**ceph分布式存储-块存储BlueStore性能测试**

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**一、 集群环境**

**1.1 部署环境说明**

**mon组件部署：** ceph-xxx-osd00, ceph-xxx-osd01, ceph-xxx-osd02  
**osd组件部署：** ceph-xxx-osd00, ceph-xxx-osd01, ceph-xxx-osd02，ceph-xxx-osd03, ceph-xxx-osd04  
**磁盘：** SATA  
**ceph版本：** ceph 12.2.2 bluestore

**二、 性能测试**

**2.1 rados bench测试**

**2.1.1 写测试**

//默认block size是4M，30个线程并发，测试时间200s  
测试结果：30线程并发写，带宽：1119.68 MB/s 平均IOPS：279 平均延迟：0.107s

rados bench -p test\_pool 200 write -t 30 --no-cleanup --cluster=test

Total time run: 200.075896

Total writes made: 56005

Write size: 4194304

Object size: 4194304

Bandwidth (MB/sec): 1119.68

Stddev Bandwidth: 13.3296

Max bandwidth (MB/sec): 1148

Min bandwidth (MB/sec): 1048

Average IOPS: 279

Stddev IOPS: 3

Max IOPS: 287

Min IOPS: 262

Average Latency(s): 0.107161

Stddev Latency(s): 0.0469331

Max latency(s): 0.50955

Min latency(s): 0.0251761

**2.1.2 顺序读**

//默认block size是4M，30个线程并发，测试时间200s  
测试结果：30线程并发，带宽：1121.07 MB/s 平均IOPS：280 平均延迟0.106s

rados bench -p test\_pool 200 seq -t 30 --no-cleanup --cluster=test

Total time run: 199.827279

Total reads made: 56005

Read size: 4194304

Object size: 4194304

Bandwidth (MB/sec): 1121.07

Average IOPS: 280

Stddev IOPS: 2

Max IOPS: 288

Min IOPS: 260

Average Latency(s): 0.106283

Max latency(s): 0.780835

Min latency(s): 0.0198169

**2.1.3 随机读**

//默认block size是4M，30个线程并发，测试时间200s  
测试结果：30线程并发，带宽：1109.64 MB/s 平均IOPS：279 平均延迟：0.106s

rados bench -p test\_pool 200 rand -t 30 --no-cleanup --cluster=test

Total time run: 200.074550

Total reads made: 56003

Read size: 4194304

Object size: 4194304

Bandwidth (MB/sec): 1119.64

Average IOPS: 279

Stddev IOPS: 3

Max IOPS: 286

Min IOPS: 245

Average Latency(s): 0.106435

Max latency(s): 0.732702

Min latency(s): 0.0216828

**2.2 rbd性能测试**

**2.2.1 顺序读写**

//默认block size是4k，30个线程并发  
测试结果：30线程并发，带宽：297 MB/s 平均IOPS：72681.76

rbd bench-write test\_image --io-threads 30 --pool=test\_pool --io-pattern seq --io-total 17199730000 --cluster=test

elapsed: 57 ops: 4199153 ops/sec: 72681.76 bytes/sec: 297704487.46

//block size是4M，30个线程并发  
测试结果：30线程并发，带宽：844MB/s 平均IOPS：206.16

rbd bench-write test\_image --io-threads 30 --pool=test\_pool --io-pattern seq --io-total 17199730000 --io-size 4096000 --cluster=test

elapsed: 20 ops: 4200 ops/sec: 206.16 bytes/sec: 844451109.43

**2.2.2 随机读写**

//默认block size是4k，30个线程并发  
测试结果：30线程并发，带宽：36 MB/s 平均IOPS：8925.40

rbd bench-write test\_image --io-threads 30 --pool=test\_pool --io-pattern rand --io-total 17199730000 --cluster=test

elapsed: 470 ops: 4199153 ops/sec: 8925.40 bytes/sec: 36558420.10

//block size是4M，30个线程并发  
测试结果：30线程并发，带宽：860 MB/s 平均IOPS： 210.18

rbd bench-write test\_image --io-threads 30 --pool=test\_pool --io-pattern rand --io-total 17199730000 --io-size 4096000 --cluster=test

elapsed: 19 ops: 4200 ops/sec: 210.18 bytes/sec: 860894998.27

**2.3 fio+libaio测试**

**2.3.1 顺序读(block size 4M)**

//block size是4M, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：2365.5 MB/s 平均IOPS： 591 耗时：50.58ms

