➢ 服务器内存占用率: 70%以内 优秀 70% ~85% 一般 85%以上 差
➢ TPS	➢ 每秒成功完成的业务请求数量，反映系统处理能力，一般值越大，系统性能越好

➢ 响应时间	➢ 业务请求从开始到响应结果结束所经历的时间，值越小，系统用户体验越好

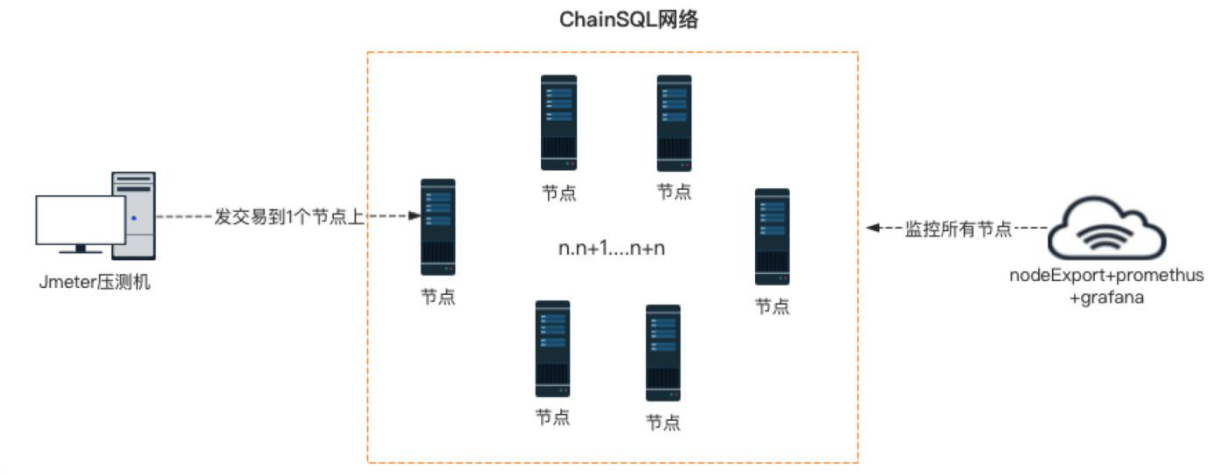
3.测试环境

3.1 测试机器配置

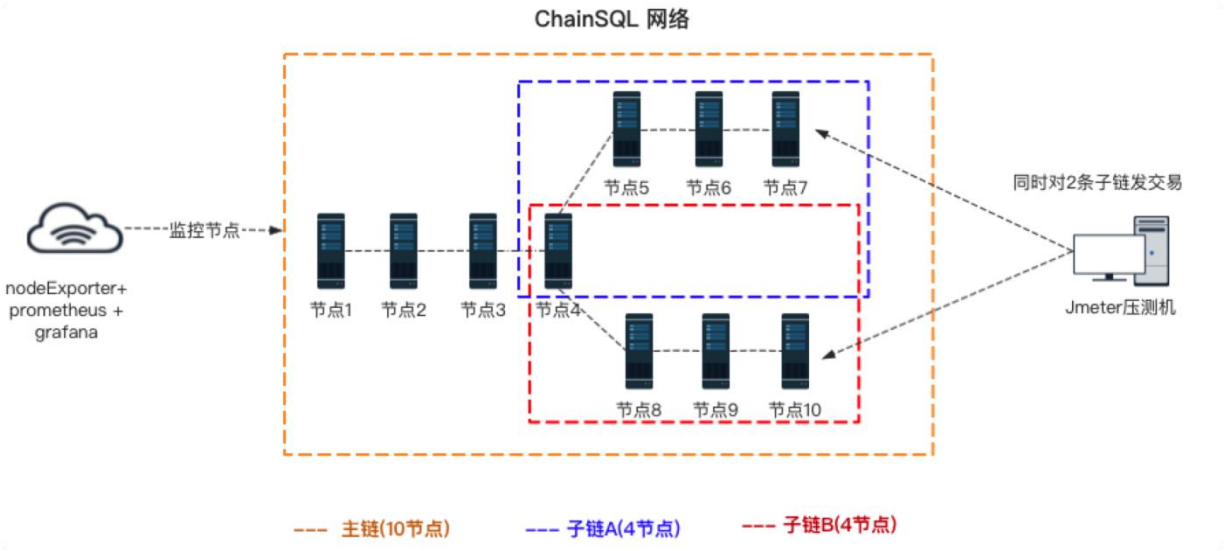
测试机型	硬件指标	操作系统	用途
阿里云机器	CPU:8C 内存:16G 磁盘:540G 带宽:100M	Ubuntu18.04	搭建 chainsql 节点
阿里云机器	CPU:8C 内存:16G 磁盘:40G	Ubuntu18.04	部署 Jmeter 压测工具发起压测

3.2 测试环境架构图

◆ 单条链



◆ 多链



4.测试工具

工具类型	工具名称	用途
压测工具	Jmeter	使用 Jmeter 模拟用户对 chainsql 链发起上链交易
监控工具	prometheus+nodeExporter+granfana	监控节点所在机器的硬件指标性能

5.测试相关人员

人员名称	工作职责	联系方式
高丽丽	负责主要的压测工作	gaolili@peersafe.cn
路京磊	负责解决和优化压测过程中出现的问题	lujinglei@peersafe.cn
王超	负责解决和优化压测过程中出现的问题	wangchao@peersafe.cn

6.测试场景设计与结果分析

6.1 容量测试

6.1.1 4 个节点(非国密)

(1) POP 算法

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 14:43:32 CST 2021 (1619505812918)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:00 =    5.1/s Avg:    16 Min:    16 Max:    16 Err:     0 (0.00%) Active: 7 Started: 7 Finished: 0
summary + 184514 in 00:00:27 = 6959.6/s Avg:    12 Min:     0 Max:   602 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 184515 in 00:00:27 = 6908.1/s Avg:    12 Min:     0 Max:   602 Err:     0 (0.00%)
summary + 185048 in 00:00:30 = 6168.3/s Avg:    15 Min:     0 Max:  1203 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 369563 in 00:00:57 = 6516.7/s Avg:    14 Min:     0 Max:  1203 Err:     0 (0.00%)
summary + 183149 in 00:00:30 = 6105.0/s Avg:    16 Min:     1 Max:   615 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 552712 in 00:01:27 = 6374.3/s Avg:    14 Min:     0 Max:  1203 Err:     0 (0.00%)
summary + 187511 in 00:00:30 = 6250.4/s Avg:    15 Min:     0 Max:   404 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 740223 in 00:01:57 = 6342.4/s Avg:    15 Min:     0 Max:  1203 Err:     0 (0.00%)
summary + 180077 in 00:00:30 = 6001.6/s Avg:    16 Min:     1 Max:   498 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 920300 in 00:02:27 = 6272.7/s Avg:    15 Min:     0 Max:  1203 Err:     0 (0.00%)
summary +  79700 in 00:00:14 = 5785.4/s Avg:    15 Min:     0 Max:   416 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:40 = 6230.9/s Avg:    15 Min:     0 Max:  1203 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 14:46:13 CST 2021 (1619505973781)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 159
txn_count = 1000041
txn_success = 1000041
txn_failure = 0
每秒落账交易的TPS = 6289.56/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 1 发送和共识结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/batch-SSH# sh StartChainsql.sh
开始运行Chainsql 节点 :
serverListFilePath:/root/batch-SSH/serverList.xlsx
downloadDirPath:/root/batch-SSH/Download
chainsqlFilePath:/root/batch-SSH/chainsqld.tar.gz
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 2:39:12 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.180:6006
connect success
ledger index:157,ledger time:0,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:158,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:159,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:160,ledger time:2,txn_count:17159,txn_success:17159,txn_failure:0
ledger index:161,ledger time:3,txn_count:14534,txn_success:14534,txn_failure:0
ledger index:162,ledger time:3,txn_count:17361,txn_success:17361,txn_failure:0
ledger index:163,ledger time:2,txn_count:14534,txn_success:14534,txn_failure:0
ledger index:164,ledger time:1,txn_count:10921,txn_success:10921,txn_failure:0
ledger index:165,ledger time:1,txn_count:5413,txn_success:5413,txn_failure:0
ledger index:166,ledger time:2,txn_count:11960,txn_success:11960,txn_failure:0
ledger index:167,ledger time:3,txn_count:15664,txn_success:15664,txn_failure:0
ledger index:168,ledger time:1,txn_count:12388,txn_success:12388,txn_failure:0
ledger index:169,ledger time:1,txn_count:5031,txn_success:5031,txn_failure:0
ledger index:170,ledger time:3,txn_count:17577,txn_success:17577,txn_failure:0
ledger index:171,ledger time:2,txn_count:13678,txn_success:13678,txn_failure:0
ledger index:172,ledger time:2,txn_count:14220,txn_success:14220,txn_failure:0
ledger index:173,ledger time:1,txn_count:6106,txn_success:6106,txn_failure:0
ledger index:174,ledger time:3,txn_count:15378,txn_success:15378,txn_failure:0
ledger index:175,ledger time:2,txn_count:12893,txn_success:12893,txn_failure:0
ledger index:176,ledger time:1,txn_count:6806,txn_success:6806,txn_failure:0
ledger index:177,ledger time:1,txn_count:2331,txn_success:2331,txn_failure:0
ledger index:178,ledger time:3,txn_count:10533,txn_success:10533,txn_failure:0
ledger index:179,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:180,ledger time:1,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:181,ledger time:3,txn_count:14414,txn_success:14414,txn_failure:0
ledger index:182,ledger time:3,txn_count:15020,txn_success:15020,txn_failure:0
ledger index:183,ledger time:2,txn_count:11877,txn_success:11877,txn_failure:0
ledger index:184,ledger time:1,txn_count:9499,txn_success:9499,txn_failure:0
ledger index:185,ledger time:1,txn_count:5960,txn_success:5960,txn_failure:0
ledger index:186,ledger time:2,txn_count:10412,txn_success:10412,txn_failure:0
ledger index:187,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:188,ledger time:1,txn_count:14585,txn_success:14585,txn_failure:0
ledger index:189,ledger time:2,txn_count:6647,txn_success:6647,txn_failure:0
ledger index:190,ledger time:3,txn_count:14234,txn_success:14234,txn_failure:0
ledger index:191,ledger time:1,txn_count:11893,txn_success:11893,txn_failure:0
ledger index:192,ledger time:1,txn_count:9258,txn_success:9258,txn_failure:0
ledger index:193,ledger time:1,txn_count:2897,txn_success:2897,txn_failure:0
ledger index:194,ledger time:3,txn_count:11593,txn_success:11593,txn_failure:0
ledger index:195,ledger time:1,txn_count:8754,txn_success:8754,txn_failure:0
ledger index:196,ledger time:1,txn_count:4474,txn_success:4474,txn_failure:0
ledger index:197,ledger time:1,txn_count:4494,txn_success:4494,txn_failure:0
ledger index:198,ledger time:1,txn_count:7957,txn_success:7957,txn_failure:0
ledger index:199,ledger time:1,txn_count:6483,txn_success:6483,txn_failure:0
ledger index:200,ledger time:1,txn_count:6422,txn_success:6422,txn_failure:0
ledger index:201,ledger time:1,txn_count:5576,txn_success:5576,txn_failure:0
ledger index:202,ledger time:1,txn_count:6580,txn_success:6580,txn_failure:0
ledger index:203,ledger time:1,txn_count:5725,txn_success:5725,txn_failure:0
ledger index:204,ledger time:1,txn_count:5676,txn_success:5676,txn_failure:0
ledger index:205,ledger time:1,txn_count:4872,txn_success:4872,txn_failure:0
ledger index:206,ledger time:1,txn_count:4988,txn_success:4988,txn_failure:0
ledger index:207,ledger time:1,txn_count:5489,txn_success:5489,txn_failure:0
ledger index:208,ledger time:1,txn_count:7048,txn_success:7048,txn_failure:0
ledger index:209,ledger time:1,txn_count:4874,txn_success:4874,txn_failure:0
ledger index:210,ledger time:1,txn_count:6443,txn_success:6443,txn_failure:0
ledger index:211,ledger time:1,txn_count:6050,txn_success:6050,txn_failure:0
ledger index:212,ledger time:1,txn_count:8316,txn_success:8316,txn_failure:0
ledger index:213,ledger time:1,txn_count:8051,txn_success:8051,txn_failure:0
ledger index:214,ledger time:1,txn_count:7166,txn_success:7166,txn_failure:0
ledger index:215,ledger time:1,txn_count:5258,txn_success:5258,txn_failure:0
ledger index:216,ledger time:1,txn_count:4835,txn_success:4835,txn_failure:0
ledger index:217,ledger time:1,txn_count:5962,txn_success:5962,txn_failure:0
ledger index:218,ledger time:1,txn_count:10717,txn_success:10717,txn_failure:0
ledger index:219,ledger time:1,txn_count:8276,txn_success:8276,txn_failure:0
ledger index:220,ledger time:1,txn_count:7291,txn_success:7291,txn_failure:0
ledger index:221,ledger time:1,txn_count:3698,txn_success:3698,txn_failure:0
ledger index:222,ledger time:2,txn_count:11148,txn_success:11148,txn_failure:0
ledger index:223,ledger time:2,txn_count:10487,txn_success:10487,txn_failure:0
ledger index:224,ledger time:1,txn_count:9983,txn_success:9983,txn_failure:0
```

图 2　订阅区块结果

图 3　节点资源监控

1.3 结果分析

从图 1 分析出，测试 4 个节点 POP 算法下 Payment 接口的发送 100 万交易时所有交易都成功落块，由于区块超过 256 区块会生成 41 个 Features 交易，**交易成功率为 100% ,交易共识速率 TPS 为 6289.56/s；**

从图 2 可看出，出块时间最小为 1s ,最大出块时间为 3s，**交易处理完成的平均响应时间 2s 左右；**

从图 3 可看出，接收交易的节点开始接收交易后，CPU 使用率上来了最高达到 73%，交易发送完了 CPU 使用率恢复正常；节点机器增加了定时任务定时释放内存，内存能正常释放，不存在内存泄露问题。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 14:27:44 CST 2021 (1619504864228)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 127469 in 00:00:15 = 8273.4/s Avg:     9 Min:     0 Max:   262 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 224289 in 00:00:30 = 7476.3/s Avg:    13 Min:     1 Max:   273 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 351758 in 00:00:45 = 7746.8/s Avg:    11 Min:     0 Max:   273 Err:     0 (0.00%)
summary + 207527 in 00:00:30 = 6917.6/s Avg:    14 Min:     0 Max:   334 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 559285 in 00:01:15 = 7416.9/s Avg:    12 Min:     0 Max:   334 Err:     0 (0.00%)
summary + 206206 in 00:00:30 = 6873.5/s Avg:    14 Min:     1 Max:   322 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 765491 in 00:01:45 = 7262.2/s Avg:    13 Min:     0 Max:   334 Err:     0 (0.00%)
summary + 199787 in 00:00:30 = 6649.4/s Avg:    14 Min:     1 Max:   440 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 965278 in 00:02:15 = 7126.3/s Avg:    13 Min:     0 Max:   440 Err:     0 (0.00%)
summary +  34722 in 00:00:07 = 5271.3/s Avg:    14 Min:     0 Max:   238 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:22 = 7040.2/s Avg:    13 Min:     0 Max:   440 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 14:30:06 CST 2021 (1619505006634)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 141
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 7092.19/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 4 发送和共识结果

```
root@iz0j10b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 2:27:36 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.180:6006
connect success
ledger index:148,ledger time:0,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:149,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:150,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:151,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:152,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:153,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:154,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:155,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:156,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:157,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:158,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:159,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:160,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:161,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:162,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:163,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:164,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:165,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:166,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:167,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:168,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:169,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:170,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:171,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:172,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:173,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:174,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:175,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:176,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:177,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:178,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:179,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:180,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:181,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:182,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:183,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:184,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:185,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:186,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:187,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:188,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:189,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:190,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:191,ledger time:2,txn_count:17159,txn_success:17159,txn_failure:0
ledger index:192,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:193,ledger time:3,txn_count:19781,txn_success:19781,txn_failure:0
ledger index:194,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:195,ledger time:2,txn_count:16638,txn_success:16638,txn_failure:0
ledger index:196,ledger time:3,txn_count:17781,txn_success:17781,txn_failure:0
ledger index:197,ledger time:3,txn_count:14064,txn_success:14064,txn_failure:0
ledger index:198,ledger time:2,txn_count:14577,txn_success:14577,txn_failure:0
```

图 5 订阅区块结果

图 6 节点资源监控

2.3 结果分析

从图 4，5，6 分析出，测试 4 个节点 POP 算法下 InsertMent 接口的发送 100 万交易时所有交易都成功落块，**交易成功率为 100% ,交易共识速率 TPS 为 7092.19/s；交易处理完成的平均响应时间 3s 左右；**接收交易的节点开始接收交易后，CPU 使用率上来了最高达到 81%，当交易发送完了 CPU，内存使用率恢复正常；

(2) HOTSTUFF 算法

1.Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 15:14:17 CST 2021 (1619507657164)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  89262 in 00:00:13 = 7019.1/s Avg:     9 Min:     0 Max:  1174 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
summary + 188129 in 00:00:30 = 6325.4/s Avg:    15 Min:     0 Max:  1145 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
summary = 277391 in 00:00:42 = 6533.1/s Avg:    13 Min:     0 Max:  1174 Err:     0 (0.00%)
summary + 179804 in 00:00:30 = 5993.5/s Avg:    16 Min:     1 Max:  1253 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
summary = 457195 in 00:01:12 = 6309.7/s Avg:    14 Min:     0 Max:  1253 Err:     0 (0.00%)
summary + 174817 in 00:00:30 = 5827.2/s Avg:    16 Min:     0 Max:  1482 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
summary = 632012 in 00:01:42 = 6168.4/s Avg:    15 Min:     0 Max:  1482 Err:     0 (0.00%)
summary + 170873 in 00:00:30 = 5677.8/s Avg:    17 Min:     1 Max:  1433 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
summary = 802885 in 00:02:13 = 6057.0/s Avg:    15 Min:     0 Max:  1482 Err:     0 (0.00%)
summary + 173608 in 00:00:30 = 5805.3/s Avg:    16 Min:     1 Max:  1233 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
summary = 976493 in 00:02:42 = 6010.7/s Avg:    15 Min:     0 Max:  1482 Err:     0 (0.00%)
summary +  23507 in 00:00:08 = 2853.1/s Avg:    21 Min:     0 Max:  1022 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 1
summary = 1000000 in 00:02:51 = 5858.3/s Avg:    16 Min:     0 Max:  1482 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 15:17:08 CST 2021 (1619507828239)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 169
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 5917.15/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 7 发送和共识结果

图 8 节点资源监控

1.3 结果分析

从上图 7，8 可看出 Hotstuff 算法下的发送 100 万 Payment 交易都成功落块，**交易成功率为 100%，交易共识速度平均为 5917/s，**节点 CPU 使用率达到了 66%，内存使用率达到 60%，交易发送结束后，机器的使用率资源恢复正常。

2. Insertment 用例

2.1 用例设计

场景	运行场景设置	测试点
InsertMent 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

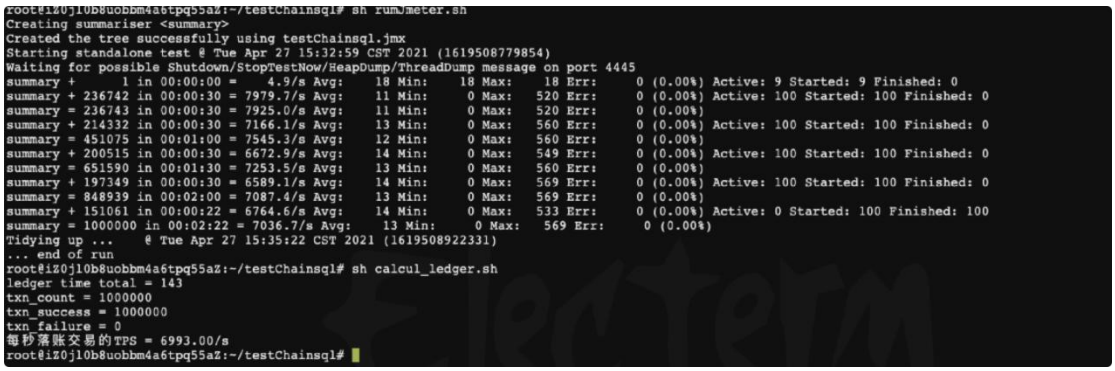


图 9 发送和共识结果图

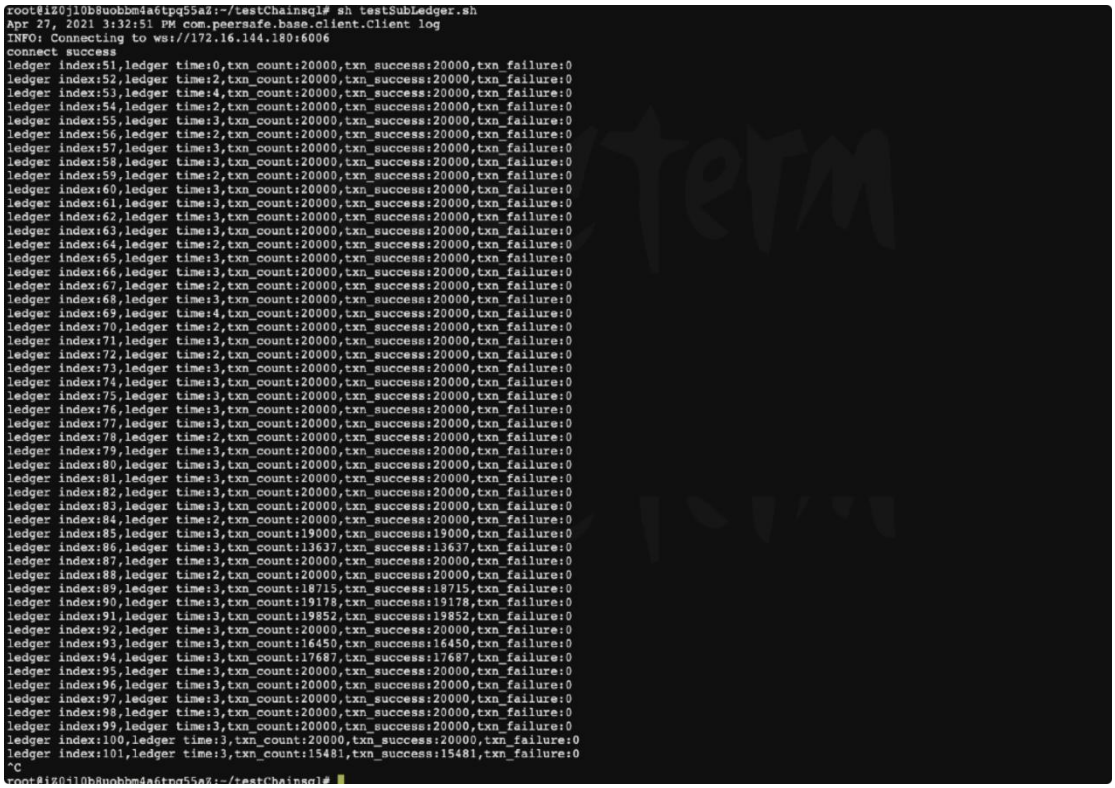


图 10 订阅区块结果

图 11 节点资源监控

2.3 结果分析

从上图 9,10, 11 可看出 Hotstuff 算法下的发送 100 万 InsertMent 交易都成功落块，**交易成功率为 100%，交易共识速度平均为 6993/s，区块生成时间在 2-4s 之间，交易响应时间平均 3s 左右；** 交易发送结束后，机器的使用率资源恢复正常。

6.1.2 4 个节点(软国密)

(1) POP 算法

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 17:19:40 CST 2021 (1619515180582)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 141695 in 00:00:19 = 7449.0/s Avg:    10 Min:     0 Max:   927 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 176219 in 00:00:30 = 5874.0/s Avg:    16 Min:     1 Max:  1167 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 317914 in 00:00:49 = 6485.1/s Avg:    13 Min:     0 Max:  1167 Err:     0 (0.00%)
summary + 167233 in 00:00:30 = 5557.8/s Avg:    17 Min:     1 Max:   915 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 485147 in 00:01:19 = 6132.4/s Avg:    15 Min:     0 Max:  1167 Err:     0 (0.00%)
summary + 175652 in 00:00:30 = 5872.7/s Avg:    16 Min:     1 Max:   935 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 660799 in 00:01:49 = 6061.2/s Avg:    15 Min:     0 Max:  1167 Err:     0 (0.00%)
summary + 169259 in 00:00:30 = 5642.0/s Avg:    17 Min:     1 Max:  1028 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 830058 in 00:02:19 = 5970.7/s Avg:    15 Min:     0 Max:  1167 Err:     0 (0.00%)
summary + 165327 in 00:00:30 = 5510.9/s Avg:    17 Min:     1 Max:   858 Err:     0 (0.00%) Active: 88 Started: 100 Finished: 12
summary = 995385 in 00:02:49 = 5889.1/s Avg:    16 Min:     0 Max:  1167 Err:     0 (0.00%)
summary +   4615 in 00:00:03 = 1648.2/s Avg:     5 Min:     0 Max:    21 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:52 = 5819.9/s Avg:    16 Min:     0 Max:  1167 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 17:22:32 CST 2021 (1619515352801)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 172
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 5813.95/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 12 发送和共识结果

