1.使用Serial GC

1.1.启动服务

分别使用512M和4G堆内存

```
java -jar -Xms512m -Xmx512m -XX:+UseSerialGC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.Serial.log gateway-server-0.0.1-SNAPSHOT.jar
```

```
java -jar -Xms4g -Xmx4g -XX:+UseSerialGC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.Serial-4g.log gateway-server-0.0.1-SNAPSHOT.jar
```

1.2.ab压测

```
ab -n 1000000 -c 1000 http://localhost:8088/api/hello
```

1.3.压测结果：

512M压测报告：

```
$ ab -n 1000000 -c 1000 http://localhost:8088/api/hello
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   171.141 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    5843.13 [#/sec] (mean)
Time per request:       171.141 [ms] (mean)
Time per request:       0.171 [ms] (mean, across all concurrent requests)
Transfer rate:          821.69 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   1.0      0     514
Processing:    28  171  41.6    164    1257
Waiting:        3   92  53.9     90    1053
Total:         28  171  41.6    164    1258

Percentage of the requests served within a certain time (ms)
  50%    164
  66%    169
  75%    173
```

```
  80%    178
  90%    195
  95%    213
  98%    250
  99%    292
 100%   1258 (longest request)
```

4G压测报告：

```
$ ab -n 1000000 -c 1000 http://localhost:8088/api/hello
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   169.009 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    5916.85 [#/sec] (mean)
Time per request:       169.009 [ms] (mean)
Time per request:       0.169 [ms] (mean, across all concurrent requests)
Transfer rate:          832.06 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   1.9      0     516
Processing:    24  168  59.5    159     929
Waiting:       21  117  60.0    117     733
Total:         24  168  59.5    159     930

Percentage of the requests served within a certain time (ms)
  50%    159
  66%    164
  75%    167
```

```
 80%    169
 90%    179
 95%    197
 98%    256
 99%    654
100%    930 (longest request)
```

1.4 GC日志报告（512M）

Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

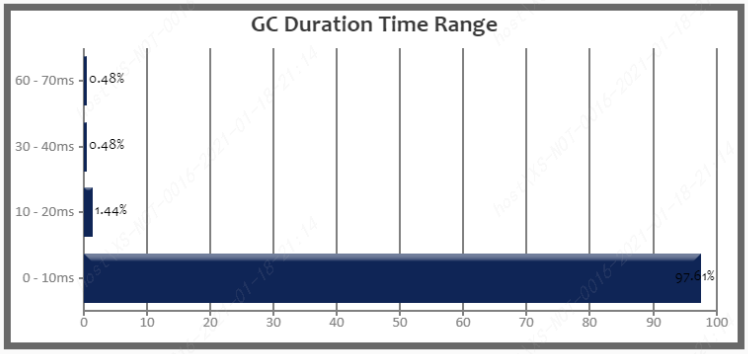
1 Throughput : 99.939%

2 Latency:

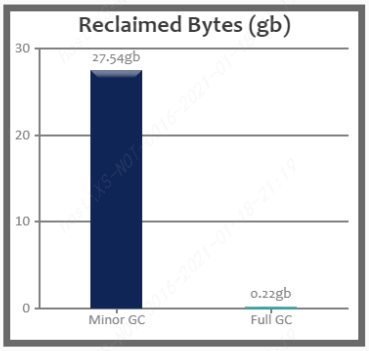
Avg Pause GC Time	1.00 ms
Max Pause GC Time	60.0 ms

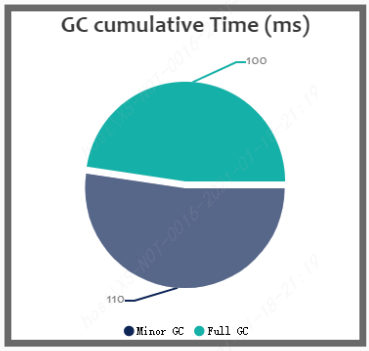
GC Pause Duration Time Range:

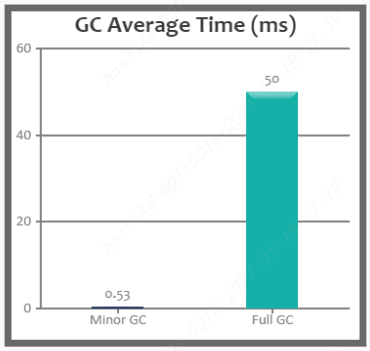
Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	204	97.61%
10 - 20	3	1.44%
30 - 40	1	0.48%
60 - 70	1	0.48%



GC Statistics







Total GC stats

Total GC count	209
Total reclaimed bytes	27.76 gb
Total GC time	210 ms
Avg GC time	1.00 ms
GC avg time std dev	5.66 ms
GC min/max time	0 / 60.0 ms
GC Interval avg time	1 sec 649 ms

Minor GC stats

Minor GC count	207
Minor GC reclaimed	27.54 gb
Minor GC total time	110 ms
Minor GC avg time	0.531 ms
Minor GC avg time std dev	2.82 ms
Minor GC min/max time	0 / 20.0 ms
Minor GC Interval avg	1 sec 665 ms

Full GC stats

Full GC Count	2
Full GC reclaimed	220.41 mb
Full GC total time	100 ms
Full GC avg time	50.0 ms
Full GC avg time std dev	10.0 ms
Full GC min/max time	40.0 ms / 60.0 ms
Full GC Interval avg	1 min 10 sec 87 ms

Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	27.81 gb
Total promoted bytes	30.38 mb
Avg creation rate	82.98 mb/sec
Avg promotion rate	90 kb/sec

1.5 GC日志报告（4G）

Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

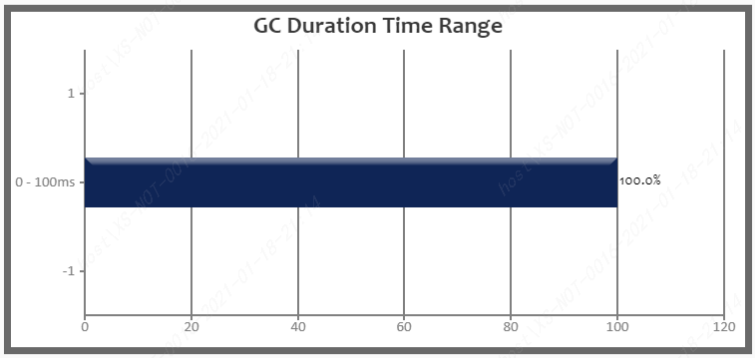
1 Throughput : 99.799%

2 Latency:

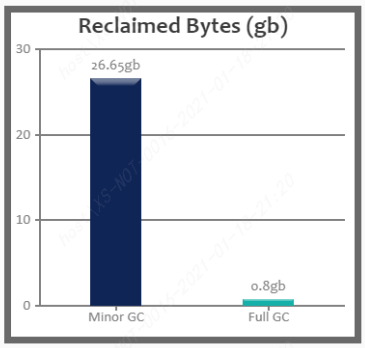
Avg Pause GC Time	13.0 ms
Max Pause GC Time	100 ms