fio -filename=/mnt/test/xxx -direct=1 -iodepth 1 -thread -rw=read -ioengine=libaio -bs=4M -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=read, bs=4M-4M/4M-4M/4M-4M, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [R(30)] [100.0% done] [2580MB/0KB/0KB /s] [645/0/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=32265: Tue Jan 16 14:42:45 2018

read : io=30720MB, bw=2365.5MB/s, iops=591, runt= 12987msec

slat (usec): min=381, max=111307, avg=39421.29, stdev=12150.39

clat (usec): min=806, max=99391, avg=11156.56, stdev=8561.94

lat (msec): min=2, max=127, avg=50.58, stdev=11.41

clat percentiles (usec):

| 1.00th=[ 4128], 5.00th=[ 6496], 10.00th=[ 7072], 20.00th=[ 7072],

| 30.00th=[ 7072], 40.00th=[ 7136], 50.00th=[ 7136], 60.00th=[ 7200],

| 70.00th=[ 9152], 80.00th=[14528], 90.00th=[21888], 95.00th=[29568],

| 99.00th=[47360], 99.50th=[49920], 99.90th=[54528], 99.95th=[94720],

| 99.99th=[99840]

bw (KB /s): min=67764, max=105233, per=3.33%, avg=80770.99, stdev=4432.59

lat (usec) : 1000=0.04%

lat (msec) : 2=0.25%, 4=0.55%, 10=69.62%, 20=17.27%, 50=11.76%

lat (msec) : 100=0.52%

cpu : usr=0.01%, sys=0.79%, ctx=23227, majf=0, minf=15436

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=7680/w=0/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=30720MB, aggrb=2365.5MB/s, minb=2365.5MB/s, maxb=2365.5MB/s, mint=12987msec, maxt=12987msec

Disk stats (read/write):

nbd0: ios=243854/2, merge=0/1, ticks=1801606/27, in\_queue=1802231, util=99.28%

**2.3.1 随机读(block size 4M)**

//block size是4M, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：1172.9 MB/s 平均IOPS： 293 耗时：101.27ms

fio -filename=/mnt/test/xxx -direct=1 -iodepth 1 -thread -rw=randread -ioengine=libaio -bs=4M -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=randread, bs=4M-4M/4M-4M/4M-4M, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 19 (f=18): [\_(1),r(3),\_(1),r(3),\_(1),r(2),\_(1),r(1),\_(1),r(1),\_(1),r(1),\_(2),r(5),\_(1),r(3),\_(2)] [96.4% done] [1312MB/0KB/0KB /s] [328/0/0 iops] [eta 00m:01s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=34255: Tue Jan 16 14:50:14 2018

read : io=30720MB, bw=1172.9MB/s, iops=293, runt= 26194msec

slat (usec): min=320, max=215905, avg=76016.00, stdev=31251.51

clat (usec): min=774, max=249806, avg=25251.42, stdev=16090.29

lat (msec): min=1, max=341, avg=101.27, stdev=35.33

clat percentiles (usec):

| 1.00th=[ 1544], 5.00th=[ 8256], 10.00th=[12992], 20.00th=[17024],

| 30.00th=[19584], 40.00th=[21632], 50.00th=[23680], 60.00th=[25728],

| 70.00th=[28032], 80.00th=[31360], 90.00th=[36608], 95.00th=[43264],

| 99.00th=[66048], 99.50th=[102912], 99.90th=[228352], 99.95th=[238592],

| 99.99th=[248832]

bw (KB /s): min=19200, max=81593, per=3.34%, avg=40089.91, stdev=6232.06

lat (usec) : 1000=0.03%

lat (msec) : 2=2.71%, 4=0.86%, 10=2.83%, 20=25.34%, 50=65.53%

lat (msec) : 100=2.20%, 250=0.51%

cpu : usr=0.01%, sys=0.43%, ctx=23282, majf=0, minf=15444

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=7680/w=0/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=30720MB, aggrb=1172.9MB/s, minb=1172.9MB/s, maxb=1172.9MB/s, mint=26194msec, maxt=26194msec