```
root@iZ0j10b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 5:19:27 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.180:6006
connect success
ledger index:133,ledger time:0,txn_count:181,txn_success:181,txn_failure:0
ledger index:134,ledger time:1,txn_count:1381,txn_success:1381,txn_failure:0
ledger index:135,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:136,ledger time:2,txn_count:19672,txn_success:19672,txn_failure:0
ledger index:137,ledger time:2,txn_count:18634,txn_success:18634,txn_failure:0
ledger index:138,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:139,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:140,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:141,ledger time:2,txn_count:9626,txn_success:9626,txn_failure:0
ledger index:142,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:143,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:144,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:145,ledger time:2,txn_count:10760,txn_success:10760,txn_failure:0
ledger index:146,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:147,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:148,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:149,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:150,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:151,ledger time:1,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:152,ledger time:2,txn_count:8832,txn_success:8832,txn_failure:0
ledger index:153,ledger time:1,txn_count:7558,txn_success:7558,txn_failure:0
ledger index:154,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:155,ledger time:3,txn_count:17932,txn_success:17932,txn_failure:0
ledger index:156,ledger time:2,txn_count:8052,txn_success:8052,txn_failure:0
ledger index:157,ledger time:1,txn_count:8081,txn_success:8081,txn_failure:0
ledger index:158,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:159,ledger time:2,txn_count:18393,txn_success:18393,txn_failure:0
ledger index:160,ledger time:1,txn_count:9553,txn_success:9553,txn_failure:0
ledger index:161,ledger time:2,txn_count:9403,txn_success:9403,txn_failure:0
ledger index:162,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:163,ledger time:1,txn_count:16713,txn_success:16713,txn_failure:0
ledger index:164,ledger time:2,txn_count:11180,txn_success:11180,txn_failure:0
ledger index:165,ledger time:2,txn_count:8139,txn_success:8139,txn_failure:0
ledger index:166,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:167,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:168,ledger time:2,txn_count:6134,txn_success:6134,txn_failure:0
ledger index:169,ledger time:1,txn_count:7975,txn_success:7975,txn_failure:0
ledger index:170,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:171,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:172,ledger time:2,txn_count:9705,txn_success:9705,txn_failure:0
ledger index:173,ledger time:1,txn_count:6509,txn_success:6509,txn_failure:0
ledger index:174,ledger time:3,txn_count:19623,txn_success:19623,txn_failure:0
ledger index:175,ledger time:4,txn_count:18578,txn_success:18578,txn_failure:0
ledger index:176,ledger time:1,txn_count:9997,txn_success:9997,txn_failure:0
ledger index:177,ledger time:2,txn_count:10625,txn_success:10625,txn_failure:0
ledger index:178,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:179,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:180,ledger time:2,txn_count:17386,txn_success:17386,txn_failure:0
ledger index:181,ledger time:2,txn_count:5302,txn_success:5302,txn_failure:0
ledger index:182,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:183,ledger time:2,txn_count:19422,txn_success:19422,txn_failure:0
ledger index:184,ledger time:2,txn_count:10323,txn_success:10323,txn_failure:0
ledger index:185,ledger time:1,txn_count:9744,txn_success:9744,txn_failure:0
ledger index:186,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:187,ledger time:3,txn_count:18314,txn_success:18314,txn_failure:0
ledger index:188,ledger time:1,txn_count:7602,txn_success:7602,txn_failure:0
ledger index:189,ledger time:2,txn_count:11545,txn_success:11545,txn_failure:0
ledger index:190,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:191,ledger time:2,txn_count:19571,txn_success:19571,txn_failure:0
ledger index:192,ledger time:2,txn_count:7900,txn_success:7900,txn_failure:0
ledger index:193,ledger time:1,txn_count:7268,txn_success:7268,txn_failure:0
ledger index:194,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:195,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:196,ledger time:2,txn_count:10560,txn_success:10560,txn_failure:0
ledger index:197,ledger time:1,txn_count:11081,txn_success:11081,txn_failure:0
ledger index:198,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:199,ledger time:3,txn_count:10746,txn_success:10746,txn_failure:0
```

图 13　订阅区块结果

图 14　节点资源监控

1.3 结果分析

从上图 12，13，14 分析出，使用软国密 POP 算法下的 100 万 payment 交易的共识 TPS 为 5813.95/s，交易落块响应时间在 1-5s 之间,交易成功率为 100%，节点资源机器的使用率从开始接收交易到交易发送结束期间，CPU 使用最大为 67%，内存使用和释放正常不存在泄露问题。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 16:52:22 CST 2021 (1619513542872)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  47414 in 00:00:07 = 7014.9/s Avg:     5 Min:     0 Max:   218 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 211182 in 00:00:30 = 7039.4/s Avg:     7 Min:     0 Max:   327 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 258596 in 00:00:37 = 7034.9/s Avg:     6 Min:     0 Max:   327 Err:     0 (0.00%)
summary + 208362 in 00:00:30 = 6943.1/s Avg:     9 Min:     0 Max:   409 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 466958 in 00:01:07 = 6993.6/s Avg:     8 Min:     0 Max:   409 Err:     0 (0.00%)
summary + 208365 in 00:00:30 = 6947.8/s Avg:    11 Min:     0 Max:   902 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 675323 in 00:01:37 = 6979.4/s Avg:     9 Min:     0 Max:   902 Err:     0 (0.00%)
summary + 211849 in 00:00:30 = 7061.6/s Avg:    12 Min:     0 Max:   334 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 887172 in 00:02:07 = 6998.9/s Avg:    10 Min:     0 Max:   902 Err:     0 (0.00%)
summary + 112828 in 00:00:16 = 6949.2/s Avg:    11 Min:     0 Max:   322 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:23 = 6993.2/s Avg:    10 Min:     0 Max:   902 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 16:54:46 CST 2021 (1619513686237)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 154
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 6493.50/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 15　发送和共识结果

```
INFO: Connecting to ws://172.16.144.180:6006
connect success
ledger index:101,ledger time:0,txn_count:349,txn_success:349,txn_failure:0
ledger index:102,ledger time:1,txn_count:3385,txn_success:3385,txn_failure:0
ledger index:103,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:104,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:105,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:106,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:107,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:108,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:109,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:110,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:111,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:112,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:113,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:114,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:115,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:116,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:117,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:118,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:119,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:120,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:121,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:122,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:123,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:124,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:125,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:126,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:127,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:128,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:129,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:130,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:131,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:132,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:133,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:134,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:135,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:136,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:137,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:138,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:139,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:140,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:141,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:142,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:143,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:144,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:145,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:146,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:147,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:148,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:149,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:150,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:151,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:152,ledger time:2,txn_count:16266,txn_success:16266,txn_failure:0
```

图 16 订阅区块结果

图 17 节点资源监控

1.3 结果分析

从上图 15，16，17 图看出，软国密 POP 算法下的 Insertment 接口的 100 万交易共识的

TPS 为 6493/s,交易上链完成的响应时间大概为 2-4s，交易成功率 100%，节点机器资源使用正常。

(2) HOTSTUFF 算法

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 17:51:59 CST 2021 (1619517119543)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:02 =    0.5/s Avg:     7 Min:     7 Max:     7 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary + 204012 in 00:00:28 = 7235.8/s Avg:    11 Min:     0 Max:  1211 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 204013 in 00:00:30 = 6782.3/s Avg:    11 Min:     0 Max:  1211 Err:     0 (0.00%)
summary + 179988 in 00:00:30 = 5999.6/s Avg:    16 Min:     0 Max:  1369 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 384001 in 00:01:00 = 6391.5/s Avg:    13 Min:     0 Max:  1369 Err:     0 (0.00%)
summary + 187396 in 00:00:30 = 6246.5/s Avg:    15 Min:     1 Max:  1590 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 571397 in 00:01:30 = 6343.2/s Avg:    14 Min:     0 Max:  1590 Err:     0 (0.00%)
summary + 180815 in 00:00:30 = 6026.8/s Avg:    16 Min:     0 Max:  1584 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 752212 in 00:02:00 = 6264.2/s Avg:    14 Min:     0 Max:  1590 Err:     0 (0.00%)
summary + 180197 in 00:00:30 = 6007.0/s Avg:    16 Min:     0 Max:  1313 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 932409 in 00:02:30 = 6212.7/s Avg:    15 Min:     0 Max:  1590 Err:     0 (0.00%)
summary +  67591 in 00:00:13 = 5315.0/s Avg:    16 Min:     0 Max:  1461 Err:     0 (0.00%) Active: 0 Started: 100 Finished:
100
summary = 1000000 in 00:02:43 = 6142.6/s Avg:    15 Min:     0 Max:  1590 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 17:54:42 CST 2021 (1619517282717)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 161
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 6211.18/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 18 发送和共识结果图

```
root@iz0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 5:51:51 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.180:6006
connect success
ledger index:38,ledger time:0,txn_count:3674,txn_success:3674,txn_failure:0
ledger index:39,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:40,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:41,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:42,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:43,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:44,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:45,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:46,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:47,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:48,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:49,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:50,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:51,ledger time:3,txn_count:19437,txn_success:19437,txn_failure:0
ledger index:52,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:53,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:54,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:55,ledger time:3,txn_count:16353,txn_success:16353,txn_failure:0
ledger index:56,ledger time:4,txn_count:15367,txn_success:15367,txn_failure:0
ledger index:57,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:58,ledger time:3,txn_count:16342,txn_success:16342,txn_failure:0
ledger index:59,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:60,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:61,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:62,ledger time:3,txn_count:15228,txn_success:15228,txn_failure:0
ledger index:63,ledger time:3,txn_count:18957,txn_success:18957,txn_failure:0
ledger index:64,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:65,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:66,ledger time:3,txn_count:19936,txn_success:19936,txn_failure:0
ledger index:67,ledger time:3,txn_count:17684,txn_success:17684,txn_failure:0
ledger index:68,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:69,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:70,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:71,ledger time:3,txn_count:14332,txn_success:14332,txn_failure:0
ledger index:72,ledger time:3,txn_count:15365,txn_success:15365,txn_failure:0
ledger index:73,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:74,ledger time:3,txn_count:18211,txn_success:18211,txn_failure:0
ledger index:75,ledger time:3,txn_count:16806,txn_success:16806,txn_failure:0
ledger index:76,ledger time:3,txn_count:13148,txn_success:13148,txn_failure:0
ledger index:77,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:78,ledger time:3,txn_count:14491,txn_success:14491,txn_failure:0
ledger index:79,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:80,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:81,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:82,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:83,ledger time:3,txn_count:18818,txn_success:18818,txn_failure:0
ledger index:84,ledger time:4,txn_count:16376,txn_success:16376,txn_failure:0
ledger index:85,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:86,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:87,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:88,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:89,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:90,ledger time:3,txn_count:16357,txn_success:16357,txn_failure:0
ledger index:91,ledger time:2,txn_count:13118,txn_success:13118,txn_failure:0
```

图 19 订阅区域结果

图 20 节点资源监控图

1.3 结果分析

从图 18，19，20 分析出，软国密的 hotstuff 算法下的 payment 接口 100 万全部上链，上链成功率为 100%，交易共识 6211.18/s， 交易上链落块的响应时间为 2-5s，节点机器资源使用正常。

2. InsertMent 用例

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 16:09:47 CST 2021 (1619510987220)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 115621 in 00:00:12 = 9332.6/s Avg:     8 Min:     0 Max:   502 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 246746 in 00:00:30 = 8224.9/s Avg:    11 Min:     1 Max:   576 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 362367 in 00:00:42 = 8548.6/s Avg:    10 Min:     0 Max:   576 Err:     0 (0.00%)
summary + 233599 in 00:00:30 = 7786.6/s Avg:    12 Min:     1 Max:   602 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 595966 in 00:01:12 = 8232.8/s Avg:    11 Min:     0 Max:   602 Err:     0 (0.00%)
summary + 217953 in 00:00:30 = 7265.1/s Avg:    13 Min:     1 Max:   783 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 813919 in 00:01:42 = 7949.3/s Avg:    11 Min:     0 Max:   783 Err:     0 (0.00%)
summary + 186081 in 00:00:28 = 6707.8/s Avg:    13 Min:     0 Max:   597 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:10 = 7684.6/s Avg:    12 Min:     0 Max:   783 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 16:11:57 CST 2021 (1619511117741)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 149
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 6711.40/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 21 发送和共识结果图

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 4:08:01 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.180:6006
connect success
ledger index:46,ledger time:0,txn_count:14336,txn_success:14336,txn_failure:0
ledger index:47,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:48,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:49,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:50,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:51,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:52,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:53,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:54,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:55,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:56,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:57,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:58,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:59,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:60,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:61,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:62,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:63,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:64,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:65,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:66,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:67,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:68,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:69,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:70,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:71,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:72,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:73,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:74,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:75,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:76,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:77,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:78,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:79,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:80,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:81,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:82,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:83,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:84,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:85,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
```

图 22 订阅区块图

图 23 节点资源监控图

1.3 结果分析

从图 21，22，23 分析出，软国密的 hotstuff 算法下的 insertment 接口 100 万全部上链，上链成功率为 100%，交易共识 6711.40/s， 交易上链落块的响应时间为 3-4s，节点机器资源使用正常。

6.1.3 4 个节点(不同区域)

1.节点区域配置

节点机器区域	节点个数	机器基本配置
上海	1	阿里云机器, 8c16g ， 带宽 100M, ubuntu18
深圳	1	阿里云机器, 8c16g ， 带宽 100M, ubuntu18
乌兰	2	阿里云机器, 8c16g ， 带宽 100M, ubuntu18

2.用例设计和执行结果

(1) POP 算法

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS， 响应时间

1.2 测试结果

```
root@iZ0j12gw5mur9c8yz5x9aeZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 11:40:34 CST 2021 (1619667634631)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:00 =    5.9/s Avg:    15 Min:    15 Max:    15 Err:     0 (0.00%) Active: 4 Started: 4 Finished: 0
summary + 134197 in 00:00:25 = 5365.9/s Avg:     8 Min:     0 Max:  2013 Err:     1 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 134198 in 00:00:25 = 5329.8/s Avg:     8 Min:     0 Max:  2013 Err:     1 (0.00%)
summary + 165102 in 00:00:30 = 5523.5/s Avg:     8 Min:     0 Max:  1323 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 299300 in 00:00:55 = 5434.9/s Avg:     8 Min:     0 Max:  2013 Err:     1 (0.00%)
summary + 159088 in 00:00:30 = 5311.4/s Avg:     9 Min:     0 Max:  1492 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 458388 in 00:01:25 = 5391.4/s Avg:     8 Min:     0 Max:  2013 Err:     1 (0.00%)
summary + 148406 in 00:00:30 = 4946.9/s Avg:     9 Min:     0 Max:  1380 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 606794 in 00:01:55 = 5275.5/s Avg:     9 Min:     0 Max:  2013 Err:     1 (0.00%)
summary + 158341 in 00:00:30 = 5278.0/s Avg:     9 Min:     0 Max:  1495 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 765135 in 00:02:25 = 5276.0/s Avg:     9 Min:     0 Max:  2013 Err:     1 (0.00%)
summary + 171911 in 00:00:30 = 5728.5/s Avg:     8 Min:     0 Max:  2022 Err:     1 (0.00%) Active: 45 Started: 50 Finished: 5
summary = 937046 in 00:02:55 = 5353.6/s Avg:     9 Min:     0 Max:  2022 Err:     2 (0.00%)
summary +  62954 in 00:00:14 = 4478.2/s Avg:     6 Min:     0 Max:  1497 Err:     0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:03:09 = 5288.5/s Avg:     8 Min:     0 Max:  2022 Err:     2 (0.00%)
Tidying up ...    @ Thu Apr 29 11:43:44 CST 2021 (1619667824069)
... end of run
root@iZ0j12gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 190
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 5263.15/s
root@iZ0j12gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 24 发送和共识结果

图 25 节点资源监控图

1.3 结果分析

从上图 24，25，节点分布在不同区域时，100 万笔交易交易的共识 TPS 为 5263/s ,交易成功率为 100%，节点机器 CPU 最大使用了 65%，交易发送和共识结束后机器资源恢复正常。

2. Insertment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 11:29:14 CST 2021 (1619666954890)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 103279 in 00:00:15 = 6993.4/s Avg:     6 Min:     0 Max:  1267 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary + 216729 in 00:00:30 = 7224.3/s Avg:     6 Min:     0 Max:  3356 Err:     6 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 320008 in 00:00:45 = 7148.1/s Avg:     6 Min:     0 Max:  3356 Err:     6 (0.00%)
summary + 208094 in 00:00:30 = 6936.5/s Avg:     7 Min:     0 Max:  1267 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 528102 in 00:01:15 = 7063.2/s Avg:     6 Min:     0 Max:  3356 Err:     6 (0.00%)
summary + 187733 in 00:00:30 = 6257.8/s Avg:     7 Min:     0 Max:  1285 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 715835 in 00:01:45 = 6832.6/s Avg:     7 Min:     0 Max:  3356 Err:     6 (0.00%)
summary + 184940 in 00:00:30 = 6164.7/s Avg:     8 Min:     0 Max:  1207 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 900775 in 00:02:15 = 6683.9/s Avg:     7 Min:     0 Max:  3356 Err:     6 (0.00%)
summary +  99225 in 00:00:17 = 5960.5/s Avg:     6 Min:     0 Max:  1083 Err:     0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:02:31 = 6604.3/s Avg:     7 Min:     0 Max:  3356 Err:     6 (0.00%)
Tidying up ...    @ Thu Apr 29 11:31:46 CST 2021 (1619667106648)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 166
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 6024.09/s
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 26 发送和共识结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh testSubLedger.sh
Apr 29, 2021 11:29:03 AM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.198:6006
connect success
ledger index:76,ledger time:0,txn_count:529,txn_success:529,txn_failure:0
ledger index:77,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:78,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:79,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:80,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:81,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:82,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:83,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:84,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:85,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:86,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:87,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:88,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:89,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:90,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:91,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:92,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:93,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:94,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:95,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:96,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:97,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:98,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:99,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:100,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:101,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:102,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:103,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:104,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:105,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:106,ledger time:3,txn_count:19945,txn_success:19945,txn_failure:0
ledger index:107,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:108,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:109,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:110,ledger time:4,txn_count:19937,txn_success:19937,txn_failure:0
ledger index:111,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:112,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:113,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:114,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:115,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:116,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:117,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:118,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:119,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:120,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:121,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:122,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:123,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:124,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:125,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:126,ledger time:2,txn_count:19589,txn_success:19589,txn_failure:0
^C
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 27 订阅区块结果

图 28 节点机器资源监控

1.3 结果分析

从图 26，27，28 上看，节点分布在不同区域 POP 算法的 Insertment 接口 100 万笔交易共识的 TPS 为 6024/s,交易成功率为 100%，交易上链落块的响应时间为 2-4s，节点机器资源使用正常。

6.1.4 4 个节点(高配机器)

(1) 节点机器配置

测试机型	硬件指标	操作系统	用途
阿里云机器	CPU:16C 内存:32G 磁盘:540G 带宽:100M	Ubuntu18.04	搭建 chainsql 节点

(2) POP 算法

1.Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ2ze0t3594oxfqc0sevtyZ:~/testChainsql# sh runJmeter.sh
runJmeter.sh: 5: runJmeter.sh: -l: not found
root@iZ2ze0t3594oxfqc0sevtyZ:~/testChainsql# Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Wed May 12 10:53:07 CST 2021 (1620787987715)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 325209 in 00:00:22 = 14715.3/s Avg:     6 Min:     0 Max:   334 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 413416 in 00:00:30 = 13737.5/s Avg:     7 Min:     0 Max:   479 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 738625 in 00:00:52 = 14151.5/s Avg:     6 Min:     0 Max:   479 Err:     0 (0.00%)
summary + 261375 in 00:00:21 = 12523.4/s Avg:     7 Min:     0 Max:   338 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:01:13 = 13686.4/s Avg:     7 Min:     0 Max:   479 Err:     0 (0.00%)
Tidying up ...    @ Wed May 12 10:54:20 CST 2021 (1620788060965)
... end of run
^C
root@iZ2ze0t3594oxfqc0sevtyZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 102
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 9803.92/s
root@iZ2ze0t3594oxfqc0sevtyZ:~/testChainsql#
```