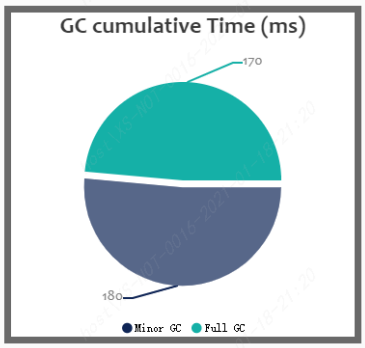
GC Pause Duration Time Range:

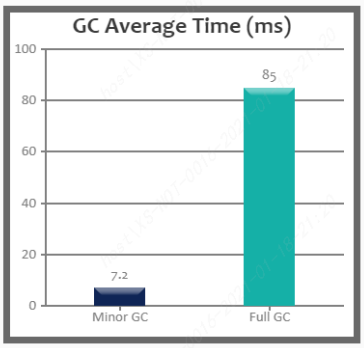
Duration (ms) 100 ms Change	No. of GCs	Percentage
0 - 100	27	100.0%



GC Statistics







Total GC stats

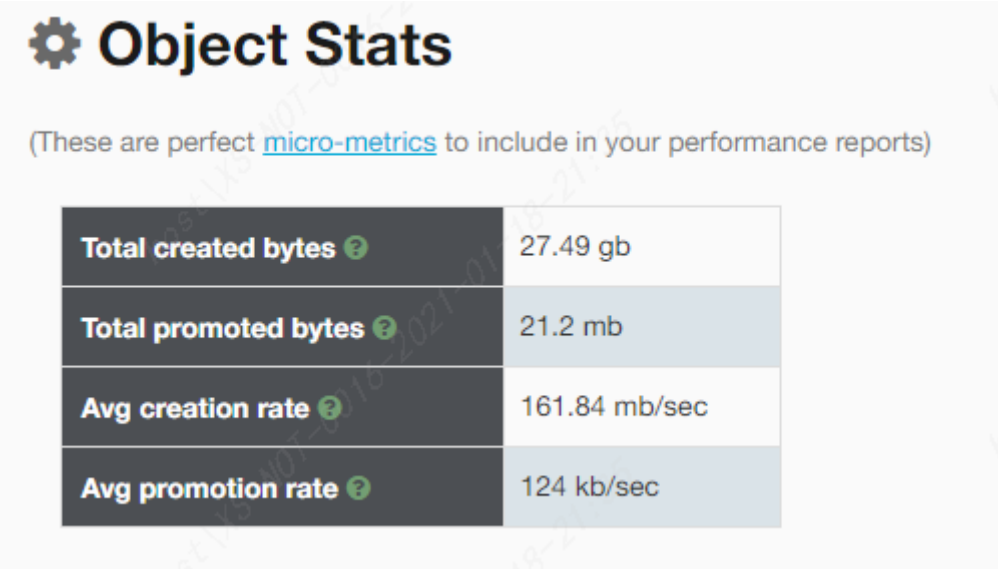
Total GC count	27
Total reclaimed bytes	27.44 gb
Total GC time	350 ms
Avg GC time	13.0 ms
GC avg time std dev	21.6 ms
GC min/max time	0 / 100 ms
GC Interval avg time	6 sec 690 ms

Minor GC stats

Minor GC count	25
Minor GC reclaimed	26.65 gb
Minor GC total time	180 ms
Minor GC avg time	7.20 ms
Minor GC avg time std dev	6.01 ms
Minor GC min/max time	0 / 20.0 ms
Minor GC Interval avg	6 sec 545 ms

Full GC stats

Full GC Count	2
Full GC reclaimed	815.06 mb
Full GC total time	170 ms
Full GC avg time	85.0 ms
Full GC avg time std dev	15.0 ms
Full GC min/max time	70.0 ms / 100 ms
Full GC Interval avg	10 sec 928 ms



- Serial GC heap内存设置为512M时，吞吐量是99.939%，当调大堆内存为4G时，吞吐量反而下降到99.799%，GC平均暂停时间从1ms增大到13ms；
- 当调大heap内存时，Minor GC次数从207次降低到25次，虽然次数减少了，但是GC时间反而增大了80ms，Full GC次数没有变化，但Full GC时间增大70ms；
- 当堆内存调大到4g时，内存的分配速率提升1倍，这也是Minor GC次数下降的原因；老年代的提升速率也有相应增长，但仍远远小于新生代分派速率，属于健康状态；
- Serial GC在大堆内存下，劣势非常明显：gc是串行的，堆内存越大，垃圾回收时间越长。

1.使用Parallel GC

1.1.启动服务

分别使用512M和4G堆内存

```
java -jar -Xms512m -Xmx512m -XX:+UseParallelGC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.Parallel.log gateway-server-0.0.1-SNAPSHOT.jar
```

```
java -jar -Xms4g -Xmx4g -XX:+UseParallelGC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.Parallel-4g.log gateway-server-0.0.1-
SNAPSHOT.jar
```

1.2.ab压测

```
ab -n 1000000 -c 1000 http://localhost:8088/api/hello
```

1.3.压测结果：

512M压测报告：

```
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
```

```
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   174.196 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    5740.67 [#/sec] (mean)
Time per request:       174.196 [ms] (mean)
Time per request:       0.174 [ms] (mean, across all concurrent requests)
Transfer rate:          807.28 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   1.5      0     515
Processing:    25  173  49.0    165     870
Waiting:       25  118  56.3    120     719
Total:         25  174  49.0    165     870

Percentage of the requests served within a certain time (ms)
  50%    165
  66%    170
  75%    176
  80%    180
  90%    196
  95%    210
  98%    245
  99%    312
 100%    870 (longest request)
```

4G压测报告：

```
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
```

```
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   172.136 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    5809.35 [#/sec] (mean)
Time per request:       172.136 [ms] (mean)
Time per request:       0.172 [ms] (mean, across all concurrent requests)
Transfer rate:          816.94 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   1.0      0     515
Processing:    28  172  38.6    164     710
Waiting:       14  118  48.4    121     706
Total:         28  172  38.7    164     710

Percentage of the requests served within a certain time (ms)
  50%    164
  66%    170
  75%    176
  80%    181
  90%    194
  95%    207
  98%    254
  99%    311
 100%    710 (longest request)
```

1.4 GC日志报告（512M）

Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

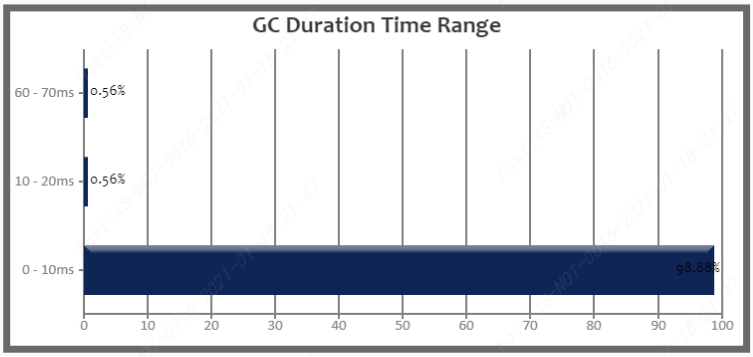
1 Throughput : 99.911%

2 Latency:

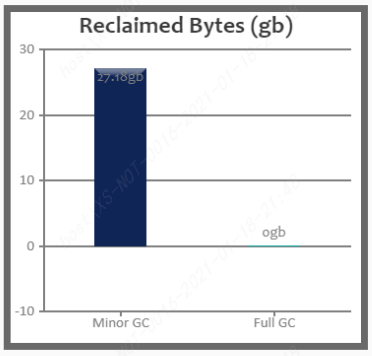
Avg Pause GC Time	0.899 ms
Max Pause GC Time	60.0 ms

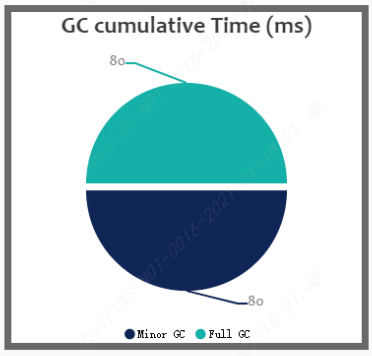
GC Pause Duration Time Range:

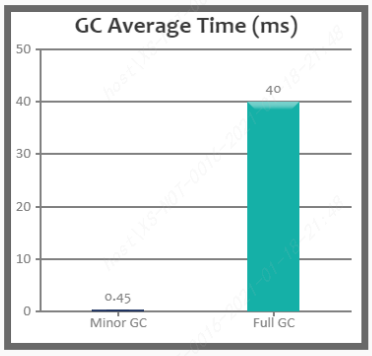
Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	176	98.88%
10 - 20	1	0.56%
60 - 70	1	0.56%



GC Statistics







Total GC stats

Total GC count	178
Total reclaimed bytes	27.18 gb
Total GC time	160 ms
Avg GC time	0.899 ms
GC avg time std dev	5.11 ms
GC min/max time	0 / 60.0 ms
GC Interval avg time	1 sec 14 ms

Minor GC stats

Minor GC count	176
Minor GC reclaimed	27.18 gb
Minor GC total time	80.0 ms
Minor GC avg time	0.455 ms
Minor GC avg time std dev	2.08 ms
Minor GC min/max time	0 / 10.0 ms
Minor GC Interval avg	1 sec 25 ms

Full GC stats

Full GC Count	2
Full GC reclaimed	2.03 mb
Full GC total time	80.0 ms
Full GC avg time	40.0 ms
Full GC avg time std dev	20.0 ms
Full GC min/max time	20.0 ms / 60.0 ms
Full GC Interval avg	5 sec 952 ms

Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	27.23 gb
Total promoted bytes	33.05 mb
Avg creation rate	155.33 mb/sec
Avg promotion rate	188 kb/sec

1.5 GC日志报告（4G）

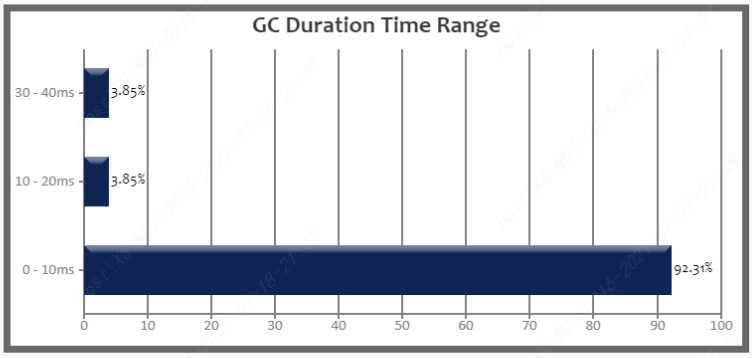
Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

1 Throughput : 99.893%

2 Latency:

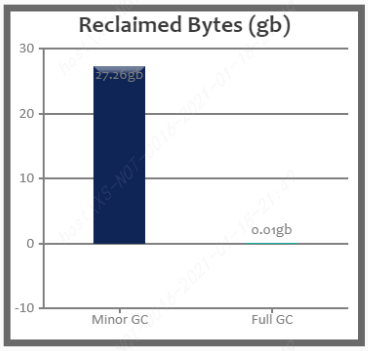
Avg Pause GC Time	6.92 ms
Max Pause GC Time	40.0 ms

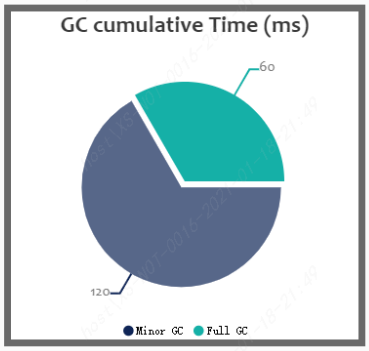


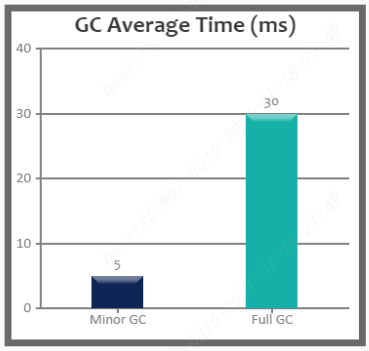
GC Pause Duration Time Range:

Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	24	92.31%
10 - 20	1	3.85%
30 - 40	1	3.85%

GC Statistics







Total GC stats

Total GC count	26
Total reclaimed bytes	27.28 gb
Total GC time	180 ms
Avg GC time	6.92 ms
GC avg time std dev	8.67 ms
GC min/max time	0 / 40.0 ms
GC Interval avg time	6 sec 748 ms