图 29 发送和共识结果

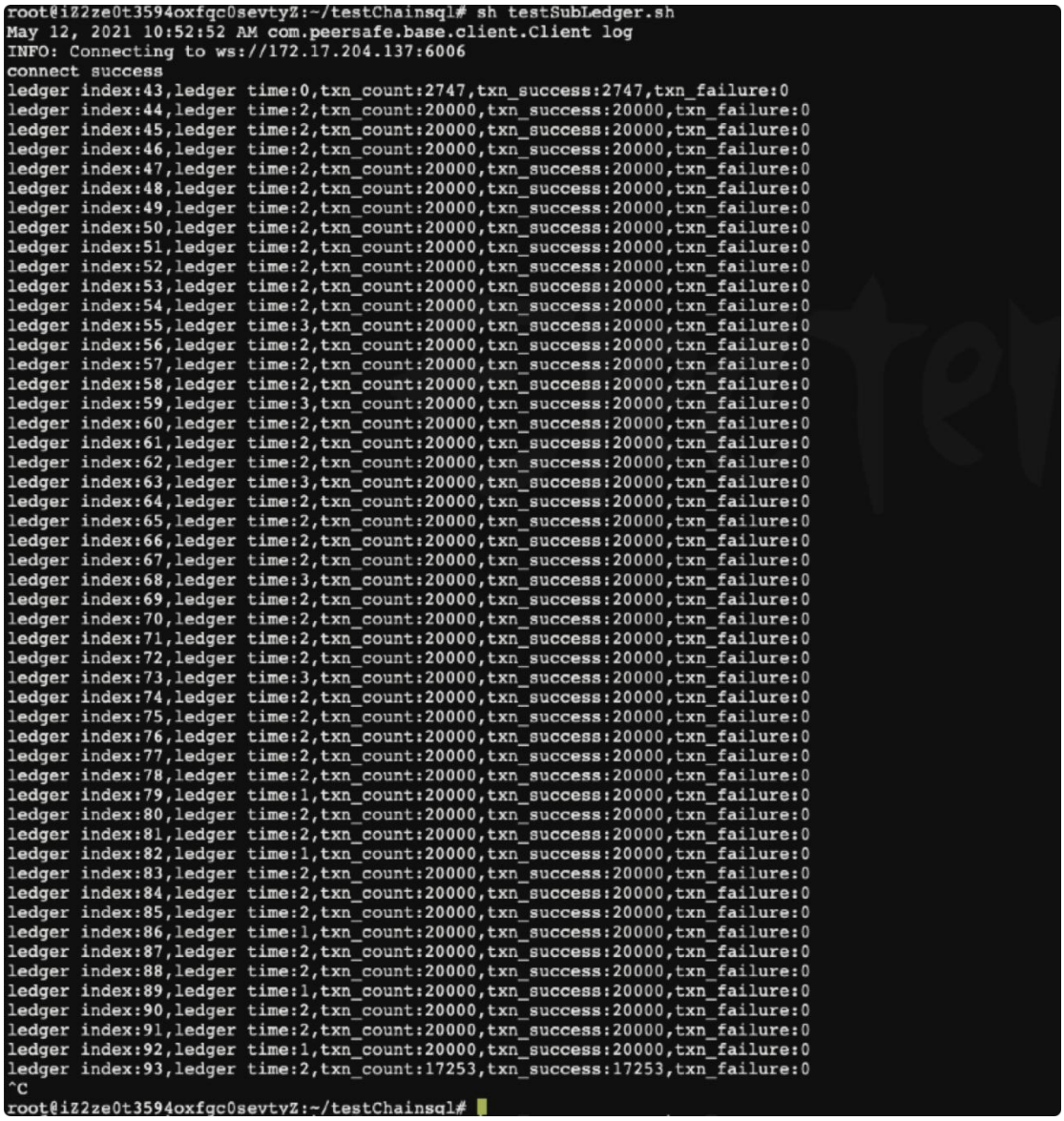


图 30 订阅区域结果

1.2 测试结果

从图 29,30 看出, 16c32G 的机器上发送 100 万插入交易，**共识 TPS 可高达 9802.92/s，成功率为 100%。**

(3) HOTSTUFF 算法

1.Insertment 用例

1.1 用例设计

场景	运行场景设置	测试点
insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

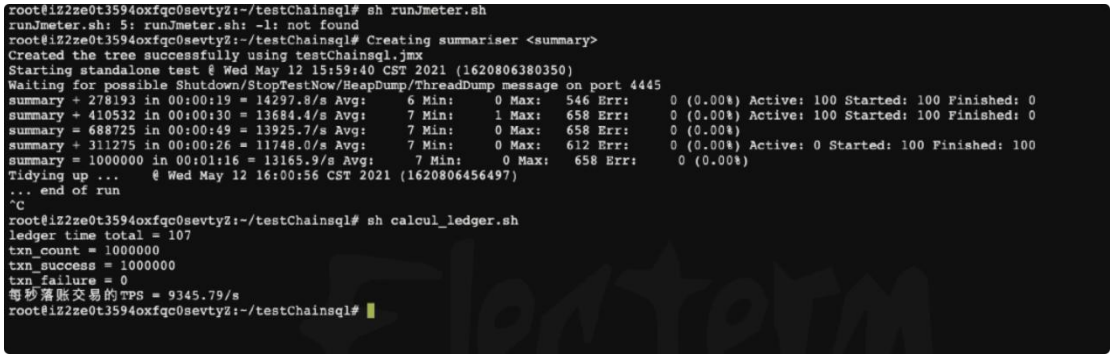


图 31 发送和共识结果

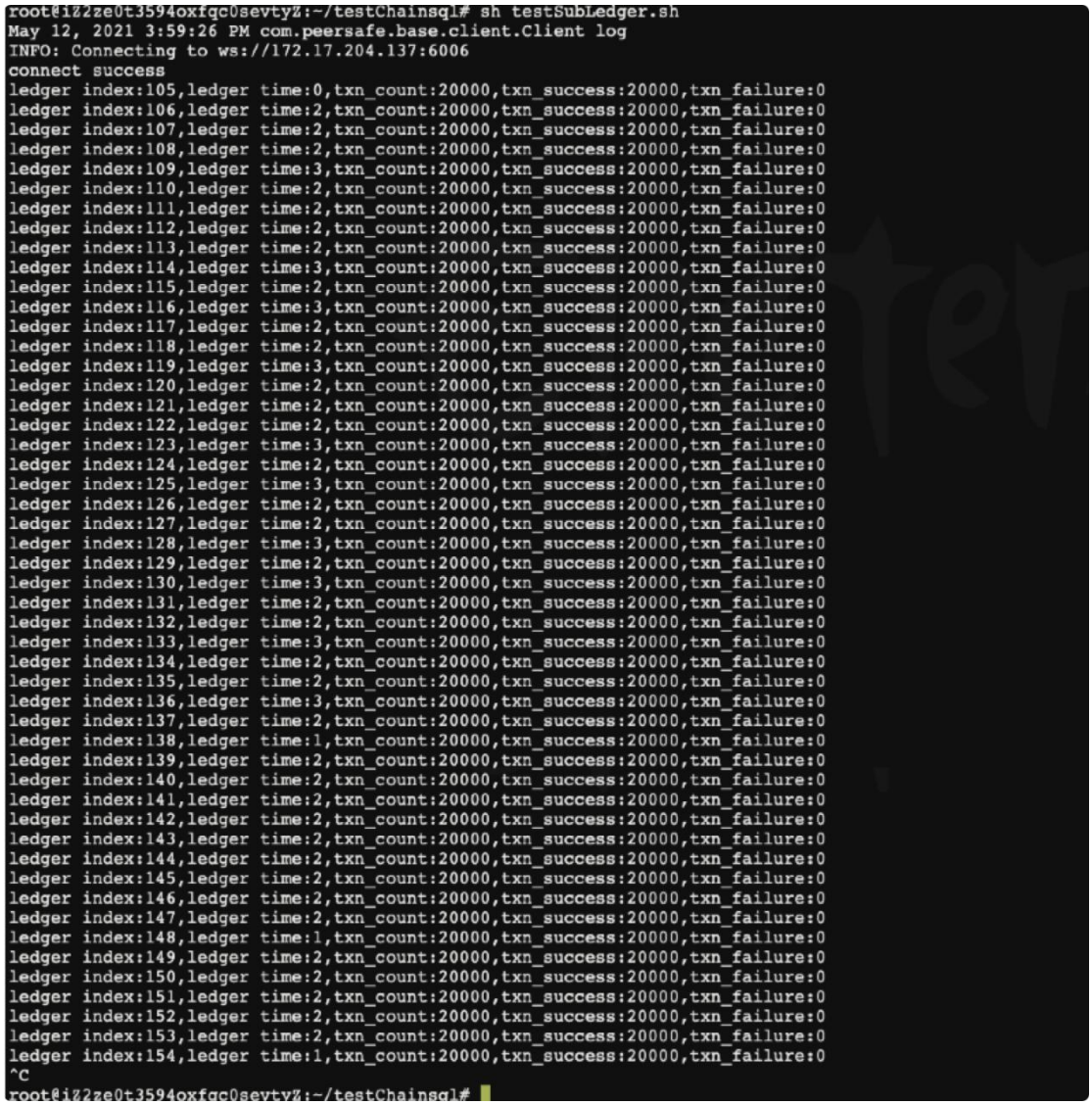


图 32 发送和共识结果

1.3 测试结果

从图 31、32 图可看出，使用 hotstuff 算法时发送 100 万笔插入交易，**共识 TPS 可达到 9345.79/s，区块落块时间为 1-3s 基本交易响应完成；交易成功率为 100%。**

6.1.4 10 个节点

(1) POP 算法

1.Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 20:15:23 CST 2021 (1619525723669)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  43043 in 00:00:06 = 7247.5/s Avg:     8 Min:     0 Max:   467 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 172327 in 00:00:30 = 5744.2/s Avg:    17 Min:     0 Max:  1180 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 215370 in 00:00:36 = 5992.7/s Avg:    15 Min:     0 Max:  1180 Err:     0 (0.00%)
summary + 213934 in 00:00:30 = 7131.1/s Avg:    13 Min:     0 Max:  1262 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 429304 in 00:01:06 = 6510.6/s Avg:    14 Min:     0 Max:  1262 Err:     0 (0.00%)
summary + 141739 in 00:00:30 = 4724.6/s Avg:    20 Min:     1 Max:  1077 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 571043 in 00:01:36 = 5952.1/s Avg:    16 Min:     0 Max:  1262 Err:     0 (0.00%)
summary + 143036 in 00:00:30 = 4767.9/s Avg:    20 Min:     1 Max:   611 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 714079 in 00:02:06 = 5670.0/s Avg:    17 Min:     0 Max:  1262 Err:     0 (0.00%)
summary + 162014 in 00:00:30 = 5400.5/s Avg:    18 Min:     1 Max:   630 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 876093 in 00:02:36 = 5618.2/s Avg:    17 Min:     0 Max:  1262 Err:     0 (0.00%)
summary + 123907 in 00:00:24 = 5264.3/s Avg:    18 Min:     1 Max:   908 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:59 = 5571.7/s Avg:    17 Min:     0 Max:  1262 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 20:18:23 CST 2021 (1619525903538)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 181
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 5524.86/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 33 发送和共识结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 8:15:06 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.177:6006
connect success
ledger index:138,ledger time:0,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:139,ledger time:3,txn_count:18189,txn_success:18189,txn_failure:0
ledger index:140,ledger time:2,txn_count:19079,txn_success:19079,txn_failure:0
ledger index:141,ledger time:3,txn_count:16242,txn_success:16242,txn_failure:0
ledger index:142,ledger time:1,txn_count:7787,txn_success:7787,txn_failure:0
ledger index:143,ledger time:3,txn_count:17724,txn_success:17724,txn_failure:0
ledger index:144,ledger time:3,txn_count:19689,txn_success:19689,txn_failure:0
ledger index:145,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:146,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:147,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:148,ledger time:2,txn_count:18897,txn_success:18897,txn_failure:0
ledger index:149,ledger time:2,txn_count:8145,txn_success:8145,txn_failure:0
ledger index:150,ledger time:1,txn_count:7622,txn_success:7622,txn_failure:0
ledger index:151,ledger time:1,txn_count:6192,txn_success:6192,txn_failure:0
ledger index:152,ledger time:2,txn_count:5127,txn_success:5127,txn_failure:0
ledger index:153,ledger time:1,txn_count:4953,txn_success:4953,txn_failure:0
ledger index:154,ledger time:1,txn_count:4525,txn_success:4525,txn_failure:0
ledger index:155,ledger time:10,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:156,ledger time:7,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:157,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:158,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:159,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:160,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:161,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:162,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:163,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:164,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:165,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:166,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:167,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:168,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:169,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:170,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:171,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:172,ledger time:3,txn_count:15438,txn_success:15438,txn_failure:0
ledger index:173,ledger time:2,txn_count:7566,txn_success:7566,txn_failure:0
ledger index:174,ledger time:1,txn_count:5424,txn_success:5424,txn_failure:0
ledger index:175,ledger time:3,txn_count:11145,txn_success:11145,txn_failure:0
ledger index:176,ledger time:1,txn_count:12175,txn_success:12175,txn_failure:0
ledger index:177,ledger time:2,txn_count:6158,txn_success:6158,txn_failure:0
ledger index:178,ledger time:1,txn_count:8950,txn_success:8950,txn_failure:0
ledger index:179,ledger time:1,txn_count:2979,txn_success:2979,txn_failure:0
ledger index:180,ledger time:1,txn_count:3907,txn_success:3907,txn_failure:0
ledger index:181,ledger time:1,txn_count:3589,txn_success:3589,txn_failure:0
ledger index:182,ledger time:1,txn_count:467,txn_success:467,txn_failure:0
ledger index:183,ledger time:1,txn_count:3197,txn_success:3197,txn_failure:0
ledger index:184,ledger time:1,txn_count:3606,txn_success:3606,txn_failure:0
ledger index:185,ledger time:1,txn_count:7649,txn_success:7649,txn_failure:0
ledger index:186,ledger time:1,txn_count:7531,txn_success:7531,txn_failure:0
ledger index:187,ledger time:1,txn_count:6144,txn_success:6144,txn_failure:0
ledger index:188,ledger time:2,txn_count:9566,txn_success:9566,txn_failure:0
ledger index:189,ledger time:1,txn_count:7790,txn_success:7790,txn_failure:0
ledger index:190,ledger time:2,txn_count:10969,txn_success:10969,txn_failure:0
ledger index:191,ledger time:2,txn_count:10660,txn_success:10660,txn_failure:0
ledger index:192,ledger time:3,txn_count:11784,txn_success:11784,txn_failure:0
ledger index:193,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:194,ledger time:2,txn_count:16953,txn_success:16953,txn_failure:0
ledger index:195,ledger time:3,txn_count:12693,txn_success:12693,txn_failure:0
ledger index:196,ledger time:2,txn_count:8164,txn_success:8164,txn_failure:0
ledger index:197,ledger time:1,txn_count:3747,txn_success:3747,txn_failure:0
ledger index:198,ledger time:1,txn_count:3150,txn_success:3150,txn_failure:0
ledger index:199,ledger time:1,txn_count:4453,txn_success:4453,txn_failure:0
ledger index:200,ledger time:1,txn_count:6175,txn_success:6175,txn_failure:0
ledger index:201,ledger time:1,txn_count:7890,txn_success:7890,txn_failure:0
ledger index:202,ledger time:1,txn_count:6257,txn_success:6257,txn_failure:0
ledger index:203,ledger time:2,txn_count:8023,txn_success:8023,txn_failure:0
ledger index:204,ledger time:1,txn_count:5973,txn_success:5973,txn_failure:0
ledger index:205,ledger time:1,txn_count:6022,txn_success:6022,txn_failure:0
ledger index:206,ledger time:1,txn_count:4372,txn_success:4372,txn_failure:0
ledger index:207,ledger time:1,txn_count:4273,txn_success:4273,txn_failure:0
ledger index:208,ledger time:1,txn_count:7367,txn_success:7367,txn_failure:0
ledger index:209,ledger time:1,txn_count:6972,txn_success:6972,txn_failure:0
ledger index:210,ledger time:2,txn_count:8595,txn_success:8595,txn_failure:0
ledger index:211,ledger time:1,txn_count:8476,txn_success:8476,txn_failure:0
ledger index:212,ledger time:1,txn_count:3713,txn_success:3713,txn_failure:0
ledger index:213,ledger time:1,txn_count:4955,txn_success:4955,txn_failure:0
ledger index:214,ledger time:1,txn_count:2656,txn_success:2656,txn_failure:0
ledger index:215,ledger time:1,txn_count:5775,txn_success:5775,txn_failure:0
ledger index:216,ledger time:1,txn_count:3702,txn_success:3702,txn_failure:0
ledger index:217,ledger time:1,txn_count:2915,txn_success:2915,txn_failure:0
ledger index:218,ledger time:1,txn_count:5759,txn_success:5759,txn_failure:0
ledger index:219,ledger time:2,txn_count:12005,txn_success:12005,txn_failure:0
ledger index:220,ledger time:2,txn_count:15419,txn_success:15419,txn_failure:0
ledger index:221,ledger time:2,txn_count:13083,txn_success:13083,txn_failure:0
ledger index:222,ledger time:2,txn_count:8299,txn_success:8299,txn_failure:0
ledger index:223,ledger time:1,txn_count:7269,txn_success:7269,txn_failure:0
ledger index:224,ledger time:1,txn_count:140,txn_success:140,txn_failure:0
ledger index:225,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:226,ledger time:2,txn_count:13890,txn_success:13890,txn_failure:0
```

图 34 订阅区块结果

图 35 节点机器资源监控

1.3 结果分析

从图 33，34，35 来看，10 个节点组链 POP 算法下的 payment 接口 100 万笔交易共识的 TPS 为 5524.86/s，交易的落块中出现了一个 10s 的区块，大多数交易都能在 2-3s 就落块，从订阅区块结果图中分析落块时间，用户等待体验基本能接受；节点机器资源使用率正常。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 20:24:38 CST 2021 (1619526278935)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 159550 in 00:00:21 = 7710.0/s Avg:    11 Min:     0 Max:   366 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 210712 in 00:00:30 = 7023.7/s Avg:    14 Min:     0 Max:   344 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 370262 in 00:00:51 = 7303.9/s Avg:    12 Min:     0 Max:   366 Err:     0 (0.00%)
summary + 190842 in 00:00:30 = 6361.2/s Avg:    15 Min:     1 Max:   372 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 561104 in 00:01:21 = 6953.4/s Avg:    13 Min:     0 Max:   372 Err:     0 (0.00%)
summary + 205909 in 00:00:30 = 6863.9/s Avg:    14 Min:     1 Max:   339 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 767013 in 00:01:51 = 6929.1/s Avg:    13 Min:     0 Max:   372 Err:     0 (0.00%)
summary + 174262 in 00:00:30 = 5808.7/s Avg:    17 Min:     1 Max:   564 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 941275 in 00:02:21 = 6690.2/s Avg:    14 Min:     0 Max:   564 Err:     0 (0.00%)
summary +  58725 in 00:00:13 = 4648.5/s Avg:    19 Min:     1 Max:   456 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:33 = 6522.0/s Avg:    14 Min:     0 Max:   564 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 20:27:12 CST 2021 (1619526432633)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 177
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 5649.71/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 36 发送和共识结果