Minor GC stats

Minor GC count	24
Minor GC reclaimed	27.26 gb
Minor GC total time	120 ms
Minor GC avg time	5.00 ms
Minor GC avg time std dev	5.00 ms
Minor GC min/max time	0 / 10.0 ms
Minor GC Interval avg	7 sec 335 ms

Full GC stats

Full GC Count	2
Full GC reclaimed	11.13 mb
Full GC total time	60.0 ms
Full GC avg time	30.0 ms
Full GC avg time std dev	10.0 ms
Full GC min/max time	20.0 ms / 40.0 ms
Full GC Interval avg	5 sec 28 ms

Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	27.32 gb
Total promoted bytes	26.73 mb
Avg creation rate	165.83 mb/sec
Avg promotion rate	162 kb/sec

- Parallel GC时，堆内存从512M调整为4G时，jvm吞吐量不大，稍稍降低了0.018%；
- 调大内存，MinorGC次数176次下降到24次，Full GC次数没有变化，提升了内存分派速率，符合预期；
- 新生代分派速率提升了，但老年代的提升速率反而下降了，这与Serial GC相反；这也体现Parallel GC在大内存下比Serial GC更有优势；
- 由于内存增大了，所以平均GC时间增大10倍，但是整个吞吐量却没有因为GC时间变长而直线下降。这也体现了Parallel GC的优势。

1.使用CMS GC

1.1.启动服务

分别使用512M和4G堆内存

```
java -jar -Xms512m -Xmx512m -XX:+UseConcMarkSweepGC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.cms.log gateway-server-0.0.1-SNAPSHOT.jar
```

```
java -jar -Xms4g -Xmx4g -XX:+UseConcMarkSweepGC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.cms-4g.log gateway-server-0.0.1-SNAPSHOT.jar
```

1.2.ab压测

```
ab -n 1000000 -c 1000 http://localhost:8088/api/hello
```

1.3.压测结果：

512M压测报告：

```
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
```

```
Time taken for tests:   195.015 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    5127.80 [#/sec] (mean)
Time per request:       195.015 [ms] (mean)
Time per request:       0.195 [ms] (mean, across all concurrent requests)
Transfer rate:          721.10 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   0.9      0     513
Processing:    28  194  45.3    180    1238
Waiting:       17  127  57.6    129    1004
Total:         28  194  45.4    180    1238

Percentage of the requests served within a certain time (ms)
  50%    180
  66%    185
  75%    205
  80%    218
  90%    238
  95%    252
  98%    285
  99%    320
 100%   1238 (longest request)
```

4G压测报告：

```
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   202.183 seconds
```

```
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    4946.01 [#/sec] (mean)
Time per request:       202.183 [ms] (mean)
Time per request:       0.202 [ms] (mean, across all concurrent requests)
Transfer rate:          695.53 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   0.9      0     509
Processing:    26  201  43.7    188    1518
Waiting:       21  127  59.1    128    1425
Total:         26  201  43.7    188    1518

Percentage of the requests served within a certain time (ms)
  50%    188
  66%    203
  75%    212
  80%    220
  90%    240
  95%    280
  98%    308
  99%    328
 100%   1518 (longest request)
```

1.4 GC日志报告（512M）

Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

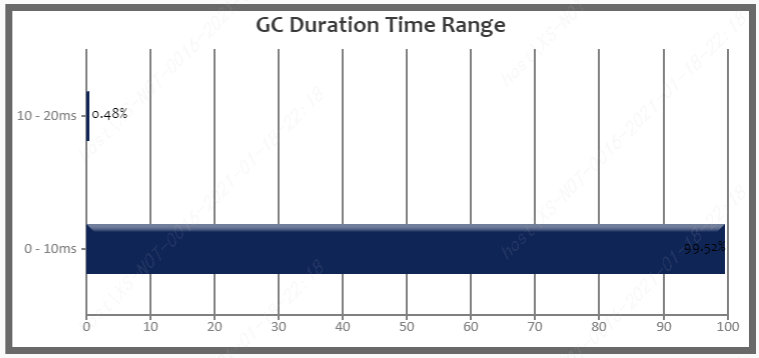
1 Throughput : 99.922%

2 Latency:

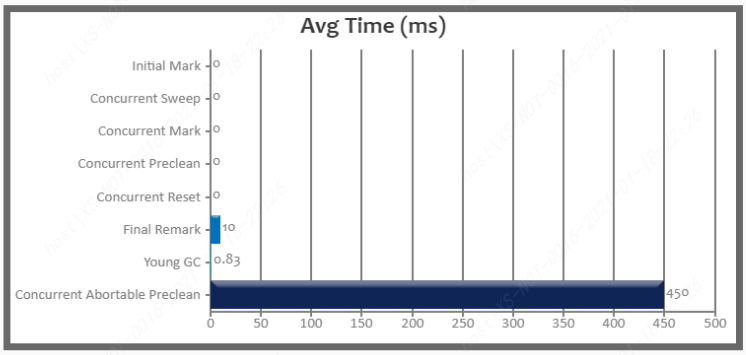
Avg Pause GC Time	0.870 ms
Max Pause GC Time	20.0 ms

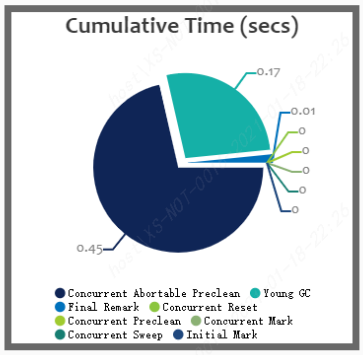
GC Pause Duration Time Range:

Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	206	99.52%
10 - 20	1	0.48%



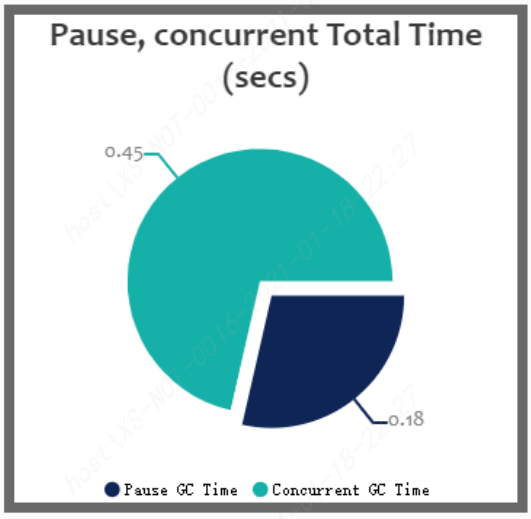
CMS Collection Phases Statistics

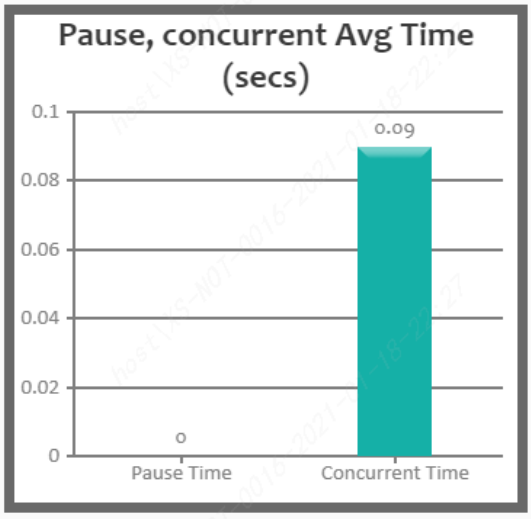




	Concurrent Abortable Preclean	Young GC	Final Remark	Concurrent Reset	Concurrent Preclean	Concurrent Mark	Concurrent Sweep	Initial Mark
Total Time	450 ms	170 ms	10.0 ms	0	0	0	0	0
Avg Time	450 ms	0.829 ms	10.0 ms	0	0	0	0	0
Std Dev Time	0	2.93 ms	0	0	0	0	0	0
Min Time	450 ms	0	10.0 ms	0	0	0	0	0
Max Time	450 ms	20.0 ms	10.0 ms	0	0	0	0	0
Interval Time	n/a	1 sec 125 ms	n/a	n/a	n/a	n/a	n/a	n/a
Count	1	205	1	1	1	1	1	1

CMS GC Time





Pause Time

Total Time	180 ms
Avg Time	0.870 ms
Std Dev Time	2.98 ms
Min Time	0
Max Time	20.0 ms

Concurrent Time

Total Time	450 ms
Avg Time	90.0 ms
Std Dev Time	180 ms
Min Time	0
Max Time	450 ms

Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	27.33 gb
Total promoted bytes	33.69 mb
Avg creation rate	121.87 mb/sec
Avg promotion rate	150 kb/sec

1.5 GC日志报告（4G）

Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

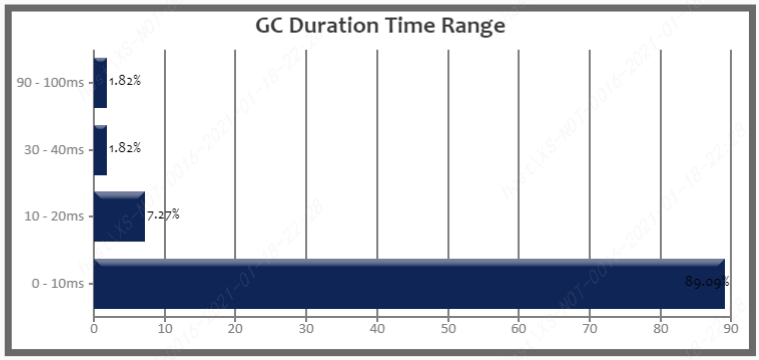
1 Throughput : 99.665%

2 Latency:

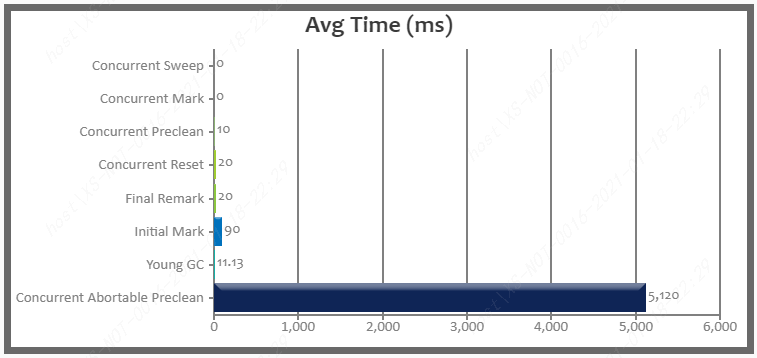
Avg Pause GC Time	12.7 ms
Max Pause GC Time	90.0 ms

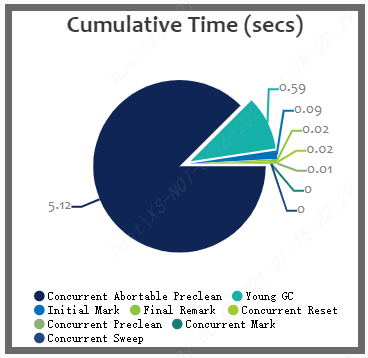
GC Pause Duration Time Range:

Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	49	89.09%
10 - 20	4	7.27%
30 - 40	1	1.82%
90 - 100	1	1.82%