```
root@120j10b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 8:24:30 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.177:6006
connect success
ledger index:146,ledger time:0,txn_count:744,txn_success:744,txn_failure:0
ledger index:147,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:148,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:149,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:150,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:151,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:152,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:153,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:154,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:155,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:156,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:157,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:158,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:159,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:160,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:161,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:162,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:163,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:164,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:165,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:166,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:167,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:168,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:169,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:170,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:171,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:172,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:173,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:174,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:175,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:176,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:177,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:178,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:179,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:180,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:181,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
```

图 37 订阅区块结果

图 38 节点机器资源监控

2.3 结果分析

从图 36、37、38 中看出 10 个节点时 POP 算法下 100 万笔 InsertMent 交易共识 TPS 为 5649.71/s，交易落块时间 3-6s，交易成功率为 100%，节点资源使用正常。

(2) HOTSTUFF 算法

1.Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 20:42:29 CST 2021 (1619527349877)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:01 =    0.7/s Avg:     6 Min:     6 Max:     6 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 161763 in 00:00:28 = 5704.7/s Avg:    12 Min:     0 Max:   880 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 161764 in 00:00:30 = 5439.6/s Avg:    12 Min:     0 Max:   880 Err:     0 (0.00%)
summary + 164093 in 00:00:30 = 5469.8/s Avg:    16 Min:     0 Max:  1211 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 325857 in 00:01:00 = 5454.8/s Avg:    14 Min:     0 Max:  1211 Err:     0 (0.00%)
summary + 159056 in 00:00:30 = 5301.9/s Avg:    18 Min:     0 Max:  1254 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 484913 in 00:01:30 = 5403.7/s Avg:    15 Min:     0 Max:  1254 Err:     0 (0.00%)
summary + 162339 in 00:00:30 = 5411.3/s Avg:    18 Min:     1 Max:  1220 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 647252 in 00:02:00 = 5405.6/s Avg:    16 Min:     0 Max:  1254 Err:     0 (0.00%)
summary + 174317 in 00:00:30 = 5791.6/s Avg:    10 Min:     0 Max:  1379 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 821569 in 00:02:30 = 5483.1/s Avg:    15 Min:     0 Max:  1379 Err:     0 (0.00%)
summary + 167645 in 00:00:30 = 5606.5/s Avg:     5 Min:     0 Max:   690 Err: 57416 (34.25%) Active: 100 Started: 100 Finished: 0
summary = 989214 in 00:03:00 = 5503.6/s Avg:    13 Min:     0 Max:  1379 Err: 57416 (5.80%)
summary +  10786 in 00:00:02 = 4689.6/s Avg:     3 Min:     0 Max:   163 Err: 10786 (100.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:03:02 = 5493.4/s Avg:    13 Min:     0 Max:  1379 Err: 68202 (6.82%)
Tidying up ...    @ Tue Apr 27 20:45:32 CST 2021 (1619527532300)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 168
txn_count = 931798
txn_success = 931798
txn_failure = 0
每秒落账交易的TPS = 5546.41/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 39 发送和共识结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 8:42:15 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.177:6006
connect success
ledger index:55,ledger time:0,txn_count:16745,txn_success:16745,txn_failure:0
ledger index:56,ledger time:3,txn_count:19318,txn_success:19318,txn_failure:0
ledger index:57,ledger time:3,txn_count:17315,txn_success:17315,txn_failure:0
ledger index:58,ledger time:3,txn_count:16559,txn_success:16559,txn_failure:0
ledger index:59,ledger time:3,txn_count:16434,txn_success:16434,txn_failure:0
ledger index:60,ledger time:3,txn_count:16417,txn_success:16417,txn_failure:0
ledger index:61,ledger time:3,txn_count:11609,txn_success:11609,txn_failure:0
ledger index:62,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:63,ledger time:3,txn_count:17623,txn_success:17623,txn_failure:0
ledger index:64,ledger time:3,txn_count:14603,txn_success:14603,txn_failure:0
ledger index:65,ledger time:3,txn_count:17498,txn_success:17498,txn_failure:0
ledger index:66,ledger time:3,txn_count:15852,txn_success:15852,txn_failure:0
ledger index:67,ledger time:3,txn_count:14127,txn_success:14127,txn_failure:0
ledger index:68,ledger time:3,txn_count:14507,txn_success:14507,txn_failure:0
ledger index:69,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:70,ledger time:3,txn_count:15521,txn_success:15521,txn_failure:0
ledger index:71,ledger time:4,txn_count:18937,txn_success:18937,txn_failure:0
ledger index:72,ledger time:3,txn_count:16105,txn_success:16105,txn_failure:0
ledger index:73,ledger time:3,txn_count:18750,txn_success:18750,txn_failure:0
ledger index:74,ledger time:3,txn_count:18715,txn_success:18715,txn_failure:0
ledger index:75,ledger time:3,txn_count:14877,txn_success:14877,txn_failure:0
ledger index:76,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:77,ledger time:3,txn_count:14624,txn_success:14624,txn_failure:0
ledger index:78,ledger time:3,txn_count:12186,txn_success:12186,txn_failure:0
ledger index:79,ledger time:3,txn_count:15923,txn_success:15923,txn_failure:0
ledger index:80,ledger time:3,txn_count:17194,txn_success:17194,txn_failure:0
ledger index:81,ledger time:4,txn_count:15095,txn_success:15095,txn_failure:0
ledger index:82,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:83,ledger time:3,txn_count:16802,txn_success:16802,txn_failure:0
ledger index:84,ledger time:3,txn_count:11675,txn_success:11675,txn_failure:0
ledger index:85,ledger time:1,txn_count:8248,txn_success:8248,txn_failure:0
ledger index:86,ledger time:3,txn_count:10890,txn_success:10890,txn_failure:0
ledger index:87,ledger time:3,txn_count:16755,txn_success:16755,txn_failure:0
ledger index:88,ledger time:3,txn_count:16760,txn_success:16760,txn_failure:0
ledger index:89,ledger time:3,txn_count:17945,txn_success:17945,txn_failure:0
ledger index:90,ledger time:3,txn_count:12831,txn_success:12831,txn_failure:0
ledger index:91,ledger time:3,txn_count:11608,txn_success:11608,txn_failure:0
ledger index:92,ledger time:3,txn_count:16650,txn_success:16650,txn_failure:0
ledger index:93,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:94,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:95,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:96,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:97,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:98,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:99,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:100,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:101,ledger time:8,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:102,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:103,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:104,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:105,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:106,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:107,ledger time:3,txn_count:19287,txn_success:19287,txn_failure:0
ledger index:108,ledger time:3,txn_count:14698,txn_success:14698,txn_failure:0
ledger index:109,ledger time:2,txn_count:11115,txn_success:11115,txn_failure:0
```

图 40 订阅区块结果

图 41 节点机器资源监控

1.3 结果分析

从图 39、40、41 结果来看，10 个节点的 HOTSTUFF 算法下的 Payment 共识 TPS 为 5546.41/s，交易成功率为 100%；交易落块响应时间大概为 2-3s ， 节点机器资源使用正常。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS， 响应时间

2.2 测试结果

```
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Tue Apr 27 19:39:10 CST 2021 (1619523550293)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 107039 in 00:00:19 = 5536.0/s Avg:     4 Min:     0 Max:   219 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 164149 in 00:00:30 = 5468.4/s Avg:     7 Min:     0 Max:   291 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 271188 in 00:00:49 = 5494.6/s Avg:     6 Min:     0 Max:   291 Err:     0 (0.00%)
summary + 164568 in 00:00:30 = 5489.3/s Avg:    10 Min:     0 Max:   243 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 435756 in 00:01:19 = 5492.6/s Avg:     7 Min:     0 Max:   291 Err:     0 (0.00%)
summary + 164123 in 00:00:30 = 5470.8/s Avg:    11 Min:     0 Max:   290 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 599879 in 00:01:49 = 5486.6/s Avg:     8 Min:     0 Max:   291 Err:     0 (0.00%)
summary + 166246 in 00:00:30 = 5541.5/s Avg:    14 Min:     0 Max:   318 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 766125 in 00:02:19 = 5498.4/s Avg:    10 Min:     0 Max:   318 Err:     0 (0.00%)
summary + 163752 in 00:00:30 = 5458.4/s Avg:    14 Min:     0 Max:   552 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 929877 in 00:02:49 = 5491.3/s Avg:    10 Min:     0 Max:   552 Err:     0 (0.00%)
summary +  70123 in 00:00:13 = 5247.9/s Avg:    14 Min:     0 Max:   300 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:03:03 = 5473.5/s Avg:    11 Min:     0 Max:   552 Err:     0 (0.00%)
Tidying up ...    @ Tue Apr 27 19:42:13 CST 2021 (1619523733362)
... end of run
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 185
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 5405.40/s
root@iZ0jl0b8uobbm4a6tpq55aZ:~/testChainsql#
```

图 42 发送和共识结果

```
root@120j10b8u0bbmq4a6tpq55az:~/testChainsql# sh testSubLedger.sh
Apr 27, 2021 7:38:48 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.177:6006
connect success
ledger index:55,ledger time:0,txn_count:12986,txn_success:12986,txn_failure:0
ledger index:56,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:57,ledger time:3,txn_count:17773,txn_success:17773,txn_failure:0
ledger index:58,ledger time:3,txn_count:16898,txn_success:16898,txn_failure:0
ledger index:59,ledger time:3,txn_count:15717,txn_success:15717,txn_failure:0
ledger index:60,ledger time:3,txn_count:17558,txn_success:17558,txn_failure:0
ledger index:61,ledger time:3,txn_count:15535,txn_success:15535,txn_failure:0
ledger index:62,ledger time:3,txn_count:16939,txn_success:16939,txn_failure:0
ledger index:63,ledger time:3,txn_count:15685,txn_success:15685,txn_failure:0
ledger index:64,ledger time:3,txn_count:17386,txn_success:17386,txn_failure:0
ledger index:65,ledger time:3,txn_count:16256,txn_success:16256,txn_failure:0
ledger index:66,ledger time:3,txn_count:16553,txn_success:16553,txn_failure:0
ledger index:67,ledger time:3,txn_count:16085,txn_success:16085,txn_failure:0
ledger index:68,ledger time:3,txn_count:15872,txn_success:15872,txn_failure:0
ledger index:69,ledger time:3,txn_count:17444,txn_success:17444,txn_failure:0
ledger index:70,ledger time:3,txn_count:16230,txn_success:16230,txn_failure:0
ledger index:71,ledger time:3,txn_count:16267,txn_success:16267,txn_failure:0
ledger index:72,ledger time:3,txn_count:16047,txn_success:16047,txn_failure:0
ledger index:73,ledger time:3,txn_count:16992,txn_success:16992,txn_failure:0
ledger index:74,ledger time:3,txn_count:13679,txn_success:13679,txn_failure:0
ledger index:75,ledger time:3,txn_count:18439,txn_success:18439,txn_failure:0
ledger index:76,ledger time:3,txn_count:15645,txn_success:15645,txn_failure:0
ledger index:77,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:78,ledger time:3,txn_count:18541,txn_success:18541,txn_failure:0
ledger index:79,ledger time:3,txn_count:16946,txn_success:16946,txn_failure:0
ledger index:80,ledger time:3,txn_count:17966,txn_success:17966,txn_failure:0
ledger index:81,ledger time:3,txn_count:15935,txn_success:15935,txn_failure:0
ledger index:82,ledger time:3,txn_count:18264,txn_success:18264,txn_failure:0
ledger index:83,ledger time:3,txn_count:14858,txn_success:14858,txn_failure:0
ledger index:84,ledger time:3,txn_count:16467,txn_success:16467,txn_failure:0
ledger index:85,ledger time:3,txn_count:16416,txn_success:16416,txn_failure:0
ledger index:86,ledger time:3,txn_count:13474,txn_success:13474,txn_failure:0
ledger index:87,ledger time:3,txn_count:17476,txn_success:17476,txn_failure:0
ledger index:88,ledger time:3,txn_count:18642,txn_success:18642,txn_failure:0
ledger index:89,ledger time:4,txn_count:19101,txn_success:19101,txn_failure:0
ledger index:90,ledger time:3,txn_count:15876,txn_success:15876,txn_failure:0
ledger index:91,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:92,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:93,ledger time:4,txn_count:19152,txn_success:19152,txn_failure:0
ledger index:94,ledger time:3,txn_count:18765,txn_success:18765,txn_failure:0
ledger index:95,ledger time:3,txn_count:18984,txn_success:18984,txn_failure:0
ledger index:96,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:97,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:98,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:99,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:100,ledger time:4,txn_count:18022,txn_success:18022,txn_failure:0
ledger index:101,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:102,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:103,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
```

图 43 订阅区块结果

图 44 节点机器资源监控

2.3 结果分析

从图 42、43、44 结果可看出，10 个节点 hotstuff 算法下 Insertment 接口 100 万笔交易共识的 TPS 为 5405.4/s ，交易落块时间为 3s 左右，节点资源使用释放正常。

6.1.5 20 个节点

(1) POP 算法

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 15:50:57 CST 2021 (1619682657224)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +   8836 in 00:00:02 = 3711.0/s Avg:     1 Min:     0 Max:    51 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary + 104937 in 00:00:30 = 3497.9/s Avg:     3 Min:     0 Max:   286 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 113773 in 00:00:32 = 3513.6/s Avg:     3 Min:     0 Max:   286 Err:     0 (0.00%)
summary + 105068 in 00:00:30 = 3502.3/s Avg:     3 Min:     0 Max:   188 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 218841 in 00:01:02 = 3508.1/s Avg:     3 Min:     0 Max:   286 Err:     0 (0.00%)
summary + 104854 in 00:00:30 = 3495.1/s Avg:     3 Min:     0 Max:   279 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 323695 in 00:01:32 = 3503.9/s Avg:     3 Min:     0 Max:   286 Err:     0 (0.00%)
summary + 105324 in 00:00:30 = 3510.8/s Avg:     4 Min:     0 Max:   172 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 429019 in 00:02:02 = 3505.6/s Avg:     3 Min:     0 Max:   286 Err:     0 (0.00%)
summary + 105155 in 00:00:30 = 3503.4/s Avg:     3 Min:     0 Max:   254 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 534174 in 00:02:32 = 3505.2/s Avg:     3 Min:     0 Max:   286 Err:     0 (0.00%)
summary + 104909 in 00:00:30 = 3498.7/s Avg:     4 Min:     0 Max:   306 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 639083 in 00:03:02 = 3504.1/s Avg:     3 Min:     0 Max:   306 Err:     0 (0.00%)
summary + 104728 in 00:00:30 = 3490.9/s Avg:     4 Min:     0 Max:   298 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 743811 in 00:03:32 = 3502.2/s Avg:     3 Min:     0 Max:   306 Err:     0 (0.00%)
summary + 105228 in 00:00:30 = 3507.6/s Avg:     4 Min:     0 Max:   163 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 849039 in 00:04:02 = 3502.9/s Avg:     3 Min:     0 Max:   306 Err:     0 (0.00%)
summary + 105399 in 00:00:30 = 3513.3/s Avg:     5 Min:     0 Max:   321 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 954438 in 00:04:32 = 3504.1/s Avg:     3 Min:     0 Max:   321 Err:     0 (0.00%)
summary +  45562 in 00:00:14 = 3250.2/s Avg:     4 Min:     0 Max:   207 Err:     0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:04:46 = 3491.6/s Avg:     3 Min:     0 Max:   321 Err:     0 (0.00%)
Tidying up ...    @ Thu Apr 29 15:55:44 CST 2021 (1619682944018)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 284
txn_count = 1000041
txn_success = 1000041
txn_failure = 0
每秒落账交易的TPS = 3521.27/s
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 45 发送和共识结果

图 46 节点机器资源监控

1.3 结果分析

从图 45、46 中可看出，20 个节点组链时 POP 算法下 100 万笔 payment 交易共识的 TPS 为 3521.27/s ， 节点资源使用正常。

3. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 15:31:00 CST 2021 (1619681460851)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:01 =    0.9/s Avg:    31 Min:    31 Max:    31 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary + 115815 in 00:00:28 = 4178.0/s Avg:     2 Min:     0 Max:   251 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 115816 in 00:00:29 = 4023.9/s Avg:     2 Min:     0 Max:   251 Err:     0 (0.00%)
summary + 120661 in 00:00:30 = 4021.9/s Avg:     3 Min:     0 Max:   176 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 236477 in 00:00:59 = 4022.9/s Avg:     3 Min:     0 Max:   251 Err:     0 (0.00%)
summary + 119350 in 00:00:30 = 3978.5/s Avg:     3 Min:     0 Max:   223 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 355827 in 00:01:29 = 4007.9/s Avg:     3 Min:     0 Max:   251 Err:     0 (0.00%)
summary + 119606 in 00:00:30 = 3986.9/s Avg:     4 Min:     0 Max:   369 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 475433 in 00:01:59 = 4002.6/s Avg:     3 Min:     0 Max:   369 Err:     0 (0.00%)
summary + 120527 in 00:00:30 = 4017.6/s Avg:     5 Min:     0 Max:   328 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 595960 in 00:02:29 = 4005.6/s Avg:     3 Min:     0 Max:   369 Err:     0 (0.00%)
summary + 119064 in 00:00:30 = 3968.7/s Avg:     6 Min:     0 Max:   742 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 715024 in 00:02:59 = 3999.4/s Avg:     4 Min:     0 Max:   742 Err:     0 (0.00%)
summary + 119957 in 00:00:30 = 3998.7/s Avg:     7 Min:     0 Max:   473 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 834981 in 00:03:29 = 3999.3/s Avg:     4 Min:     0 Max:   742 Err:     0 (0.00%)
summary + 121129 in 00:00:30 = 4037.6/s Avg:     6 Min:     0 Max:   433 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 956110 in 00:03:59 = 4004.1/s Avg:     5 Min:     0 Max:   742 Err:     0 (0.00%)
summary +  43890 in 00:00:12 = 3708.8/s Avg:     4 Min:     0 Max:   266 Err:     0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:04:11 = 3990.2/s Avg:     5 Min:     0 Max:   742 Err:     0 (0.00%)
Tidying up ...    @ Thu Apr 29 15:35:11 CST 2021 (1619681711834)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 254
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 3937.00/s
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 47 发送和共识结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh testSubLedger.sh
Apr 29, 2021 3:30:29 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.205:6006
connect success
ledger index:12,ledger time:0,txn_count:141,txn_success:141,txn_failure:0
ledger index:13,ledger time:3,txn_count:16660,txn_success:16660,txn_failure:0
ledger index:14,ledger time:3,txn_count:12099,txn_success:12099,txn_failure:0
ledger index:15,ledger time:2,txn_count:8197,txn_success:8197,txn_failure:0
ledger index:16,ledger time:3,txn_count:11607,txn_success:11607,txn_failure:0
ledger index:17,ledger time:1,txn_count:6413,txn_success:6413,txn_failure:0
ledger index:18,ledger time:1,txn_count:4730,txn_success:4730,txn_failure:0
ledger index:19,ledger time:1,txn_count:4114,txn_success:4114,txn_failure:0
ledger index:20,ledger time:2,txn_count:4852,txn_success:4852,txn_failure:0
ledger index:21,ledger time:3,txn_count:11964,txn_success:11964,txn_failure:0
ledger index:22,ledger time:3,txn_count:12104,txn_success:12104,txn_failure:0
ledger index:23,ledger time:1,txn_count:5960,txn_success:5960,txn_failure:0
ledger index:24,ledger time:3,txn_count:10510,txn_success:10510,txn_failure:0
ledger index:25,ledger time:1,txn_count:6691,txn_success:6691,txn_failure:0
ledger index:26,ledger time:3,txn_count:9129,txn_success:9129,txn_failure:0
ledger index:27,ledger time:1,txn_count:5891,txn_success:5891,txn_failure:0
ledger index:28,ledger time:1,txn_count:5446,txn_success:5446,txn_failure:0
ledger index:29,ledger time:2,txn_count:5356,txn_success:5356,txn_failure:0
ledger index:30,ledger time:1,txn_count:4022,txn_success:4022,txn_failure:0
ledger index:31,ledger time:1,txn_count:3814,txn_success:3814,txn_failure:0
ledger index:32,ledger time:1,txn_count:6455,txn_success:6455,txn_failure:0
ledger index:33,ledger time:2,txn_count:4901,txn_success:4901,txn_failure:0
ledger index:34,ledger time:1,txn_count:3671,txn_success:3671,txn_failure:0
ledger index:35,ledger time:1,txn_count:6218,txn_success:6218,txn_failure:0
ledger index:36,ledger time:1,txn_count:5943,txn_success:5943,txn_failure:0
ledger index:37,ledger time:3,txn_count:14063,txn_success:14063,txn_failure:0
ledger index:38,ledger time:3,txn_count:8965,txn_success:8965,txn_failure:0
ledger index:39,ledger time:2,txn_count:6486,txn_success:6486,txn_failure:0
ledger index:40,ledger time:2,txn_count:7534,txn_success:7534,txn_failure:0
ledger index:41,ledger time:2,txn_count:9153,txn_success:9153,txn_failure:0
ledger index:42,ledger time:3,txn_count:12285,txn_success:12285,txn_failure:0
ledger index:43,ledger time:3,txn_count:11487,txn_success:11487,txn_failure:0
ledger index:44,ledger time:2,txn_count:10207,txn_success:10207,txn_failure:0
ledger index:45,ledger time:3,txn_count:9361,txn_success:9361,txn_failure:0
ledger index:46,ledger time:3,txn_count:14078,txn_success:14078,txn_failure:0
ledger index:47,ledger time:3,txn_count:9773,txn_success:9773,txn_failure:0
ledger index:48,ledger time:2,txn_count:9710,txn_success:9710,txn_failure:0
ledger index:49,ledger time:2,txn_count:6205,txn_success:6205,txn_failure:0
ledger index:50,ledger time:2,txn_count:6952,txn_success:6952,txn_failure:0
ledger index:51,ledger time:1,txn_count:6007,txn_success:6007,txn_failure:0
ledger index:52,ledger time:2,txn_count:8730,txn_success:8730,txn_failure:0
ledger index:53,ledger time:2,txn_count:7350,txn_success:7350,txn_failure:0
ledger index:54,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:55,ledger time:6,txn_count:14872,txn_success:14872,txn_failure:0
ledger index:56,ledger time:4,txn_count:11683,txn_success:11683,txn_failure:0
ledger index:57,ledger time:3,txn_count:12356,txn_success:12356,txn_failure:0
ledger index:58,ledger time:4,txn_count:14184,txn_success:14184,txn_failure:0
ledger index:59,ledger time:3,txn_count:12677,txn_success:12677,txn_failure:0
ledger index:60,ledger time:3,txn_count:11176,txn_success:11176,txn_failure:0
ledger index:61,ledger time:2,txn_count:11185,txn_success:11185,txn_failure:0
ledger index:62,ledger time:2,txn_count:15700,txn_success:15700,txn_failure:0
ledger index:63,ledger time:5,txn_count:12979,txn_success:12979,txn_failure:0
ledger index:64,ledger time:4,txn_count:13073,txn_success:13073,txn_failure:0
ledger index:65,ledger time:3,txn_count:14228,txn_success:14228,txn_failure:0
ledger index:66,ledger time:4,txn_count:13000,txn_success:13000,txn_failure:0
ledger index:67,ledger time:3,txn_count:12113,txn_success:12113,txn_failure:0
ledger index:68,ledger time:3,txn_count:12336,txn_success:12336,txn_failure:0
ledger index:69,ledger time:3,txn_count:14664,txn_success:14664,txn_failure:0
ledger index:70,ledger time:3,txn_count:11517,txn_success:11517,txn_failure:0
ledger index:71,ledger time:5,txn_count:17572,txn_success:17572,txn_failure:0
ledger index:72,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:73,ledger time:3,txn_count:12483,txn_success:12483,txn_failure:0
ledger index:74,ledger time:2,txn_count:7824,txn_success:7824,txn_failure:0
ledger index:75,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:76,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:77,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:78,ledger time:7,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:79,ledger time:7,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:80,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:81,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:82,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:83,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:84,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:85,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:86,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:87,ledger time:5,txn_count:18881,txn_success:18881,txn_failure:0
ledger index:88,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:89,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:90,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:91,ledger time:6,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:92,ledger time:4,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:93,ledger time:5,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:94,ledger time:2,txn_count:263,txn_success:263,txn_failure:0
^C
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 48 订阅区块结果

图 49 节点机器资源监控

2.3 结果分析

从上图 47、48、49 中可看出 20 个节点下 POP 算法时 100 万笔 Insertment 交易的共识 TPS 为 3937/s，交易区块落块时间 3s 左右，交易成功率为 100%;节点机器资源使用正常。

(2) HOTSTUFF 算法

1.Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

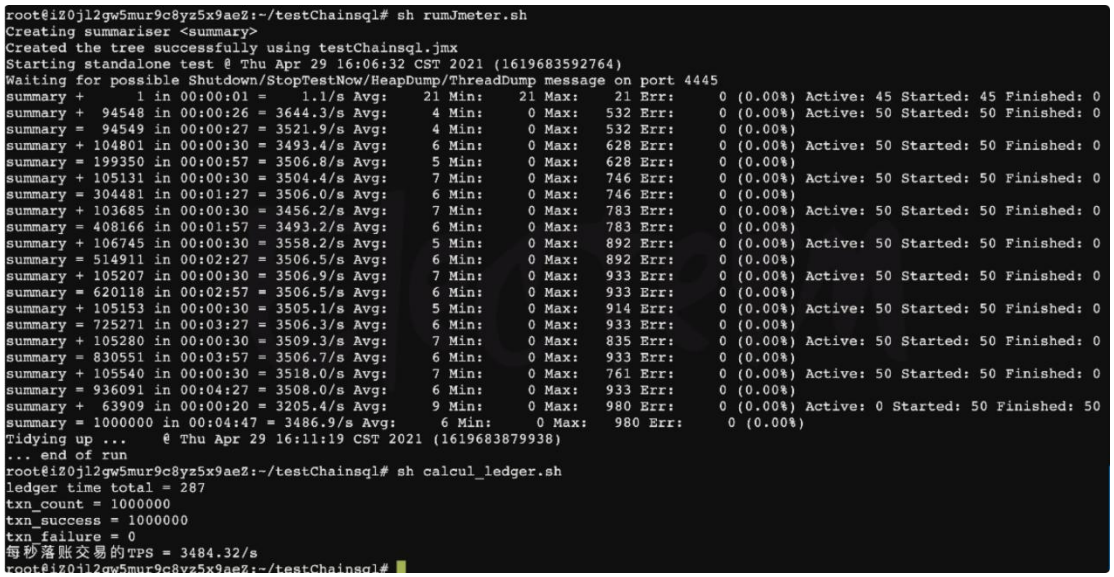

root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 16:06:32 CST 2021 (1619683592764)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 1 in 00:00:01 = 1.1/s Avg: 21 Min: 21 Max: 21 Err: 0 (0.00%) Active: 45 Started: 45 Finished: 0
summary + 94548 in 00:00:26 = 3644.3/s Avg: 4 Min: 0 Max: 532 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 94549 in 00:00:27 = 3521.9/s Avg: 4 Min: 0 Max: 532 Err: 0 (0.00%)
summary + 104801 in 00:00:30 = 3493.4/s Avg: 6 Min: 0 Max: 628 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 199350 in 00:00:57 = 3506.8/s Avg: 5 Min: 0 Max: 628 Err: 0 (0.00%)
summary + 105131 in 00:00:30 = 3504.4/s Avg: 7 Min: 0 Max: 746 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 304481 in 00:01:27 = 3506.0/s Avg: 6 Min: 0 Max: 746 Err: 0 (0.00%)
summary + 103685 in 00:00:30 = 3456.2/s Avg: 7 Min: 0 Max: 783 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 408166 in 00:01:57 = 3493.2/s Avg: 6 Min: 0 Max: 783 Err: 0 (0.00%)
summary + 106745 in 00:00:30 = 3558.2/s Avg: 5 Min: 0 Max: 892 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 514911 in 00:02:27 = 3506.5/s Avg: 6 Min: 0 Max: 892 Err: 0 (0.00%)
summary + 105207 in 00:00:30 = 3506.9/s Avg: 7 Min: 0 Max: 933 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 620118 in 00:02:57 = 3506.5/s Avg: 6 Min: 0 Max: 933 Err: 0 (0.00%)
summary + 105153 in 00:00:30 = 3505.1/s Avg: 5 Min: 0 Max: 914 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 725271 in 00:03:27 = 3506.3/s Avg: 6 Min: 0 Max: 933 Err: 0 (0.00%)
summary + 105280 in 00:00:30 = 3509.3/s Avg: 7 Min: 0 Max: 835 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 830551 in 00:03:57 = 3506.7/s Avg: 6 Min: 0 Max: 933 Err: 0 (0.00%)
summary + 105540 in 00:00:30 = 3518.0/s Avg: 7 Min: 0 Max: 761 Err: 0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 936091 in 00:04:27 = 3508.0/s Avg: 6 Min: 0 Max: 933 Err: 0 (0.00%)
summary + 63909 in 00:00:20 = 3205.4/s Avg: 9 Min: 0 Max: 980 Err: 0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:04:47 = 3486.9/s Avg: 6 Min: 0 Max: 980 Err: 0 (0.00%)
Tidying up ... @ Thu Apr 29 16:11:19 CST 2021 (1619683879938)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 287
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 3484.32/s
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#

图 50 发送和共识结果

```
root@120j12gw5mur9c8yz5x9ae2:~/testChainsql# sh testSubLedger.sh
Apr 29, 2021 4:06:13 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.205:6006
connect success
ledger index:9,ledger time:0,txn_count:2377,txn_success:2377,txn_failure:0
ledger index:10,ledger time:3,txn_count:13199,txn_success:13199,txn_failure:0
ledger index:11,ledger time:3,txn_count:10918,txn_success:10918,txn_failure:0
ledger index:12,ledger time:3,txn_count:10249,txn_success:10249,txn_failure:0
ledger index:13,ledger time:3,txn_count:10767,txn_success:10767,txn_failure:0
ledger index:14,ledger time:3,txn_count:10344,txn_success:10344,txn_failure:0
ledger index:15,ledger time:3,txn_count:10212,txn_success:10212,txn_failure:0
ledger index:16,ledger time:3,txn_count:10305,txn_success:10305,txn_failure:0
ledger index:17,ledger time:3,txn_count:11063,txn_success:11063,txn_failure:0
ledger index:18,ledger time:3,txn_count:9965,txn_success:9965,txn_failure:0
ledger index:19,ledger time:3,txn_count:10853,txn_success:10853,txn_failure:0
ledger index:20,ledger time:3,txn_count:10332,txn_success:10332,txn_failure:0
ledger index:21,ledger time:3,txn_count:9756,txn_success:9756,txn_failure:0
ledger index:22,ledger time:3,txn_count:11494,txn_success:11494,txn_failure:0
ledger index:23,ledger time:3,txn_count:9869,txn_success:9869,txn_failure:0
ledger index:24,ledger time:3,txn_count:10416,txn_success:10416,txn_failure:0
ledger index:25,ledger time:3,txn_count:10856,txn_success:10856,txn_failure:0
ledger index:26,ledger time:3,txn_count:11007,txn_success:11007,txn_failure:0
ledger index:27,ledger time:3,txn_count:10288,txn_success:10288,txn_failure:0
ledger index:28,ledger time:3,txn_count:10303,txn_success:10303,txn_failure:0
ledger index:29,ledger time:3,txn_count:11010,txn_success:11010,txn_failure:0
ledger index:30,ledger time:3,txn_count:10015,txn_success:10015,txn_failure:0
ledger index:31,ledger time:3,txn_count:10698,txn_success:10698,txn_failure:0
ledger index:32,ledger time:3,txn_count:10094,txn_success:10094,txn_failure:0
ledger index:33,ledger time:3,txn_count:10100,txn_success:10100,txn_failure:0
ledger index:34,ledger time:3,txn_count:9460,txn_success:9460,txn_failure:0
ledger index:35,ledger time:3,txn_count:12312,txn_success:12312,txn_failure:0
ledger index:36,ledger time:3,txn_count:7926,txn_success:7926,txn_failure:0
ledger index:37,ledger time:3,txn_count:13345,txn_success:13345,txn_failure:0
ledger index:38,ledger time:3,txn_count:9814,txn_success:9814,txn_failure:0
ledger index:39,ledger time:3,txn_count:11345,txn_success:11345,txn_failure:0
ledger index:40,ledger time:3,txn_count:8056,txn_success:8056,txn_failure:0
ledger index:41,ledger time:3,txn_count:10684,txn_success:10684,txn_failure:0
ledger index:42,ledger time:3,txn_count:10639,txn_success:10639,txn_failure:0
ledger index:43,ledger time:3,txn_count:13595,txn_success:13595,txn_failure:0
ledger index:44,ledger time:3,txn_count:8985,txn_success:8985,txn_failure:0
ledger index:45,ledger time:1,txn_count:3132,txn_success:3132,txn_failure:0
ledger index:46,ledger time:3,txn_count:10734,txn_success:10734,txn_failure:0
ledger index:47,ledger time:3,txn_count:10473,txn_success:10473,txn_failure:0
ledger index:48,ledger time:3,txn_count:10023,txn_success:10023,txn_failure:0
ledger index:49,ledger time:3,txn_count:10727,txn_success:10727,txn_failure:0
ledger index:50,ledger time:3,txn_count:10480,txn_success:10480,txn_failure:0
ledger index:51,ledger time:3,txn_count:10968,txn_success:10968,txn_failure:0
ledger index:52,ledger time:3,txn_count:10043,txn_success:10043,txn_failure:0
ledger index:53,ledger time:3,txn_count:8542,txn_success:8542,txn_failure:0
ledger index:54,ledger time:3,txn_count:10900,txn_success:10900,txn_failure:0
ledger index:55,ledger time:3,txn_count:12730,txn_success:12730,txn_failure:0
ledger index:56,ledger time:3,txn_count:10742,txn_success:10742,txn_failure:0
ledger index:57,ledger time:3,txn_count:10425,txn_success:10425,txn_failure:0
ledger index:58,ledger time:3,txn_count:10677,txn_success:10677,txn_failure:0
ledger index:59,ledger time:3,txn_count:9900,txn_success:9900,txn_failure:0
ledger index:60,ledger time:3,txn_count:11321,txn_success:11321,txn_failure:0
ledger index:61,ledger time:3,txn_count:9831,txn_success:9831,txn_failure:0
ledger index:62,ledger time:3,txn_count:8342,txn_success:8342,txn_failure:0
ledger index:63,ledger time:3,txn_count:13370,txn_success:13370,txn_failure:0
ledger index:64,ledger time:2,txn_count:4309,txn_success:4309,txn_failure:0
ledger index:65,ledger time:3,txn_count:12817,txn_success:12817,txn_failure:0
ledger index:66,ledger time:3,txn_count:10695,txn_success:10695,txn_failure:0
ledger index:67,ledger time:3,txn_count:10200,txn_success:10200,txn_failure:0
ledger index:68,ledger time:1,txn_count:2928,txn_success:2928,txn_failure:0
ledger index:69,ledger time:3,txn_count:8451,txn_success:8451,txn_failure:0
ledger index:70,ledger time:3,txn_count:13128,txn_success:13128,txn_failure:0
ledger index:71,ledger time:3,txn_count:10793,txn_success:10793,txn_failure:0
ledger index:72,ledger time:3,txn_count:10569,txn_success:10569,txn_failure:0
```

图 51 订阅区块结果

图 52 节点机器资源监控

1.3 结果分析

从图 50、51、52 可看出 20 个节点 HOTSTUFF 算法下 100 万笔 Insertment 交易共识 TPS 为 3484.32/s，交易落块时间为 3s，节点机器资源使用正常。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/batch-SSH# cd ../testChainsql/
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 16:20:01 CST 2021 (1619684401410)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:01 =     0.9/s Avg:     26 Min:     26 Max:     26 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary + 112599 in 00:00:27 = 4145.6/s Avg:      2 Min:      0 Max:    213 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 112600 in 00:00:28 = 3989.4/s Avg:      2 Min:      0 Max:    213 Err:      0 (0.00%)
summary + 120086 in 00:00:30 = 4002.9/s Avg:      3 Min:      0 Max:    199 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 232686 in 00:00:58 = 3996.3/s Avg:      3 Min:      0 Max:    213 Err:      0 (0.00%)
summary + 119645 in 00:00:30 = 3988.2/s Avg:      3 Min:      0 Max:    253 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 352331 in 00:01:28 = 3993.6/s Avg:      3 Min:      0 Max:    253 Err:      0 (0.00%)
summary + 120116 in 00:00:30 = 4003.9/s Avg:      4 Min:      0 Max:    352 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 472447 in 00:01:58 = 3996.2/s Avg:      3 Min:      0 Max:    352 Err:      0 (0.00%)
summary + 119885 in 00:00:30 = 3996.2/s Avg:      3 Min:      0 Max:    626 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 592332 in 00:02:28 = 3996.2/s Avg:      3 Min:      0 Max:    626 Err:      0 (0.00%)
summary + 120298 in 00:00:30 = 4009.9/s Avg:      0 Min:      0 Max:     69 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 712630 in 00:02:58 = 3998.5/s Avg:      3 Min:      0 Max:    626 Err:      0 (0.00%)
summary + 120011 in 00:00:30 = 4000.4/s Avg:      2 Min:      0 Max:    327 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 832641 in 00:03:28 = 3998.8/s Avg:      3 Min:      0 Max:    626 Err:      0 (0.00%)
summary + 119272 in 00:00:30 = 3975.7/s Avg:      3 Min:      0 Max:    275 Err:      0 (0.00%) Active: 50 Started: 50 Finishe
summary = 951913 in 00:03:58 = 3995.9/s Avg:      3 Min:      0 Max:    626 Err:      0 (0.00%)
summary +  48087 in 00:00:14 = 3542.6/s Avg:      5 Min:      0 Max:    588 Err:      0 (0.00%) Active: 0 Started: 50 Finished
summary = 1000000 in 00:04:12 = 3971.4/s Avg:      3 Min:      0 Max:    626 Err:      0 (0.00%)
Tidying up ...    @ Thu Apr 29 16:24:13 CST 2021 (1619684653575)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 284
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 3521.12/s
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 53 发送和共识结果

图 54 节点机器资源监控

2.3 结果分析

从上图 53、54 结果图可得出，20 个节点 HOTSTUFF 算法下 100 万笔 Insertment 交易共识的 TPS 为 3521/s ,节点机器资源使用正常。