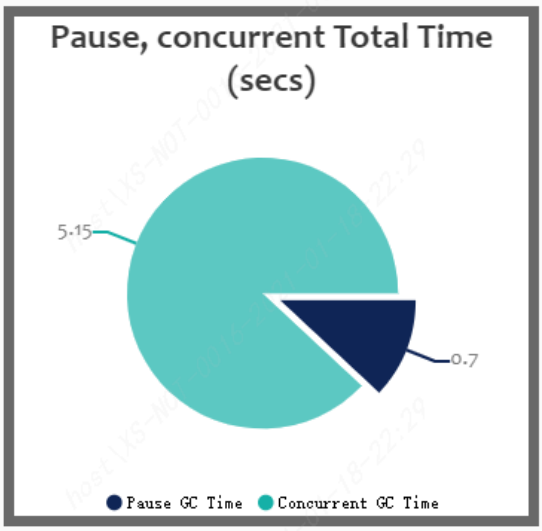
CMS Collection Phases Statistics

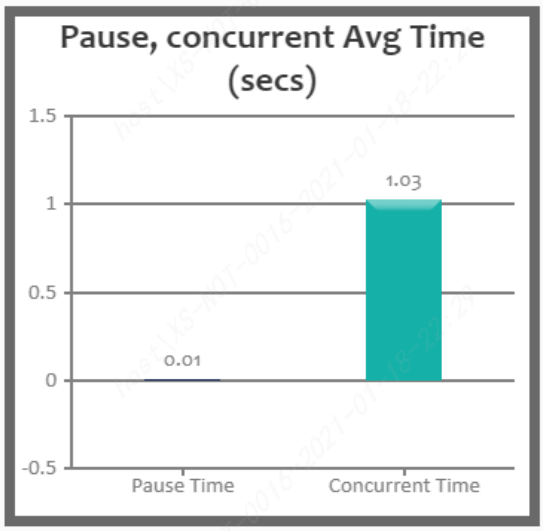




	Concurrent Abortable Preclean	Young GC	Initial Mark	Final Remark	Concurrent Reset	Concurrent Preclean	Concurrent Mark	Concurrent Sweep
Total Time	5 sec 120 ms	590 ms	90.0 ms	20.0 ms	20.0 ms	10.0 ms	0	0
Avg Time	5 sec 120 ms	11.1 ms	90.0 ms	20.0 ms	20.0 ms	10.0 ms	0	0
Std Dev Time	0	4.62 ms	0	0	0	0	0	0
Min Time	5 sec 120 ms	10.0 ms	90.0 ms	20.0 ms	20.0 ms	10.0 ms	0	0
Max Time	5 sec 120 ms	40.0 ms	90.0 ms	20.0 ms	20.0 ms	10.0 ms	0	0
Interval Time	n/a	4 sec 3 ms	n/a	n/a	n/a	n/a	n/a	n/a
Count	1	53	1	1	1	1	1	1

CMS GC Time



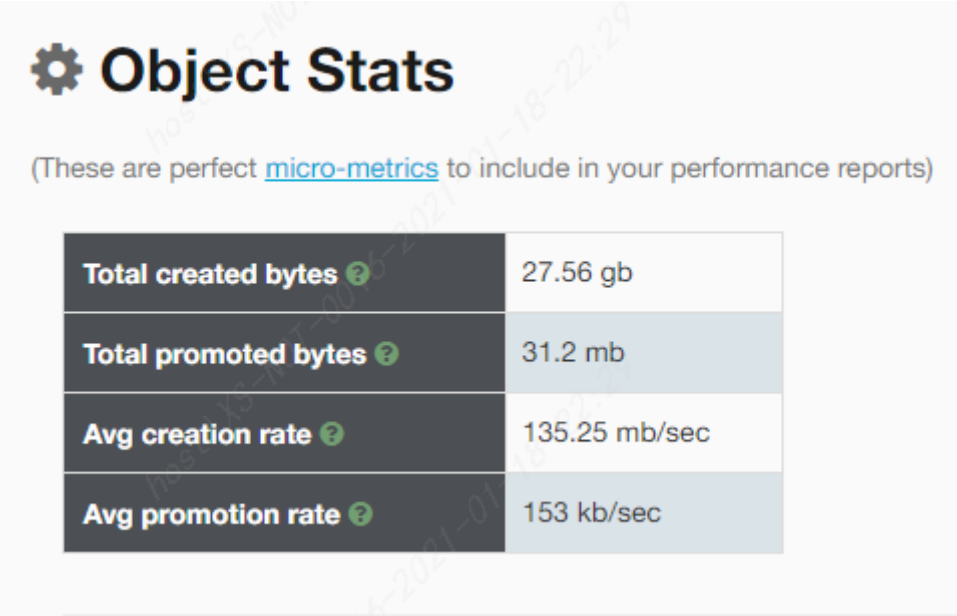


Pause Time

Total Time	700 ms
Avg Time	12.7 ms
Std Dev Time	11.5 ms
Min Time	10.0 ms
Max Time	90.0 ms

Concurrent Time

Total Time	5 sec 150 ms
Avg Time	1 sec 30 ms
Std Dev Time	2 sec 45 ms
Min Time	0
Max Time	5 sec 120 ms



Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	27.56 gb
Total promoted bytes	31.2 mb
Avg creation rate	135.25 mb/sec
Avg promotion rate	153 kb/sec

- 对内存从512M调整为4G，整个jvm的吞吐率下降；初始标记时间从0ms增大到90ms
- 因为本次压测的程序占用内存相对不大，如果过度增加内存，会使GC暂停时间整体变大，从这点可以看出，内存不是越大越好，需要根据实际情况平衡调整。

1.使用G1 GC

1.1.启动服务

分别使用512M和4G堆内存

```
java -jar -Xms512m -Xmx512m -XX:+UseG1GC -XX:+PrintGCDetails -
XX:+PrintGCDateStamps -Xloggc:gc.g1.log gateway-server-0.0.1-SNAPSHOT.jar
```

```
java -jar -Xms4g -Xmx4g -XX:+UseG1GC -XX:+PrintGCDetails -XX:+PrintGCDateStamps
-Xloggc:gc.g1-4g.log gateway-server-0.0.1-SNAPSHOT.jar
```

1.2.ab压测

```
ab -n 1000000 -c 1000 http://localhost:8088/api/hello
```

1.3.压测结果：

512M压测报告：

```
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
```

```
Completed 900000 requests
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   192.843 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    5185.58 [#/sec] (mean)
Time per request:       192.843 [ms] (mean)
Time per request:       0.193 [ms] (mean, across all concurrent requests)
Transfer rate:          729.22 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   0.8      0     510
Processing:    27  192  39.5    183    1274
Waiting:        7  101  60.4     99    1212
Total:         27  192  39.5    183    1274

Percentage of the requests served within a certain time (ms)
  50%    183
  66%    194
  75%    205
  80%    210
  90%    219
  95%    233
  98%    256
  99%    279
 100%   1274 (longest request)
```

4G压测报告：

```
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 100000 requests
Completed 200000 requests
Completed 300000 requests
Completed 400000 requests
Completed 500000 requests
Completed 600000 requests
Completed 700000 requests
Completed 800000 requests
Completed 900000 requests
```

```
Completed 1000000 requests
Finished 1000000 requests


Server Software:
Server Hostname:        localhost
Server Port:            8088

Document Path:          /api/hello
Document Length:        11 bytes

Concurrency Level:      1000
Time taken for tests:   203.844 seconds
Complete requests:      1000000
Failed requests:        0
Total transferred:      144000000 bytes
HTML transferred:       11000000 bytes
Requests per second:    4905.72 [#/sec] (mean)
Time per request:       203.844 [ms] (mean)
Time per request:       0.204 [ms] (mean, across all concurrent requests)
Transfer rate:          689.87 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   0.4      0     176
Processing:    29  203  35.6    191    1093
Waiting:       12  131  54.6    134    1034
Total:         29  203  35.7    191    1094

Percentage of the requests served within a certain time (ms)
  50%    191
  66%    211
  75%    215
  80%    218
  90%    238
  95%    259
  98%    297
  99%    321
 100%   1094 (longest request)
```