6.1.6 50 个节点

(1) POP 算法

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 17:51:01 CST 2021 (1619689861881)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +      1 in 00:00:01 =    1.6/s Avg:    17 Min:    17 Max:    17 Err:     0 (0.00%) Active: 29 Started: 29 Finished: 0
summary +  55865 in 00:00:27 = 2061.4/s Avg:     3 Min:     0 Max:   204 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary =  55866 in 00:00:28 = 2014.8/s Avg:     3 Min:     0 Max:   204 Err:     0 (0.00%)
summary +  59967 in 00:00:30 = 1998.9/s Avg:     3 Min:     0 Max:   327 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 115833 in 00:00:58 = 2006.5/s Avg:     3 Min:     0 Max:   327 Err:     0 (0.00%)
summary +  60055 in 00:00:30 = 2001.8/s Avg:     3 Min:     0 Max:   206 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 175888 in 00:01:28 = 2004.9/s Avg:     3 Min:     0 Max:   327 Err:     0 (0.00%)
summary +  60296 in 00:00:30 = 2009.8/s Avg:     3 Min:     0 Max:   134 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 236184 in 00:01:58 = 2006.2/s Avg:     3 Min:     0 Max:   327 Err:     0 (0.00%)
summary +  59683 in 00:00:30 = 1989.5/s Avg:     3 Min:     0 Max:   212 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 295867 in 00:02:28 = 2002.8/s Avg:     3 Min:     0 Max:   327 Err:     0 (0.00%)
summary +  60092 in 00:00:30 = 2003.1/s Avg:     3 Min:     0 Max:   190 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 355959 in 00:02:58 = 2002.8/s Avg:     3 Min:     0 Max:   327 Err:     0 (0.00%)
summary +  59988 in 00:00:30 = 1999.6/s Avg:     3 Min:     0 Max:   332 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 415947 in 00:03:28 = 2002.4/s Avg:     3 Min:     0 Max:   332 Err:     0 (0.00%)
summary +  59805 in 00:00:30 = 1993.5/s Avg:     5 Min:     0 Max:   240 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 475752 in 00:03:58 = 2001.2/s Avg:     3 Min:     0 Max:   332 Err:     0 (0.00%)
summary +  60312 in 00:00:30 = 2010.4/s Avg:     3 Min:     0 Max:   325 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 536064 in 00:04:28 = 2002.3/s Avg:     3 Min:     0 Max:   332 Err:     0 (0.00%)
summary +  60104 in 00:00:30 = 2003.5/s Avg:     4 Min:     0 Max:   260 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 596168 in 00:04:58 = 2002.4/s Avg:     3 Min:     0 Max:   332 Err:     0 (0.00%)
summary +  60293 in 00:00:30 = 2009.8/s Avg:     6 Min:     0 Max:   734 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 656461 in 00:05:28 = 2003.1/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
summary +  60017 in 00:00:30 = 1998.5/s Avg:     6 Min:     0 Max:   595 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 716478 in 00:05:58 = 2002.7/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
summary +  59624 in 00:00:30 = 1989.5/s Avg:     5 Min:     0 Max:   206 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 776102 in 00:06:28 = 2001.7/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
summary +  60041 in 00:00:30 = 2001.3/s Avg:     7 Min:     0 Max:   493 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 836143 in 00:06:58 = 2001.6/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
summary +  59774 in 00:00:30 = 1992.5/s Avg:     6 Min:     0 Max:   698 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 895917 in 00:07:28 = 2001.0/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
summary +  59798 in 00:00:30 = 1993.3/s Avg:     4 Min:     0 Max:   254 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 955715 in 00:07:58 = 2000.5/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
summary +  44285 in 00:00:23 = 1943.9/s Avg:     5 Min:     0 Max:   274 Err:     0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:08:21 = 1998.0/s Avg:     4 Min:     0 Max:   734 Err:     0 (0.00%)
Tidying up ...    @ Thu Apr 29 17:59:22 CST 2021 (1619690362782)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 500
txn_count = 1000041
txn_success = 1000041
txn_failure = 0
每秒落账交易的TPS = 2000.08/s
```

图 55 发送和共识结果

图 55 节点机器资源监控

1.3 结果分析

从图 54、55 结果得出，50 个节点时 POP 算法下的 100 万比 payment 的共识 TPS 为 2000/s，交易成功率为 100%，节点资源使用正常。

4. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 17:37:11 CST 2021 (1619689031559)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  36223 in 00:00:18 = 2009.6/s Avg:      2 Min:      0 Max:    206 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary +  59973 in 00:00:30 = 1999.1/s Avg:      2 Min:      0 Max:    171 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary =  96196 in 00:00:48 = 2003.0/s Avg:      2 Min:      0 Max:    206 Err:      0 (0.00%)
summary +  60028 in 00:00:30 = 2000.9/s Avg:      2 Min:      0 Max:    208 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 156224 in 00:01:18 = 2002.2/s Avg:      2 Min:      0 Max:    208 Err:      0 (0.00%)
summary +  59655 in 00:00:30 = 1988.6/s Avg:      2 Min:      0 Max:     85 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 215879 in 00:01:48 = 1998.4/s Avg:      2 Min:      0 Max:    208 Err:      0 (0.00%)
summary +  59970 in 00:00:30 = 1999.0/s Avg:      3 Min:      0 Max:    279 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 275849 in 00:02:18 = 1998.5/s Avg:      2 Min:      0 Max:    279 Err:      0 (0.00%)
summary +  60078 in 00:00:30 = 2001.7/s Avg:      2 Min:      0 Max:    240 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 335927 in 00:02:48 = 1999.1/s Avg:      2 Min:      0 Max:    279 Err:      0 (0.00%)
summary +  59786 in 00:00:30 = 1993.7/s Avg:      2 Min:      0 Max:    227 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 395713 in 00:03:18 = 1998.3/s Avg:      2 Min:      0 Max:    279 Err:      0 (0.00%)
summary +  60047 in 00:00:30 = 2001.6/s Avg:      3 Min:      0 Max:    277 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 455760 in 00:03:48 = 1998.7/s Avg:      2 Min:      0 Max:    279 Err:      0 (0.00%)
summary +  60390 in 00:00:30 = 2012.9/s Avg:      1 Min:      0 Max:    221 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 516150 in 00:04:18 = 2000.4/s Avg:      2 Min:      0 Max:    279 Err:      0 (0.00%)
summary +  60103 in 00:00:30 = 2003.5/s Avg:      3 Min:      0 Max:    480 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 576253 in 00:04:48 = 2000.7/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  59800 in 00:00:30 = 1993.3/s Avg:      3 Min:      0 Max:    269 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 636053 in 00:05:18 = 2000.0/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  60005 in 00:00:30 = 2000.2/s Avg:      1 Min:      0 Max:    208 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 696058 in 00:05:48 = 2000.0/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  60023 in 00:00:30 = 2000.7/s Avg:      4 Min:      0 Max:    225 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 756081 in 00:06:18 = 2000.1/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  59917 in 00:00:30 = 1997.3/s Avg:      3 Min:      0 Max:    238 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 815998 in 00:06:48 = 1999.9/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  60220 in 00:00:30 = 2007.3/s Avg:      3 Min:      0 Max:    145 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 876218 in 00:07:18 = 2000.4/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  59904 in 00:00:30 = 1996.8/s Avg:      2 Min:      0 Max:    214 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 936122 in 00:07:48 = 2000.2/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +  60339 in 00:00:30 = 2011.2/s Avg:      2 Min:      0 Max:    215 Err:      0 (0.00%) Active: 50 Started: 50 Finished:
summary = 996461 in 00:08:18 = 2000.8/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
summary +   3539 in 00:00:02 = 1557.7/s Avg:      9 Min:      0 Max:    242 Err:      0 (0.00%) Active: 0 Started: 50 Finished: 5
summary = 1000000 in 00:08:20 = 1998.8/s Avg:      2 Min:      0 Max:    480 Err:      0 (0.00%)
Tidying up ...    @ Thu Apr 29 17:45:32 CST 2021 (1619689532274)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 503
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 1988.07/s
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql#
```

图 56 发送和共识结果

```
root@iz0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh testSubLedger.sh
Apr 29, 2021 5:36:35 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.205:6006
connect success
ledger index:10,ledger time:0,txn_count:965,txn_success:965,txn_failure:0
ledger index:11,ledger time:3,txn_count:5990,txn_success:5990,txn_failure:0
ledger index:12,ledger time:3,txn_count:5861,txn_success:5861,txn_failure:0
ledger index:13,ledger time:3,txn_count:6076,txn_success:6076,txn_failure:0
ledger index:14,ledger time:1,txn_count:1872,txn_success:1872,txn_failure:0
ledger index:15,ledger time:3,txn_count:6280,txn_success:6280,txn_failure:0
ledger index:16,ledger time:1,txn_count:3626,txn_success:3626,txn_failure:0
ledger index:17,ledger time:2,txn_count:3404,txn_success:3404,txn_failure:0
ledger index:18,ledger time:3,txn_count:4905,txn_success:4905,txn_failure:0
ledger index:19,ledger time:3,txn_count:5781,txn_success:5781,txn_failure:0
ledger index:20,ledger time:3,txn_count:6208,txn_success:6208,txn_failure:0
ledger index:21,ledger time:1,txn_count:3573,txn_success:3573,txn_failure:0
ledger index:22,ledger time:2,txn_count:3376,txn_success:3376,txn_failure:0
ledger index:23,ledger time:2,txn_count:2849,txn_success:2849,txn_failure:0
ledger index:24,ledger time:1,txn_count:2777,txn_success:2777,txn_failure:0
ledger index:25,ledger time:3,txn_count:5319,txn_success:5319,txn_failure:0
ledger index:26,ledger time:1,txn_count:3274,txn_success:3274,txn_failure:0
ledger index:27,ledger time:3,txn_count:12866,txn_success:12866,txn_failure:0
ledger index:28,ledger time:5,txn_count:4413,txn_success:4413,txn_failure:0
ledger index:29,ledger time:3,txn_count:3826,txn_success:3826,txn_failure:0
ledger index:30,ledger time:1,txn_count:3803,txn_success:3803,txn_failure:0
ledger index:31,ledger time:2,txn_count:3186,txn_success:3186,txn_failure:0
ledger index:32,ledger time:2,txn_count:2866,txn_success:2866,txn_failure:0
ledger index:33,ledger time:3,txn_count:10740,txn_success:10740,txn_failure:0
ledger index:34,ledger time:3,txn_count:4588,txn_success:4588,txn_failure:0
ledger index:35,ledger time:3,txn_count:2766,txn_success:2766,txn_failure:0
ledger index:36,ledger time:1,txn_count:1772,txn_success:1772,txn_failure:0
ledger index:37,ledger time:1,txn_count:2137,txn_success:2137,txn_failure:0
ledger index:38,ledger time:1,txn_count:2043,txn_success:2043,txn_failure:0
ledger index:39,ledger time:1,txn_count:1741,txn_success:1741,txn_failure:0
ledger index:40,ledger time:1,txn_count:1840,txn_success:1840,txn_failure:0
ledger index:41,ledger time:1,txn_count:1968,txn_success:1968,txn_failure:0
ledger index:42,ledger time:1,txn_count:2005,txn_success:2005,txn_failure:0
ledger index:43,ledger time:1,txn_count:2091,txn_success:2091,txn_failure:0
ledger index:44,ledger time:1,txn_count:2003,txn_success:2003,txn_failure:0
ledger index:45,ledger time:1,txn_count:1969,txn_success:1969,txn_failure:0
ledger index:46,ledger time:1,txn_count:2094,txn_success:2094,txn_failure:0
ledger index:47,ledger time:1,txn_count:2175,txn_success:2175,txn_failure:0
ledger index:48,ledger time:1,txn_count:3053,txn_success:3053,txn_failure:0
ledger index:49,ledger time:1,txn_count:1577,txn_success:1577,txn_failure:0
ledger index:50,ledger time:1,txn_count:1372,txn_success:1372,txn_failure:0
ledger index:51,ledger time:1,txn_count:1818,txn_success:1818,txn_failure:0
ledger index:52,ledger time:1,txn_count:2033,txn_success:2033,txn_failure:0
ledger index:53,ledger time:2,txn_count:4074,txn_success:4074,txn_failure:0
ledger index:54,ledger time:2,txn_count:3589,txn_success:3589,txn_failure:0
ledger index:55,ledger time:1,txn_count:3321,txn_success:3321,txn_failure:0
ledger index:56,ledger time:1,txn_count:2248,txn_success:2248,txn_failure:0
ledger index:57,ledger time:1,txn_count:2298,txn_success:2298,txn_failure:0
ledger index:58,ledger time:1,txn_count:1836,txn_success:1836,txn_failure:0
ledger index:59,ledger time:1,txn_count:3510,txn_success:3510,txn_failure:0
ledger index:60,ledger time:3,txn_count:3075,txn_success:3075,txn_failure:0
ledger index:61,ledger time:1,txn_count:3260,txn_success:3260,txn_failure:0
ledger index:62,ledger time:2,txn_count:3246,txn_success:3246,txn_failure:0
ledger index:63,ledger time:2,txn_count:3210,txn_success:3210,txn_failure:0
ledger index:64,ledger time:1,txn_count:3039,txn_success:3039,txn_failure:0
ledger index:65,ledger time:10,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:66,ledger time:3,txn_count:6116,txn_success:6116,txn_failure:0
ledger index:67,ledger time:3,txn_count:5089,txn_success:5089,txn_failure:0
ledger index:68,ledger time:2,txn_count:3938,txn_success:3938,txn_failure:0
ledger index:69,ledger time:2,txn_count:3414,txn_success:3414,txn_failure:0
ledger index:70,ledger time:1,txn_count:3589,txn_success:3589,txn_failure:0
ledger index:71,ledger time:1,txn_count:2233,txn_success:2233,txn_failure:0
ledger index:72,ledger time:1,txn_count:1665,txn_success:1665,txn_failure:0
ledger index:73,ledger time:12,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:74,ledger time:3,txn_count:9430,txn_success:9430,txn_failure:0
```

图 57 部分订阅区块结果

图 58 节点机器资源监控

2.3 结果分析

从图 56、57、58 可看出 pop 算法 100 万 Insertment 交易的共识 TPS 为 1988/s，区块会出现个别 10-12s 才落块的情况，但总体是 1-3s 就会落块；节点机器在交易产生期间 CPU，内存等使用都正常。

(2) HOTSTUFF 算法

1.Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Thu Apr 29 18:16:49 CST 2021 (1619691409111)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  15952 in 00:00:11 = 1516.8/s Avg:     2 Min:     0 Max:   179 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary +  44642 in 00:00:30 = 1488.1/s Avg:     3 Min:     0 Max:   407 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary =  60594 in 00:00:41 = 1495.6/s Avg:     2 Min:     0 Max:   407 Err:     0 (0.00%)
summary +  44782 in 00:00:30 = 1492.6/s Avg:     0 Min:     0 Max:    62 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 105376 in 00:01:11 = 1494.3/s Avg:     2 Min:     0 Max:   407 Err:     0 (0.00%)
summary +  44830 in 00:00:30 = 1494.4/s Avg:     7 Min:     0 Max:  1223 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 150206 in 00:01:41 = 1494.3/s Avg:     3 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  45382 in 00:00:30 = 1512.7/s Avg:     4 Min:     0 Max:   487 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 195588 in 00:02:11 = 1498.6/s Avg:     4 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  44818 in 00:00:30 = 1493.9/s Avg:     5 Min:     0 Max:   439 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 240406 in 00:02:41 = 1497.7/s Avg:     4 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  44996 in 00:00:30 = 1499.9/s Avg:     4 Min:     0 Max:   397 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 285402 in 00:03:11 = 1498.0/s Avg:     4 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  43964 in 00:00:30 = 1461.0/s Avg:     2 Min:     0 Max:   715 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 329366 in 00:03:41 = 1493.0/s Avg:     4 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  45930 in 00:00:30 = 1535.7/s Avg:     6 Min:     0 Max:   737 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 375296 in 00:04:11 = 1498.1/s Avg:     4 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  45214 in 00:00:30 = 1507.1/s Avg:     1 Min:     0 Max:   206 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 420510 in 00:04:41 = 1499.1/s Avg:     4 Min:     0 Max:  1223 Err:     0 (0.00%)
summary +  43854 in 00:00:30 = 1438.5/s Avg:     5 Min:     0 Max:  1338 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 464364 in 00:05:11 = 1493.1/s Avg:     4 Min:     0 Max:  1338 Err:     0 (0.00%)
summary +  46431 in 00:00:30 = 1573.1/s Avg:     8 Min:     0 Max:  1344 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 510795 in 00:05:41 = 1500.1/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  44936 in 00:00:30 = 1497.9/s Avg:     4 Min:     0 Max:   431 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 555731 in 00:06:11 = 1499.9/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  44934 in 00:00:30 = 1497.8/s Avg:     5 Min:     0 Max:   401 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 600665 in 00:06:41 = 1499.7/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  45023 in 00:00:30 = 1500.7/s Avg:     1 Min:     0 Max:   336 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 645688 in 00:07:11 = 1499.8/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  44810 in 00:00:30 = 1493.7/s Avg:     7 Min:     0 Max:   776 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 690498 in 00:07:41 = 1499.4/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  44963 in 00:00:30 = 1498.9/s Avg:     1 Min:     0 Max:   204 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 735461 in 00:08:11 = 1499.4/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  45045 in 00:00:30 = 1501.5/s Avg:     5 Min:     0 Max:  1071 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 780506 in 00:08:41 = 1499.5/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  44750 in 00:00:30 = 1491.6/s Avg:     8 Min:     0 Max:  1339 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 825256 in 00:09:11 = 1499.1/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  45103 in 00:00:30 = 1503.4/s Avg:     4 Min:     0 Max:   439 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 870359 in 00:09:41 = 1499.3/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  44925 in 00:00:30 = 1497.5/s Avg:     5 Min:     0 Max:   503 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 915284 in 00:10:11 = 1499.2/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  45182 in 00:00:30 = 1506.1/s Avg:     3 Min:     0 Max:   363 Err:     0 (0.00%) Active: 50 Started: 50 Finished: 0
summary = 960466 in 00:10:41 = 1499.5/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
summary +  39534 in 00:00:26 = 1493.4/s Avg:     7 Min:     0 Max:   757 Err:     0 (0.00%) Active: 0 Started: 50 Finished: 50
summary = 1000000 in 00:11:07 = 1499.3/s Avg:     4 Min:     0 Max:  1344 Err:     0 (0.00%)
Tidying up ...    @ Thu Apr 29 18:27:56 CST 2021 (1619692076473)
... end of run
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh calcul_ledger.sh
ledger time total = 662
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 1510.57/s
```

图 59 发送和共识结果

图 60 节点机器资源监控

1.3 结果分析

从图 59、60 结果可得出，50 个节点组链 HOTSTUFF 算法下 Payment 接口的共识 TPS 为 1510/s ,交易成功率为 100%；节点机器资源使用正常。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

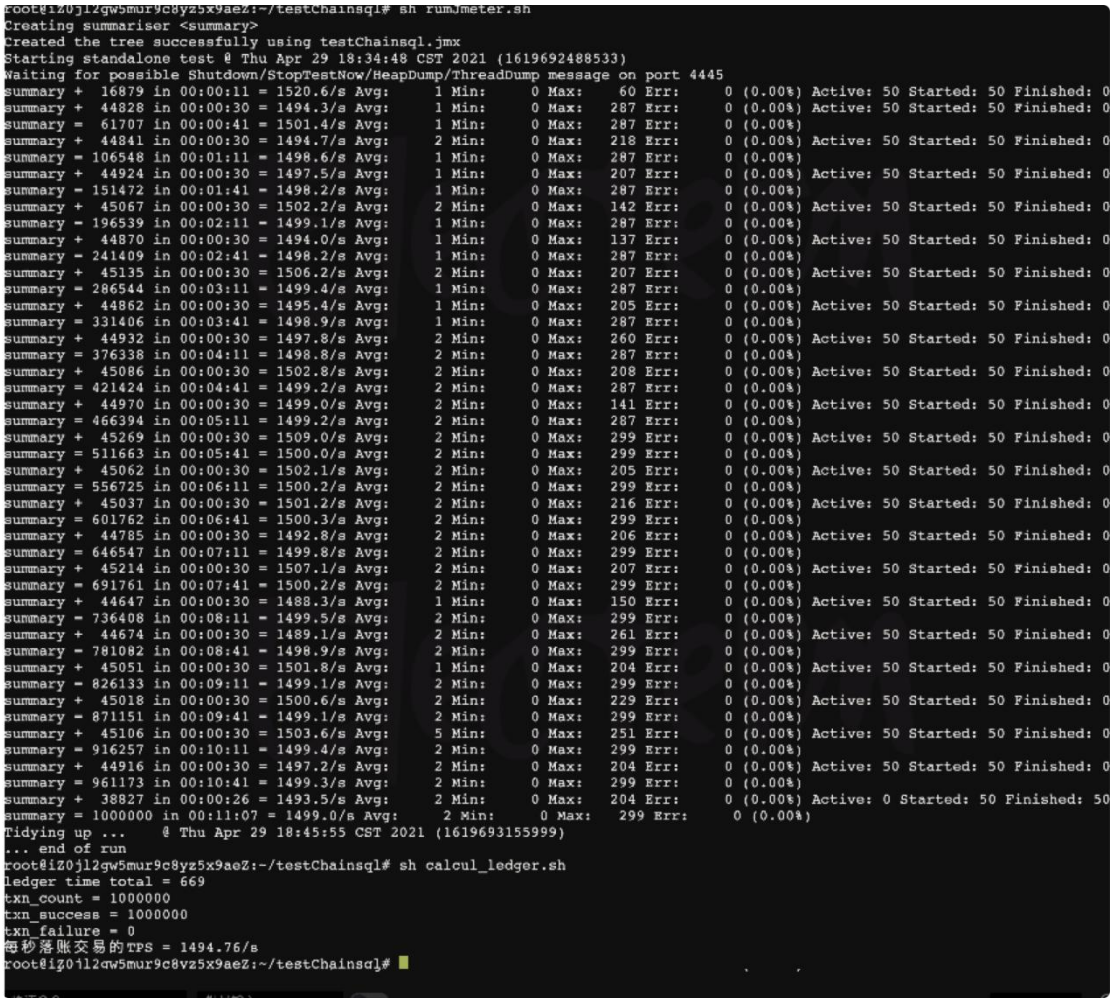


图 61 发送和共识结果

```
root@iZ0jl2gw5mur9c8yz5x9aeZ:~/testChainsql# sh testSubLedger.sh
Apr 29, 2021 6:34:36 PM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.205:6006
connect success
ledger index:9,ledger time:0,txn_count:30,txn_success:30,txn_failure:0
ledger index:10,ledger time:3,txn_count:5473,txn_success:5473,txn_failure:0
ledger index:11,ledger time:3,txn_count:4334,txn_success:4334,txn_failure:0
ledger index:12,ledger time:8,txn_count:12160,txn_success:12160,txn_failure:0
ledger index:13,ledger time:3,txn_count:4394,txn_success:4394,txn_failure:0
ledger index:14,ledger time:3,txn_count:4958,txn_success:4958,txn_failure:0
ledger index:15,ledger time:3,txn_count:4269,txn_success:4269,txn_failure:0
ledger index:16,ledger time:3,txn_count:4308,txn_success:4308,txn_failure:0
ledger index:17,ledger time:3,txn_count:4922,txn_success:4922,txn_failure:0
ledger index:18,ledger time:3,txn_count:4092,txn_success:4092,txn_failure:0
ledger index:19,ledger time:16,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:20,ledger time:3,txn_count:8328,txn_success:8328,txn_failure:0
ledger index:21,ledger time:3,txn_count:4719,txn_success:4719,txn_failure:0
ledger index:22,ledger time:3,txn_count:4436,txn_success:4436,txn_failure:0
ledger index:23,ledger time:3,txn_count:4506,txn_success:4506,txn_failure:0
ledger index:24,ledger time:3,txn_count:4544,txn_success:4544,txn_failure:0
ledger index:25,ledger time:3,txn_count:4281,txn_success:4281,txn_failure:0
ledger index:26,ledger time:8,txn_count:11986,txn_success:11986,txn_failure:0
ledger index:27,ledger time:3,txn_count:4548,txn_success:4548,txn_failure:0
ledger index:28,ledger time:3,txn_count:4276,txn_success:4276,txn_failure:0
ledger index:29,ledger time:3,txn_count:4633,txn_success:4633,txn_failure:0
ledger index:30,ledger time:8,txn_count:12245,txn_success:12245,txn_failure:0
ledger index:31,ledger time:3,txn_count:4420,txn_success:4420,txn_failure:0
ledger index:32,ledger time:8,txn_count:12730,txn_success:12730,txn_failure:0
ledger index:33,ledger time:3,txn_count:3142,txn_success:3142,txn_failure:0
ledger index:34,ledger time:3,txn_count:5056,txn_success:5056,txn_failure:0
ledger index:35,ledger time:3,txn_count:4320,txn_success:4320,txn_failure:0
ledger index:36,ledger time:3,txn_count:4367,txn_success:4367,txn_failure:0
ledger index:37,ledger time:3,txn_count:4782,txn_success:4782,txn_failure:0
ledger index:38,ledger time:3,txn_count:4376,txn_success:4376,txn_failure:0
ledger index:39,ledger time:3,txn_count:4630,txn_success:4630,txn_failure:0
ledger index:40,ledger time:3,txn_count:4442,txn_success:4442,txn_failure:0
ledger index:41,ledger time:3,txn_count:4504,txn_success:4504,txn_failure:0
ledger index:42,ledger time:8,txn_count:12203,txn_success:12203,txn_failure:0
ledger index:43,ledger time:3,txn_count:4236,txn_success:4236,txn_failure:0
ledger index:44,ledger time:8,txn_count:12069,txn_success:12069,txn_failure:0
ledger index:45,ledger time:3,txn_count:4276,txn_success:4276,txn_failure:0
ledger index:46,ledger time:8,txn_count:12217,txn_success:12217,txn_failure:0
ledger index:47,ledger time:3,txn_count:4691,txn_success:4691,txn_failure:0
ledger index:48,ledger time:3,txn_count:4314,txn_success:4314,txn_failure:0
ledger index:49,ledger time:3,txn_count:4371,txn_success:4371,txn_failure:0
ledger index:50,ledger time:3,txn_count:4453,txn_success:4453,txn_failure:0
ledger index:51,ledger time:3,txn_count:4508,txn_success:4508,txn_failure:0
ledger index:52,ledger time:3,txn_count:4535,txn_success:4535,txn_failure:0
ledger index:53,ledger time:8,txn_count:12150,txn_success:12150,txn_failure:0
ledger index:54,ledger time:3,txn_count:4481,txn_success:4481,txn_failure:0
ledger index:55,ledger time:3,txn_count:4525,txn_success:4525,txn_failure:0
```

图 62 部分订阅区块结果

图 63 节点机器资源监控

2.3 结果分析

从上图 61、52、63 图中结果可得出，50 个节点下 hotstuff 算法 100 万笔 insertment 交易的共识 TPS 为 1494/s ，出现了 1 个 73s 才落块的区块，大部分区块都能在 3s 落块；节点机器资源使用正常。

6.1.7 查询数据

(1)admin 方式查询用例设计

场景	运行场景设置	测试点
不加密表中有 1 条数据	100 个用户发送 admin 查询交易运行 10000 次	获得 TPS，响应时间

A.测试结果截图：