1.4 GC日志报告（512M）

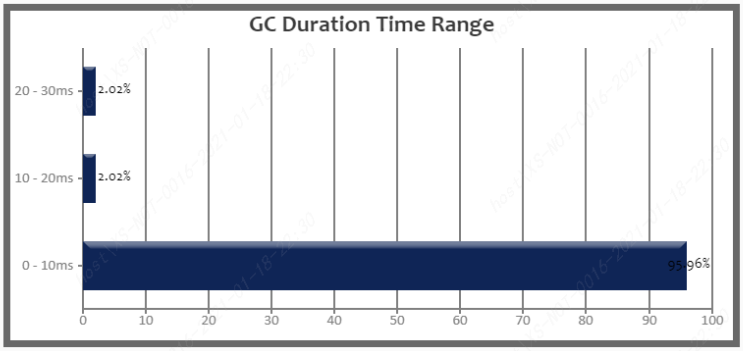
Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

1 Throughput : 99.945%

2 Latency:

Avg Pause GC Time	1.41 ms
Max Pause GC Time	30.0 ms

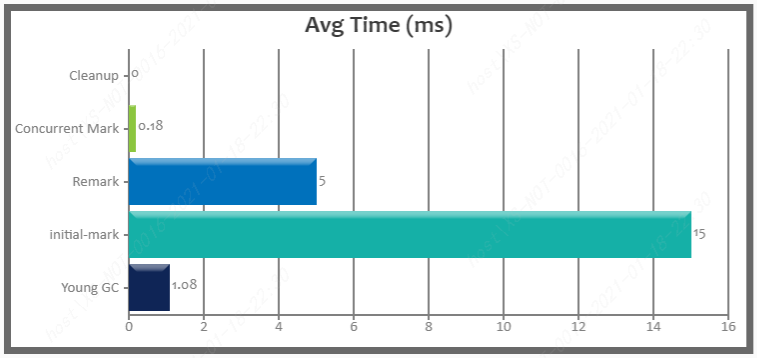


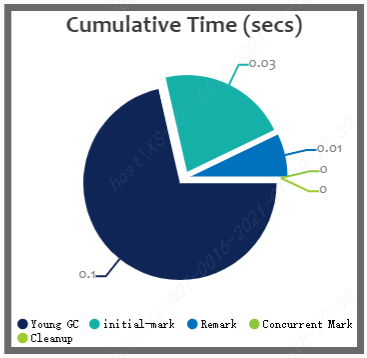
GC Pause Duration Time Range:

Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	95	95.96%
10 - 20	2	2.02%
20 - 30	2	2.02%

G1 Collection Phases Statistics

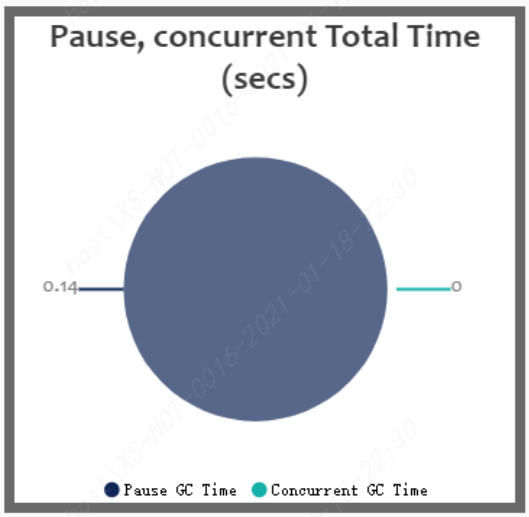
(One G1 GC event has multiple phases. This section provides detailed statistics of each G1 phases.)

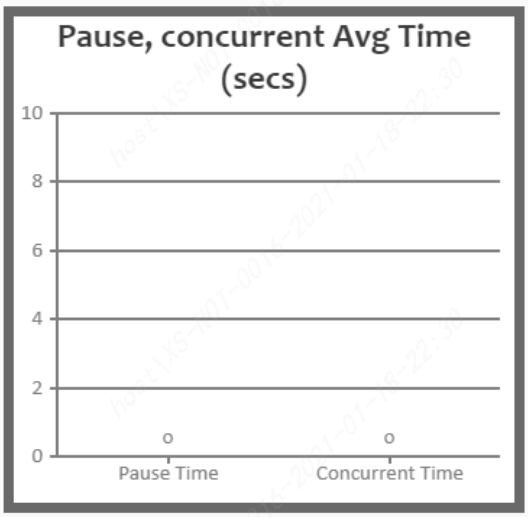




	Young GC	initial-mark	Remark	Concurrent Mark	Cleanup	Total
Count	93	2	2	2	2	101
Total GC Time	100 ms	30.0 ms	10.0 ms	0.363 ms	0	140 ms
Avg GC Time	1.08 ms	15.0 ms	5.00 ms	0.182 ms	0	1.39 ms
Avg Time std dev	4.96 ms	5.00 ms	5.00 ms	0.0681 ms	0	5.27 ms
Min/Max Time	0 / 30.0 ms	0 / 20.0 ms	0 / 10.0 ms	0 / 0.250 ms	0 / 0	0 / 30.0 ms
Avg Interval Time	2 sec 783 ms	1 min 4 sec 722 ms	1 min 4 sec 736 ms	1 min 4 sec 732 ms	1 min 4 sec 741 ms	5 sec 365 ms

G1 GC Time





Pause Time

Total Time	140 ms
Avg Time	1.41 ms
Std Dev Time	5.32 ms
Min Time	0
Max Time	30.0 ms

Concurrent Time

Total Time	0.363 ms
Avg Time	0.182 ms
Std Dev Time	0.0681 ms
Min Time	0.114 ms
Max Time	0.250 ms

Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	27.17 gb
Total promoted bytes	39.51 mb
Avg creation rate	108.61 mb/sec
Avg promotion rate	157 kb/sec

1.5 GC日志报告（4G）

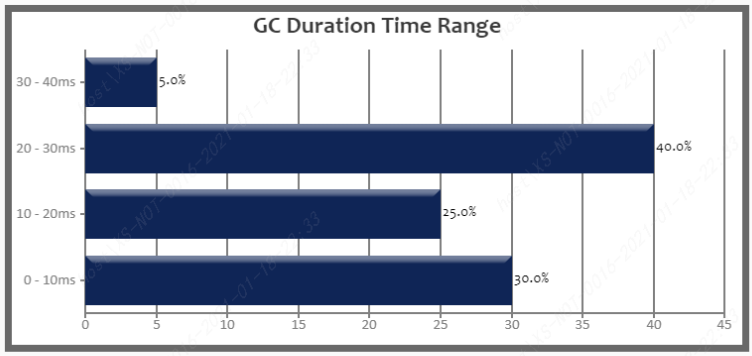
Key Performance Indicators

(Important section of the report. To learn more about KPIs, click here)