```
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Mon Apr 12 11:58:13 CST 2021 (1618199893456)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 251291 in 00:00:16 = 15531.9/s Avg:     4 Min:     0 Max:   205 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary + 514464 in 00:00:30 = 17148.8/s Avg:     5 Min:     0 Max:   120 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 765755 in 00:00:46 = 16582.3/s Avg:     5 Min:     0 Max:   205 Err:     0 (0.00%)
summary + 234245 in 00:00:16 = 14753.7/s Avg:     5 Min:     0 Max:    91 Err:     0 (0.00%) Active: 0 Started: 100 Finished:
100
summary = 1000000 in 00:01:02 = 16114.5/s Avg:     5 Min:     0 Max:   205 Err:     0 (0.00%)
Tidying up ...    @ Mon Apr 12 11:59:15 CST 2021 (1618199955877)
... end of run
root@host04:~/testChainsql#
```

图 64 查询结果

图 65 查询结果监控图

B.结果分析

从上图表中可得出，表中有 1 条数据，100 个用户查询 100 万笔数据用 admin 方式查询表数据的最大 TPS 为 17380/s,平均响应时间为 5.42ms。

(2) get 方式查询

场景	运行场景设置	测试点
不加密表中有 1 条数据	100 个用户发送 admin 查询交易运行 10000 次	获得 TPS，响应时间

A.测试结果截图：

```
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Mon Apr 12 11:37:28 CST 2021 (1618198648572)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +    5959 in 00:00:01 = 5648.3/s Avg:     1 Min:     0 Max:    27 Err:     0 (0.00%) Active: 100 Started: 100 Finished:
 0
summary + 406730 in 00:00:30 = 13557.7/s Avg:     6 Min:     0 Max:   213 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 412689 in 00:00:31 = 13289.0/s Avg:     6 Min:     0 Max:   213 Err:     0 (0.00%)
summary + 419020 in 00:00:30 = 13967.3/s Avg:     6 Min:     0 Max:    82 Err:     0 (0.00%) Active: 100 Started: 100 Finished
: 0
summary = 831709 in 00:01:01 = 13622.3/s Avg:     6 Min:     0 Max:   213 Err:     0 (0.00%)
summary + 168291 in 00:00:18 = 9599.1/s Avg:     6 Min:     0 Max:   212 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 1
00
summary = 1000000 in 00:01:19 = 12724.8/s Avg:     6 Min:     0 Max:   213 Err:     0 (0.00%)
```

图 66 查询结果

图 67 查询结果监控图

B.结果分析

从上图分析，使用 get 方式查询 100 万次表数据平均 TPS 为 13330/s，平均响应时间为 7ms。

6.1.8 多链

(1)多链配置

总节点数	子链条数	子链节点个数	重复节点数
10	2	4	1

(2)对单条子链发交易

1. Payment 用例

1.1 用例设计

场景	运行场景设置	测试点
Payment 接口	100 个用户给一条子链发送交易运行 10000 次	获得 TPS，响应时间

1.2 测试结果

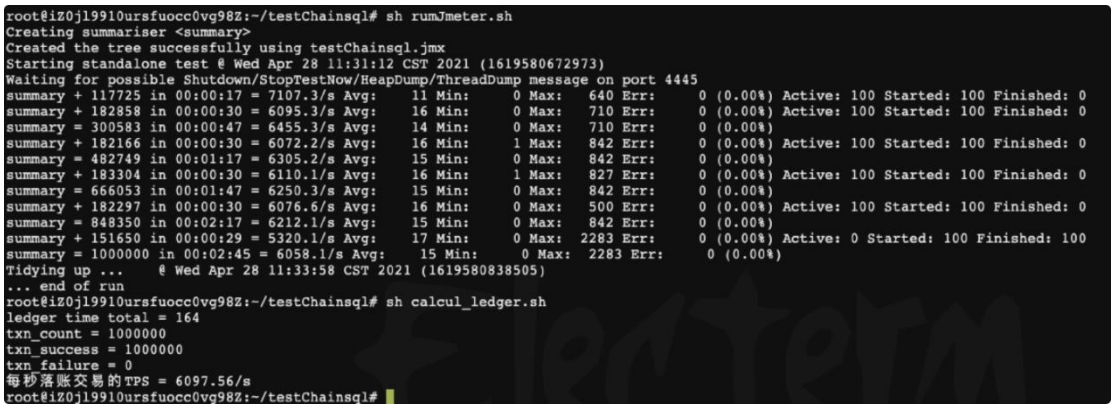

root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Wed Apr 28 11:31:12 CST 2021 (1619580672973)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 117725 in 00:00:17 = 7107.3/s Avg: 11 Min: 0 Max: 640 Err: 0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 182858 in 00:00:30 = 6095.3/s Avg: 16 Min: 0 Max: 710 Err: 0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 300583 in 00:00:47 = 6455.3/s Avg: 14 Min: 0 Max: 710 Err: 0 (0.00%)
summary + 182166 in 00:00:30 = 6072.2/s Avg: 16 Min: 1 Max: 842 Err: 0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 482749 in 00:01:17 = 6305.2/s Avg: 15 Min: 0 Max: 842 Err: 0 (0.00%)
summary + 183304 in 00:00:30 = 6110.1/s Avg: 16 Min: 1 Max: 827 Err: 0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 666053 in 00:01:47 = 6250.3/s Avg: 15 Min: 0 Max: 842 Err: 0 (0.00%)
summary + 182297 in 00:00:30 = 6076.6/s Avg: 16 Min: 0 Max: 500 Err: 0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 848350 in 00:02:17 = 6212.1/s Avg: 15 Min: 0 Max: 842 Err: 0 (0.00%)
summary + 151650 in 00:00:29 = 5320.1/s Avg: 17 Min: 0 Max: 2283 Err: 0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:45 = 6058.1/s Avg: 15 Min: 0 Max: 2283 Err: 0 (0.00%)
Tidying up ... @ Wed Apr 28 11:33:58 CST 2021 (1619580838505)
... end of run
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql# sh calcul_ledger.sh
ledger time total = 164
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 6097.56/s
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql#

图 68 发送和共识结果

```
root@120j19910ursfuocc0vg98z:~/testChainsql# sh testSubLedger.sh
Apr 28, 2021 11:25:50 AM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.189:6006
connect success
ledger index:2,ledger time:0,txn_count:6373,txn_success:6373,txn_failure:0
ledger index:3,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:4,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:5,ledger time:2,txn_count:16252,txn_success:16252,txn_failure:0
ledger index:6,ledger time:2,txn_count:11298,txn_success:11298,txn_failure:0
ledger index:7,ledger time:2,txn_count:10707,txn_success:10707,txn_failure:0
ledger index:8,ledger time:1,txn_count:6952,txn_success:6952,txn_failure:0
ledger index:9,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:10,ledger time:3,txn_count:15991,txn_success:15991,txn_failure:
ledger index:11,ledger time:2,txn_count:13488,txn_success:13488,txn_failure:
ledger index:12,ledger time:1,txn_count:8831,txn_success:8831,txn_failure:0
ledger index:13,ledger time:3,txn_count:13544,txn_success:13544,txn_failure:
ledger index:14,ledger time:1,txn_count:9047,txn_success:9047,txn_failure:0
ledger index:15,ledger time:2,txn_count:9796,txn_success:9796,txn_failure:0
ledger index:16,ledger time:1,txn_count:6987,txn_success:6987,txn_failure:0
ledger index:17,ledger time:3,txn_count:19185,txn_success:19185,txn_failure:
ledger index:18,ledger time:1,txn_count:12871,txn_success:12871,txn_failure:
ledger index:19,ledger time:2,txn_count:6830,txn_success:6830,txn_failure:0
ledger index:20,ledger time:1,txn_count:4414,txn_success:4414,txn_failure:0
ledger index:21,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:
ledger index:22,ledger time:2,txn_count:14900,txn_success:14900,txn_failure:
ledger index:23,ledger time:2,txn_count:7497,txn_success:7497,txn_failure:0
ledger index:24,ledger time:1,txn_count:3692,txn_success:3692,txn_failure:0
ledger index:25,ledger time:1,txn_count:1196,txn_success:1196,txn_failure:0
ledger index:26,ledger time:1,txn_count:4864,txn_success:4864,txn_failure:0
ledger index:27,ledger time:1,txn_count:5707,txn_success:5707,txn_failure:0
ledger index:28,ledger time:1,txn_count:6508,txn_success:6508,txn_failure:0
ledger index:29,ledger time:1,txn_count:6420,txn_success:6420,txn_failure:0
ledger index:30,ledger time:1,txn_count:6884,txn_success:6884,txn_failure:0
ledger index:31,ledger time:1,txn_count:7152,txn_success:7152,txn_failure:0
ledger index:32,ledger time:1,txn_count:5128,txn_success:5128,txn_failure:0
ledger index:33,ledger time:1,txn_count:4784,txn_success:4784,txn_failure:0
ledger index:34,ledger time:1,txn_count:6670,txn_success:6670,txn_failure:0
ledger index:35,ledger time:1,txn_count:6138,txn_success:6138,txn_failure:0
ledger index:36,ledger time:1,txn_count:7292,txn_success:7292,txn_failure:0
ledger index:37,ledger time:1,txn_count:6232,txn_success:6232,txn_failure:0
ledger index:38,ledger time:1,txn_count:5304,txn_success:5304,txn_failure:0
ledger index:39,ledger time:1,txn_count:5577,txn_success:5577,txn_failure:0
ledger index:40,ledger time:1,txn_count:4656,txn_success:4656,txn_failure:0
ledger index:41,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:
ledger index:42,ledger time:1,txn_count:20000,txn_success:20000,txn_failure:
ledger index:43,ledger time:3,txn_count:9503,txn_success:9503,txn_failure:0
ledger index:44,ledger time:1,txn_count:4942,txn_success:4942,txn_failure:0
ledger index:45,ledger time:1,txn_count:1635,txn_success:1635,txn_failure:0
ledger index:46,ledger time:1,txn_count:3899,txn_success:3899,txn_failure:0
ledger index:47,ledger time:1,txn_count:6743,txn_success:6743,txn_failure:0
ledger index:48,ledger time:1,txn_count:4327,txn_success:4327,txn_failure:0
```

图 69 订阅区块结果

图 70 节点机器资源监控

1.3 结果分析

从图 68、69、70 来看，3 条链(1 主 2 子)对其中一条子链发送 100 万 payment 交易的 TPS 为 6097/s ,交易区块落块时间 1-3s 左右，子链节点机器资源使用正常。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户给一条子链发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql# sh rumJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Wed Apr 28 11:31:12 CST 2021 (1619580672973)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary + 117725 in 00:00:17 = 7107.3/s Avg:    11 Min:     0 Max:   640 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 182858 in 00:00:30 = 6095.3/s Avg:    16 Min:     0 Max:   710 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 300583 in 00:00:47 = 6455.3/s Avg:    14 Min:     0 Max:   710 Err:     0 (0.00%)
summary + 182166 in 00:00:30 = 6072.2/s Avg:    16 Min:     1 Max:   842 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 482749 in 00:01:17 = 6305.2/s Avg:    15 Min:     0 Max:   842 Err:     0 (0.00%)
summary + 183304 in 00:00:30 = 6110.1/s Avg:    16 Min:     1 Max:   827 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 666053 in 00:01:47 = 6250.3/s Avg:    15 Min:     0 Max:   842 Err:     0 (0.00%)
summary + 182297 in 00:00:30 = 6076.6/s Avg:    16 Min:     0 Max:   500 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 848350 in 00:02:17 = 6212.1/s Avg:    15 Min:     0 Max:   842 Err:     0 (0.00%)
summary + 151650 in 00:00:29 = 5320.1/s Avg:    17 Min:     0 Max:  2283 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 1000000 in 00:02:45 = 6058.1/s Avg:    15 Min:     0 Max:  2283 Err:     0 (0.00%)
Tidying up ...    @ Wed Apr 28 11:33:58 CST 2021 (1619580838505)
... end of run
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql# sh calcul_ledger.sh
ledger time total = 164
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 6097.56/s
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql#
```

图 71 发送和共识结果

```
root@iZ0j19910ursfuoccOvg98Z:~/testChainsql# sh testSubLedger.sh
Apr 28, 2021 11:25:50 AM com.peersafe.base.client.Client log
INFO: Connecting to ws://172.16.144.189:6006
connect success
ledger index:2,ledger time:0,txn_count:6373,txn_success:6373,txn_failure:0
ledger index:3,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:4,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:5,ledger time:2,txn_count:16252,txn_success:16252,txn_failure:0
ledger index:6,ledger time:2,txn_count:11298,txn_success:11298,txn_failure:0
ledger index:7,ledger time:2,txn_count:10707,txn_success:10707,txn_failure:0
ledger index:8,ledger time:1,txn_count:6952,txn_success:6952,txn_failure:0
ledger index:9,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:10,ledger time:3,txn_count:15991,txn_success:15991,txn_failure:0
ledger index:11,ledger time:2,txn_count:13488,txn_success:13488,txn_failure:0
ledger index:12,ledger time:1,txn_count:8831,txn_success:8831,txn_failure:0
ledger index:13,ledger time:3,txn_count:13544,txn_success:13544,txn_failure:0
ledger index:14,ledger time:1,txn_count:9047,txn_success:9047,txn_failure:0
ledger index:15,ledger time:2,txn_count:9796,txn_success:9796,txn_failure:0
ledger index:16,ledger time:1,txn_count:6987,txn_success:6987,txn_failure:0
ledger index:17,ledger time:3,txn_count:19185,txn_success:19185,txn_failure:0
ledger index:18,ledger time:1,txn_count:12871,txn_success:12871,txn_failure:0
ledger index:19,ledger time:2,txn_count:6830,txn_success:6830,txn_failure:0
ledger index:20,ledger time:1,txn_count:4414,txn_success:4414,txn_failure:0
ledger index:21,ledger time:2,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:22,ledger time:2,txn_count:14900,txn_success:14900,txn_failure:0
ledger index:23,ledger time:2,txn_count:7497,txn_success:7497,txn_failure:0
ledger index:24,ledger time:1,txn_count:3692,txn_success:3692,txn_failure:0
ledger index:25,ledger time:1,txn_count:1196,txn_success:1196,txn_failure:0
ledger index:26,ledger time:1,txn_count:4864,txn_success:4864,txn_failure:0
ledger index:27,ledger time:1,txn_count:5707,txn_success:5707,txn_failure:0
ledger index:28,ledger time:1,txn_count:6508,txn_success:6508,txn_failure:0
ledger index:29,ledger time:1,txn_count:6420,txn_success:6420,txn_failure:0
ledger index:30,ledger time:1,txn_count:6884,txn_success:6884,txn_failure:0
ledger index:31,ledger time:1,txn_count:7152,txn_success:7152,txn_failure:0
ledger index:32,ledger time:1,txn_count:5128,txn_success:5128,txn_failure:0
ledger index:33,ledger time:1,txn_count:4784,txn_success:4784,txn_failure:0
ledger index:34,ledger time:1,txn_count:6670,txn_success:6670,txn_failure:0
ledger index:35,ledger time:1,txn_count:6138,txn_success:6138,txn_failure:0
ledger index:36,ledger time:1,txn_count:7292,txn_success:7292,txn_failure:0
ledger index:37,ledger time:1,txn_count:6232,txn_success:6232,txn_failure:0
ledger index:38,ledger time:1,txn_count:5304,txn_success:5304,txn_failure:0
ledger index:39,ledger time:1,txn_count:5577,txn_success:5577,txn_failure:0
ledger index:40,ledger time:1,txn_count:4656,txn_success:4656,txn_failure:0
ledger index:41,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:42,ledger time:1,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:43,ledger time:3,txn_count:9503,txn_success:9503,txn_failure:0
ledger index:44,ledger time:1,txn_count:4942,txn_success:4942,txn_failure:0
ledger index:45,ledger time:1,txn_count:1635,txn_success:1635,txn_failure:0
ledger index:46,ledger time:1,txn_count:3899,txn_success:3899,txn_failure:0
ledger index:47,ledger time:1,txn_count:6743,txn_success:6743,txn_failure:0
ledger index:48,ledger time:1,txn_count:4327,txn_success:4327,txn_failure:0
ledger index:49,ledger time:1,txn_count:7030,txn_success:7030,txn_failure:0
ledger index:50,ledger time:1,txn_count:6886,txn_success:6886,txn_failure:0
ledger index:51,ledger time:1,txn_count:6041,txn_success:6041,txn_failure:0
ledger index:52,ledger time:1,txn_count:5809,txn_success:5809,txn_failure:0
ledger index:53,ledger time:1,txn_count:6156,txn_success:6156,txn_failure:0
ledger index:54,ledger time:1,txn_count:7531,txn_success:7531,txn_failure:0
ledger index:55,ledger time:1,txn_count:6493,txn_success:6493,txn_failure:0
ledger index:56,ledger time:1,txn_count:5600,txn_success:5600,txn_failure:0
ledger index:57,ledger time:3,txn_count:20000,txn_success:20000,txn_failure:0
ledger index:58,ledger time:2,txn_count:19325,txn_success:19325,txn_failure:0
ledger index:59,ledger time:2,txn_count:9224,txn_success:9224,txn_failure:0
ledger index:60,ledger time:1,txn_count:7866,txn_success:7866,txn_failure:0
ledger index:61,ledger time:1,txn_count:6378,txn_success:6378,txn_failure:0
ledger index:62,ledger time:1,txn_count:4363,txn_success:4363,txn_failure:0
ledger index:63,ledger time:1,txn_count:7431,txn_success:7431,txn_failure:0
ledger index:64,ledger time:1,txn_count:5656,txn_success:5656,txn_failure:0
ledger index:65,ledger time:1,txn_count:3559,txn_success:3559,txn_failure:0
ledger index:66,ledger time:1,txn_count:4100,txn_success:4100,txn_failure:0
ledger index:67,ledger time:1,txn_count:7533,txn_success:7533,txn_failure:0
ledger index:68,ledger time:1,txn_count:6966,txn_success:6966,txn_failure:0
ledger index:69,ledger time:1,txn_count:3607,txn_success:3607,txn_failure:0
ledger index:70,ledger time:1,txn_count:2125,txn_success:2125,txn_failure:0
ledger index:71,ledger time:1,txn_count:8926,txn_success:8926,txn_failure:0
ledger index:72,ledger time:1,txn_count:6157,txn_success:6157,txn_failure:0
ledger index:73,ledger time:1,txn_count:4541,txn_success:4541,txn_failure:0
ledger index:74,ledger time:1,txn_count:7552,txn_success:7552,txn_failure:0
ledger index:75,ledger time:1,txn_count:6993,txn_success:6993,txn_failure:0
ledger index:76,ledger time:1,txn_count:5227,txn_success:5227,txn_failure:0
ledger index:78,ledger time:1,txn_count:6767,txn_success:6767,txn_failure:0
ledger index:79,ledger time:1,txn_count:7178,txn_success:7178,txn_failure:0
ledger index:80,ledger time:1,txn_count:5581,txn_success:5581,txn_failure:0
ledger index:81,ledger time:1,txn_count:3966,txn_success:3966,txn_failure:0
ledger index:82,ledger time:1,txn_count:6272,txn_success:6272,txn_failure:0
ledger index:83,ledger time:1,txn_count:5474,txn_success:5474,txn_failure:0
ledger index:84,ledger time:1,txn_count:4573,txn_success:4573,txn_failure:0
ledger index:85,ledger time:1,txn_count:7596,txn_success:7596,txn_failure:0
ledger index:86,ledger time:1,txn_count:7074,txn_success:7074,txn_failure:0
ledger index:87,ledger time:1,txn_count:7438,txn_success:7438,txn_failure:0
ledger index:88,ledger time:1,txn_count:4563,txn_success:4563,txn_failure:0
ledger index:89,ledger time:1,txn_count:5690,txn_success:5690,txn_failure:0
ledger index:90,ledger time:1,txn_count:7053,txn_success:7053,txn_failure:0
ledger index:91,ledger time:1,txn_count:5249,txn_success:5249,txn_failure:0
ledger index:92,ledger time:1,txn_count:6100,txn_success:6100,txn_failure:0
ledger index:93,ledger time:1,txn_count:7893,txn_success:7893,txn_failure:0
ledger index:94,ledger time:1,txn_count:6498,txn_success:6498,txn_failure:0
ledger index:95,ledger time:1,txn_count:4010,txn_success:4010,txn_failure:0
ledger index:96,ledger time:1,txn_count:5316,txn_success:5316,txn_failure:0
ledger index:97,ledger time:1,txn_count:6379,txn_success:6379,txn_failure:0
ledger index:98,ledger time:1,txn_count:6643,txn_success:6643,txn_failure:0
ledger index:99,ledger time:1,txn_count:5355,txn_success:5355,txn_failure:0
ledger index:100,ledger time:1,txn_count:6015,txn_success:6015,txn_failure:0
ledger index:101,ledger time:1,txn_count:6263,txn_success:6263,txn_failure:0
ledger index:102,ledger time:1,txn_count:6788,txn_success:6788,txn_failure:0
ledger index:103,ledger time:1,txn_count:7476,txn_success:7476,txn_failure:0
ledger index:104,ledger time:1,txn_count:5635,txn_success:5635,txn_failure:0
ledger index:105,ledger time:1,txn_count:3663,txn_success:3663,txn_failure:0
ledger index:106,ledger time:1,txn_count:7379,txn_success:7379,txn_failure:0
ledger index:107,ledger time:2,txn_count:15106,txn_success:15106,txn_failure:0
ledger index:108,ledger time:1,txn_count:9054,txn_success:9054,txn_failure:0
ledger index:109,ledger time:1,txn_count:3777,txn_success:3777,txn_failure:0
ledger index:110,ledger time:1,txn_count:2428,txn_success:2428,txn_failure:0
ledger index:111,ledger time:1,txn_count:1510,txn_success:1510,txn_failure:0
ledger index:112,ledger time:1,txn_count:8694,txn_success:8694,txn_failure:0
ledger index:113,ledger time:1,txn_count:9359,txn_success:9359,txn_failure:0
ledger index:114,ledger time:1,txn_count:7934,txn_success:7934,txn_failure:0
```

图 72 订阅区块结果

图 73 节点机器资源监控

2.3 结果分析

从图 71，72，73 得出，对单条子链发送 100 万笔插入交易，共识的 TPS 为 6097.56/s，交易落块时间大概为 1-3s 就会成功落块，交易成功率为 100%,；节点机器资源从交易开始到结束 CPU，内存都能正常使用和释放。

(2) 对 2 条子链同时发交易

1. Payment 用例

1.1 用例设计

1.2 测试结果

```
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Wed Apr 28 17:14:20 CST 2021 (1619601260744)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  70985 in 00:00:09 = 8009.1/s Avg:     2 Min:     0 Max:   282 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 240132 in 00:00:30 = 8004.4/s Avg:     3 Min:     0 Max:   306 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 311117 in 00:00:39 = 8005.5/s Avg:     2 Min:     0 Max:   306 Err:     0 (0.00%)
summary + 239347 in 00:00:30 = 7978.2/s Avg:     3 Min:     0 Max:   244 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 550464 in 00:01:09 = 7993.6/s Avg:     3 Min:     0 Max:   306 Err:     0 (0.00%)
summary + 240627 in 00:00:30 = 8020.9/s Avg:     3 Min:     0 Max:   208 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 791091 in 00:01:39 = 8001.9/s Avg:     3 Min:     0 Max:   306 Err:     0 (0.00%)
summary + 239857 in 00:00:30 = 7995.2/s Avg:     3 Min:     0 Max:   357 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1030948 in 00:02:09 = 8000.3/s Avg:     3 Min:     0 Max:   357 Err:     0 (0.00%)
summary + 239032 in 00:00:30 = 7967.7/s Avg:     3 Min:     0 Max:  1003 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1269980 in 00:02:39 = 7994.2/s Avg:     3 Min:     0 Max:  1003 Err:     0 (0.00%)
summary + 239410 in 00:00:30 = 7980.3/s Avg:     3 Min:     0 Max:   222 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1509390 in 00:03:09 = 7992.0/s Avg:     3 Min:     0 Max:  1003 Err:     0 (0.00%)
summary + 239736 in 00:00:30 = 7991.2/s Avg:     3 Min:     0 Max:   211 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1749126 in 00:03:39 = 7991.9/s Avg:     3 Min:     0 Max:  1003 Err:     0 (0.00%)
summary + 237115 in 00:00:30 = 7903.8/s Avg:     5 Min:     0 Max:  1335 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1986241 in 00:04:09 = 7981.3/s Avg:     3 Min:     0 Max:  1335 Err:     0 (0.00%)
summary +  13759 in 00:00:07 = 2096.4/s Avg:     5 Min:     0 Max:   435 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 2000000 in 00:04:15 = 7830.1/s Avg:     3 Min:     0 Max:  1335 Err:     0 (0.00%)
Tidying up ...    @ Wed Apr 28 17:18:36 CST 2021 (1619601516564)
... end of run
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql#
```

```
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/AB# sh calcul_ledger.sh
ledger time total = 249
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 4016.06/s
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/AB# cp calcul_ledger.sh  ../BC
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/AB# cd ../BC
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/BC# sh calcul_ledger.sh
ledger time total = 245
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 4081.63/s
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/BC#
```

A子链

B子链

图 74 发送和共识结果

图 75 节点机器资源监控

1.3 结果分析

从图 74，75 可看出，**同时对 2 条子链各发送 100 万 payment 交易时，子链 A 共识 TPS 为 4016.06/s ，子链 B 的共识 TPS 为 4081.63，两条子链的共识 TPS 差不多；节点机器资源使用正常**。

2. InsertMent 用例设计

2.1 用例设计

场景	运行场景设置	测试点
Insertment 接口	100 个用户发送交易运行 10000 次	获得 TPS，响应时间

2.2 测试结果

```
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql# sh runJmeter.sh
Creating summariser <summary>
Created the tree successfully using testChainsql.jmx
Starting standalone test @ Wed Apr 28 18:41:25 CST 2021 (1619606485196)
Waiting for possible Shutdown/StopTestNow/HeapDump/ThreadDump message on port 4445
summary +  43788 in 00:00:04 = 9888.9/s Avg:     1 Min:     0 Max:   201 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary + 439651 in 00:00:30 = 14655.0/s Avg:     3 Min:     0 Max:   317 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 483439 in 00:00:34 = 14042.0/s Avg:     3 Min:     0 Max:   317 Err:     0 (0.00%)
summary + 410853 in 00:00:30 = 13695.1/s Avg:     5 Min:     0 Max:   381 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 894292 in 00:01:04 = 13880.5/s Avg:     4 Min:     0 Max:   381 Err:     0 (0.00%)
summary + 396745 in 00:00:30 = 13224.8/s Avg:     6 Min:     0 Max:   318 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1291037 in 00:01:34 = 13672.2/s Avg:     4 Min:     0 Max:   381 Err:     0 (0.00%)
summary + 408723 in 00:00:30 = 13624.1/s Avg:     5 Min:     0 Max:   503 Err:     0 (0.00%) Active: 100 Started: 100 Finished: 0
summary = 1699760 in 00:02:04 = 13660.6/s Avg:     5 Min:     0 Max:   503 Err:     0 (0.00%)
summary + 300240 in 00:00:23 = 12900.2/s Avg:     5 Min:     0 Max:   301 Err:     0 (0.00%) Active: 0 Started: 100 Finished: 100
summary = 2000000 in 00:02:28 = 13540.8/s Avg:     5 Min:     0 Max:   503 Err:     0 (0.00%)
Tidying up ...    @ Wed Apr 28 18:43:53 CST 2021 (1619606633274)
... end of run
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql#
```

```
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/AB# sh calcul_ledger.sh
ledger time total = 221
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 4524.88/s
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/AB# cd ../ba
-bash: cd: ../ba: No such file or directory
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/AB# cd ../BC/
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/BC# sh calcul_ledger.sh
ledger time total = 233
txn_count = 1000000
txn_success = 1000000
txn_failure = 0
每秒落账交易的TPS = 4291.84/s
root@iZ0jl9910ursfuocc0vg98Z:~/testChainsql/Sub/BC#
```

图 76 发送和共识结果

图 77 节点机器资源监控

2.3 结果分析

从图 76，77 可得出,**同时对 2 条子链各发送 100 万 insertMent 交易，子链 A 的共识 TPS 为 4524.88/s，子链 B 的共识 TPS 为 4291.84/s；交易成功率为 100%**。

6.1.9 插入大数据

测试场景设定：阿里云机器 4 个节点多链，使用 jmeter 对表发送 100 万插入交易

发送网络	插入大小	支持并发数	成功率	平均响应时间
内网	100kb	2000	100%	10.002s
	400kb	700	100%	13.074s
外网	100kb	100	100%	1.646s
	400kb	50	99.8%	3.289s

6.1.20 数据库同步

测试场景：链上不加密表中存在 100 万笔交易，新起一个节点配置数据库同步表中数据

测试结果：

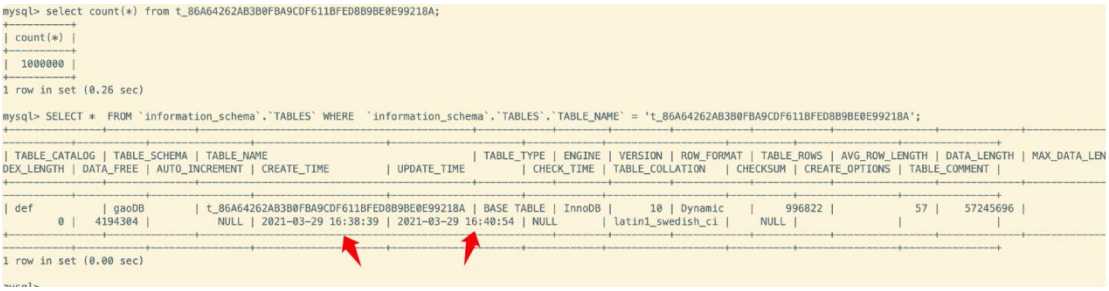


图 78 数据入库

从上图看出，节点消耗 135s 将 100 万笔表交易数据同步到本地，同步的 TPS 为 7407/s。

6.2 稳定性测试

（1）用例设计

测试目的	测试场景设置	测试点
校验 chainsql 支持 7*24h 稳定运行	每秒 50 笔交易发送 7*24h	链运行状态和交易是否正常

(2) 机器配置

机器个数	软硬配置	用途
4 台	系统：Ubuntu 14 硬件配置：8c16g 固态盘 200G	搭建 chainsql 节点

（3）测试结果

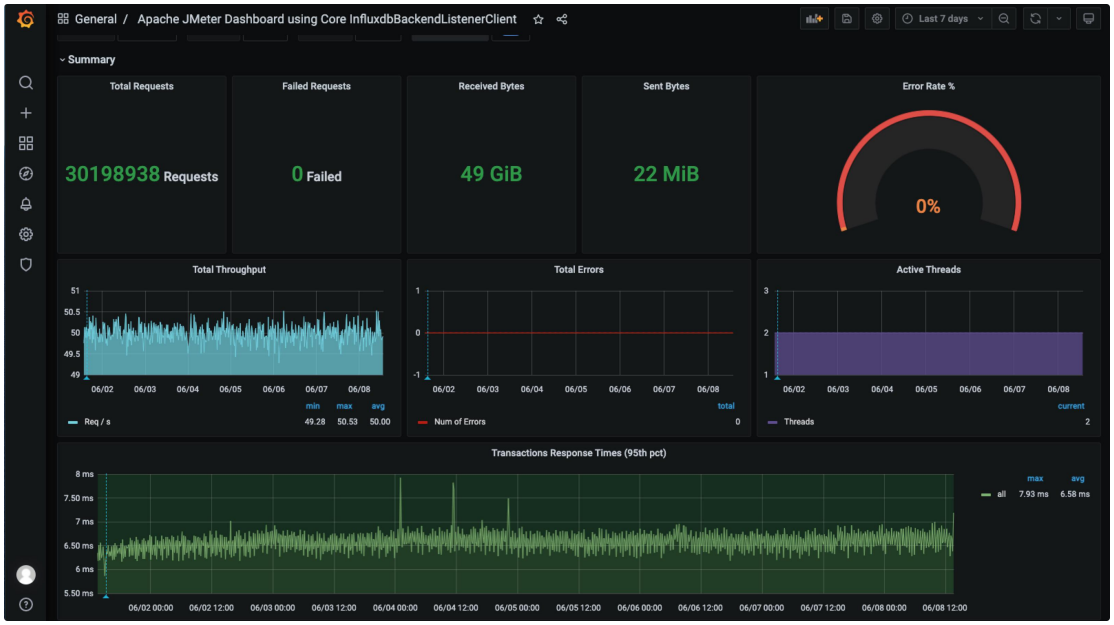


图 79 发送监控图

```
peersafe@peersafe:~/chainsql/chainsql$ ./chainsqld tx_count
Loading: "/home/peersafe/chainsql/chainsql/chainsqld.cfg"
2021-Jun-09 01:31:38.509169894 UTC HTTPClient:NFO Connecting to 127.0.0.1:5005

{
   "result" : {
      "all" : 30260043,
      "chainsql" : 30250002,
      "status" : "success"
   }
}
peersafe@peersafe:~/chainsql/chainsql$
```

图 80 链上总交易数

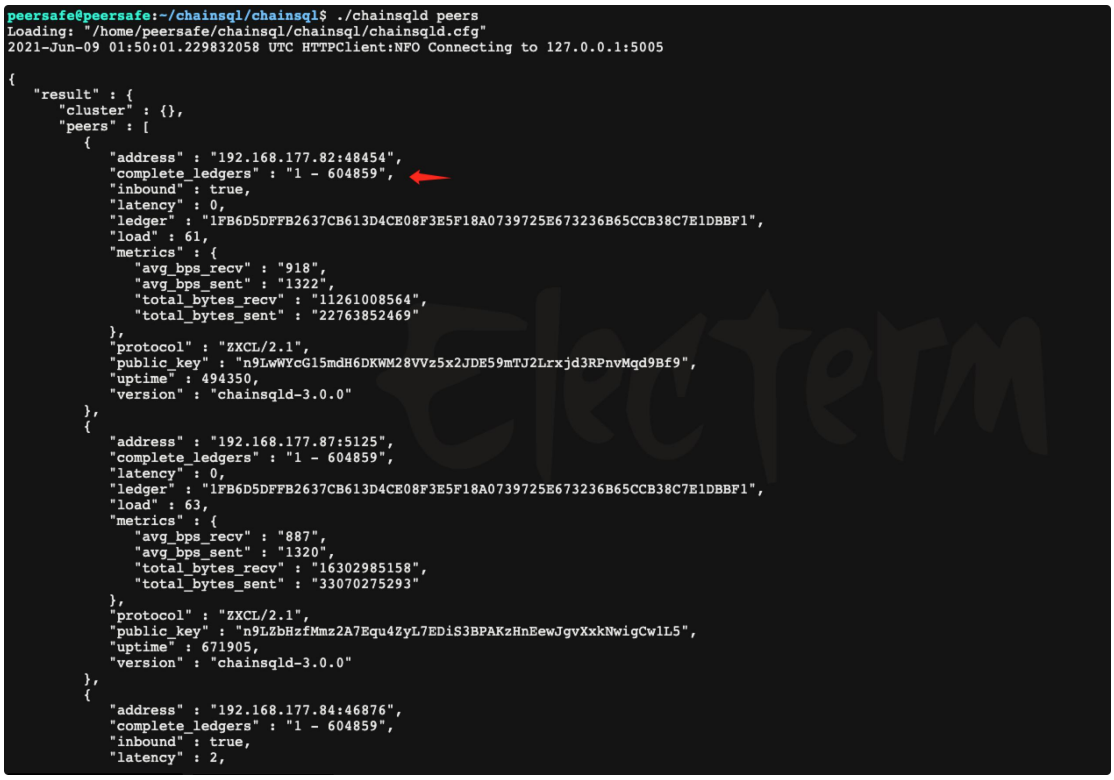


图 81 链区块数

从图 79，80，81 结果分析出，**每秒发送 50 笔交易运行 7*24h 链运行正常，链上总共有 30260043 笔交易，区块数为 604859，所有交易都成功上链，链运行正常**。

7.测试统计与总结

针对上述测试场景结果，现对测试结果进行统计并总结：

7.1 测试结果统计

(1) 节点采用 Secp256k1 非国密版本

节点个数	交易类型	共识算法	共识 TPS	平均落块时间	成功率
4 个	Payment	POP	6289.56/s	2s	100%
		HOTSTUFF	5917.15/s	3s	100%

	InsertMent	POP	7092.19/s	3s	100%
		HOTSTUFF	6993.00/s	3s	100%
10 个	Payment	POP	5524.86/s	3s	100%
		HOTSTUFF	5546.41/s	3s	100%
	InsertMent	POP	5649.71/s	3s	100%
		HOTSTUFF	5405.40/s	3s	100%
20 个	Payment	POP	3521.27/s	3s	100%
		HOTSTUFF	3484.32/s	3s	100%
	InsertMent	POP	3937.00/s	3s	100%
		HOTSTUFF	3521.12/s	3s	100%
50 个	Payment	POP	2000.08/s	3s	100%
		HOTSTUFF	1510.57/s	3s	100%
	InsertMent	POP	1988.07/s	3s	100%
		HOTSTUFF	1494.76/s	3s	100%

(2) 软国密

为对比软国密版本性能情况，现针对 gmalg 节点进行测试，测试结果如下：

节点个数	交易类型	共识算法	共识 TPS	平均落块时间	成功率
4	Payment	POP	5813.95/s	3s	100%
		HOTSTUFF	6211.18/s	3s	100%
	Insertment	POP	6493.50/s	2s	100%
		HOTSTUFF	6711.40/s	3s	100%

(3) 不同区域

以上节点机器都在同一个区域走的是内网，现需要测试不同区域 4 个节点，测试结果如下：

节点个数	交易类型	共识算法	共识 TPS	平均响应时间	成功率
4	Payment	POP	5263.15/s	3s	100%

	Insertment		6024.09/s	3s	100%

(4) 多链

场景设置	交易类型	共识算法	共识 TPS	平均落块时间	成功率
对单条子链发交易	Payment	POP	6097.56/s	3s	100%
	Insertment		6060.60/s	2s	100%

场景设置	交易类型	共识算法	共识 TPS	平均落块时间	成功率
同时对 2 条子链发交易	Payment	POP	子链 A: 4016.06/s 子链 B: 4081.63/s	3s	100%
	Insertment		子链 A: 4329.00/s 子链 B: 4291.84/s	3s	100%

(5) 高配机器

节点个数	交易类型	共识算法	共识 TPS	平均落块时间	成功率
4	Insertment	POP	9803.92/s	3s	100%
			9345.79/s	2s	100%

(6) 查询数据

查询方式	查询数据条数	查询 TPS	查询响应时间	成功率
admin 方式	1 条	17060/s	5.42ms	100%
get 方式	1 条	13710/s	7ms	

7.2 测试总结

(1) 非国密和国密版本 4 个节点 Payment 交易共识在 6298/s 左右， Inserment 交易共识 TPS 达到 7092/s 上下；

(2) 10 个节点非国密版本 Payment 和 InsertMent 交易共识 TPS 在 5500/s；

(3) 20 个节点非国密版本在 5500/s 以上；

(4) 50 个节点非国密版本在 1500-2000/s；

(5) 多链(3 条链)，单条子链(4 个节点)的共识 TPS 可达到 6000/s 以上， 2 条子链同时接收交易每条子链共识 TPS 可达到 4000/s;

(6) 高配机器(16c32g)机器的交易共识 TPS 可达到 9800/s 左右；

(7) 查询数据使用 admin 方式查询 TPS 为 17060/s ,get 方式查询可达到 13710/s；

(8) **节点支持** 7*24h **持续运行并每秒处理** 200 **条交易正常运行，链功能稳定**；

(9) 节点支持大波浪尖峰测试，链可以正常处理交易数据异常变化情况，功能稳定；支持个别节点异常，其他节点可以正常处理交易，链还正常运行状态；

(10) 内网能支持 2000 个并发同时发送 100kb 数据，100 个并发 400kb 交易；外网支持 100 个并发 100kb 数据插入，50 个 400kb 交易插入，链处理交易正常。

7.3 测试建议

（1）机器机械盘在数据量情况下会影响 chainsql 链性能，建议使用固态盘机器部署节点；

（2）节点可配置 use_tx_tables=0 , save_tx_binary=0 提升节点交易处理能力；

（3）节点配置文件中的 work 数会影响节点共识速度，一般可以设置节点所在机器核数的 2 倍。