1. Throughput : 99.797%

2. Latency:

Avg Pause GC Time	20.5 ms
Max Pause GC Time	40.0 ms

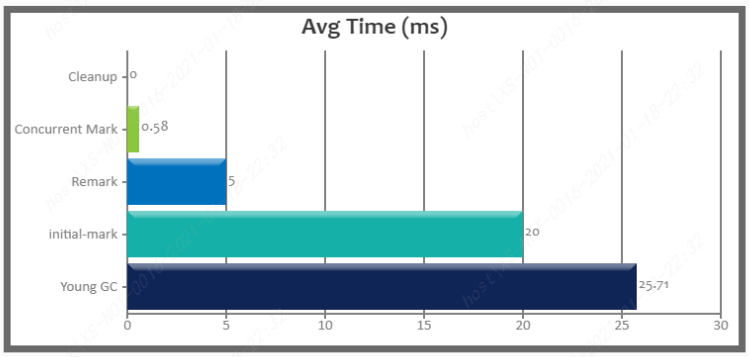


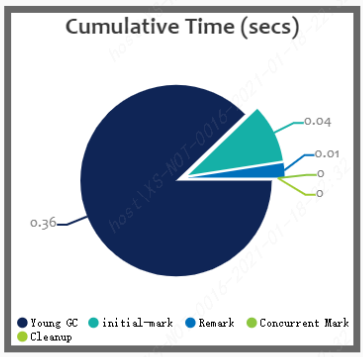
GC **Pause** Duration Time Range :

Duration (ms) 10 ms Change	No. of GCs	Percentage
0 - 10	6	30.0%
10 - 20	5	25.0%
20 - 30	8	40.0%
30 - 40	1	5.0%

G1 Collection Phases Statistics

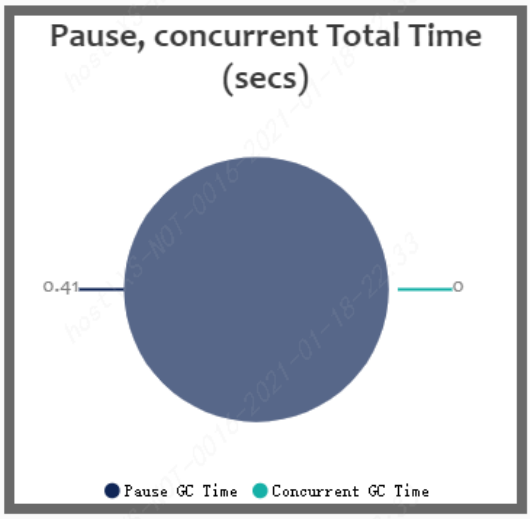
(One G1 GC event has multiple phases. This section provides detailed statistics of each G1 phases.)

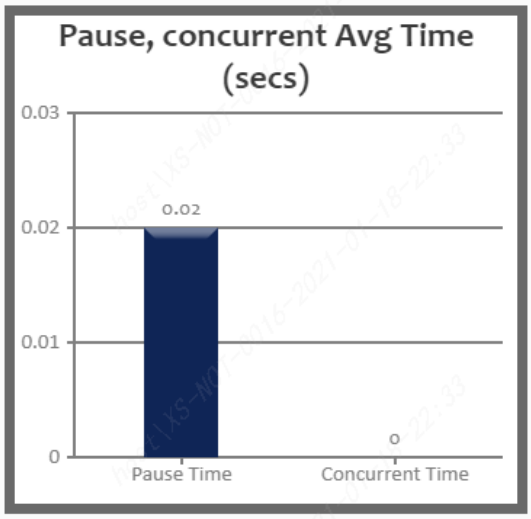




	Young GC	initial-mark	Remark	Concurrent Mark	Cleanup	Total
Count	14	2	2	2	2	22
Total GC Time	360 ms	40.0 ms	10.0 ms	1.16 ms	0	411 ms
Avg GC Time	25.7 ms	20.0 ms	5.00 ms	0.582 ms	0	18.7 ms
Avg Time std dev	7.28 ms	10.0 ms	5.00 ms	0.180 ms	0	12.5 ms
Min/Max Time	0 / 40.0 ms	0 / 30.0 ms	0 / 10.0 ms	0 / 0.762 ms	0 / 0	0 / 40.0 ms
Avg Interval Time	15 sec 548 ms	6 sec 214 ms	6 sec 251 ms	6 sec 251 ms	6 sec 256 ms	13 sec 358 ms

G1 GC Time





Pause Time

Total Time	410 ms
Avg Time	20.5 ms
Std Dev Time	11.6 ms
Min Time	0
Max Time	40.0 ms

Concurrent Time

Total Time	1.16 ms
Avg Time	0.582 ms
Std Dev Time	0.180 ms
Min Time	0.401 ms
Max Time	0.762 ms

Object Stats

(These are perfect micro-metrics to include in your performance reports)

Total created bytes	26.35 gb
Total promoted bytes	8.9 mb
Avg creation rate	133.47 mb/sec
Avg promotion rate	45 kb/sec

- G1 GC在堆内存增加到4G时，新生代的分派速率平稳增长，但是老年代的提升速率降低非常明显，这说明了G1相对前三类GC更适合大内存的堆；
- 对内存从512M调整为4G，整个jvm的吞吐率稍微下降；
- 因为本次压测的程序占用内存相对不大，如果过度增加内存，会使GC暂停时间整体变大，从这点可以看出，内存不是越大越好，需要根据实际情况平衡调整。

5.压测结果对比

并发数：1000

请求次数：1000000

硬件：CPU:i5-10210U 逻辑核数：8core

内存： 16G

QPS

jvm heap: -Xms512m -Xmx512m

Serial GC	Parallel GC	CMS GC	G1 GC
5843.13	5740.67	5127.80	5185.58

jvm heap: -Xms4G -Xmx4G

Serial GC	Parallel GC	CMS GC	G1 GC
5916.85	5809.35	4946.01	4905.72

95%响应时间（ms）

jvm heap: -Xms512m -Xmx512m

Serial GC	Parallel GC	CMS GC	G1 GC
213	210	252	233

jvm heap: -Xms4G -Xmx4G

Serial GC	Parallel GC	CMS GC	G1 GC
197	207	280	259

服务标准差（越小越稳定）

jvm heap: -Xms512m -Xmx512m

Serial GC	Parallel GC	CMS GC	G1 GC
41.6	49.0	45.4	39.5

jvm heap: -Xms4G -Xmx4G

Serial GC	Parallel GC	CMS GC	G1 GC
59.5	38.7	43.7	35.7