Disk stats (read/write):

nbd0: ios=242695/4, merge=0/1, ticks=3682263/186, in\_queue=3683531, util=99.68%

**2.3.2 顺序写(block size 4M)**

//block size是4M, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：577 MB/s 平均IOPS： 141 耗时：180.71ms

fio -filename=/mnt/test/xxxxxx -direct=1 -iodepth 1 -thread -rw=write -ioengine=libaio -bs=4M -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=write, bs=4M-4M/4M-4M/4M-4M, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 3 (f=3): [\_(14),W(1),\_(3),W(2),\_(10)] [88.7% done] [0KB/595.5MB/0KB /s] [0/148/0 iops] [eta 00m:07s] s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=39754: Tue Jan 16 15:06:52 2018

write: io=30720MB, bw=577632KB/s, iops=141, runt= 54459msec

slat (usec): min=432, max=11789K, avg=146240.74, stdev=890871.23

clat (usec): min=906, max=243958, avg=34464.33, stdev=18648.43

lat (msec): min=2, max=11820, avg=180.71, stdev=889.82

clat percentiles (usec):

| 1.00th=[ 1832], 5.00th=[ 2160], 10.00th=[ 3312], 20.00th=[27520],

| 30.00th=[34048], 40.00th=[36608], 50.00th=[38656], 60.00th=[40192],

| 70.00th=[42240], 80.00th=[44800], 90.00th=[48384], 95.00th=[51456],

| 99.00th=[59648], 99.50th=[69120], 99.90th=[238592], 99.95th=[242688],

| 99.99th=[244736]

bw (KB /s): min= 350, max=191625, per=11.71%, avg=67662.34, stdev=44038.16

lat (usec) : 1000=0.01%

lat (msec) : 2=2.62%, 4=9.49%, 10=5.60%, 20=0.35%, 50=75.18%

lat (msec) : 100=6.29%, 250=0.46%

cpu : usr=0.17%, sys=0.42%, ctx=17901, majf=0, minf=48

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=0/w=7680/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

WRITE: io=30720MB, aggrb=577632KB/s, minb=577632KB/s, maxb=577632KB/s, mint=54459msec, maxt=54459msec

Disk stats (read/write):

nbd0: ios=0/245786, merge=0/40, ticks=0/6934238, in\_queue=6934029, util=99.88%

**2.3.3 随机写(block size 4M)**

//block size是4M, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：574 MB/s 平均IOPS： 140 耗时：175.80ms

fio -filename=/mnt/test/xxxxxx1 -direct=1 -iodepth 1 -thread -rw=randwrite -ioengine=libaio -bs=4M -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=randwrite, bs=4M-4M/4M-4M/4M-4M, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 6 (f=6): [\_(6),w(1),\_(4),w(1),\_(5),w(1),\_(3),w(1),\_(3),w(1),\_(2),w(1),\_(1)] [87.3% done] [0KB/567.5MB/0KB /s] [0/141/0 iops] [eta 00m:08s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=40883: Tue Jan 16 15:10:16 2018

write: io=30720MB, bw=574531KB/s, iops=140, runt= 54753msec

slat (usec): min=419, max=10185K, avg=140967.10, stdev=907840.86

clat (msec): min=1, max=70, avg=34.83, stdev=15.47

lat (msec): min=2, max=10224, avg=175.80, stdev=907.34

clat percentiles (usec):

| 1.00th=[ 1848], 5.00th=[ 2192], 10.00th=[ 3440], 20.00th=[32384],

| 30.00th=[35584], 40.00th=[37632], 50.00th=[39168], 60.00th=[41216],

| 70.00th=[42752], 80.00th=[45312], 90.00th=[48384], 95.00th=[51456],

| 99.00th=[58112], 99.50th=[63232], 99.90th=[69120], 99.95th=[69120],

| 99.99th=[70144]

bw (KB /s): min= 410, max=128000, per=12.24%, avg=70326.68, stdev=40733.29

lat (msec) : 2=2.17%, 4=9.19%, 10=5.94%, 20=0.07%, 50=75.76%

lat (msec) : 100=6.88%

cpu : usr=0.17%, sys=0.43%, ctx=17921, majf=0, minf=53

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=0/w=7680/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

WRITE: io=30720MB, aggrb=574530KB/s, minb=574530KB/s, maxb=574530KB/s, mint=54753msec, maxt=54753msec

Disk stats (read/write):

nbd0: ios=0/245594, merge=0/35, ticks=0/7007163, in\_queue=7007071, util=99.88%

**2.3.4 顺序读写(block size 4M)**

//block size是4M, 30个线程并发，持续时间200s  
测试结果：30线程并发，  
读（带宽：980 MB/s 平均IOPS： 239 耗时：69.67ms）  
写（带宽：762 MB/s 平均IOPS： 186 耗时：66.22ms）

fio -filename=/mnt/test/xxxxxx2 -direct=1 -iodepth 1 -thread -rw=rw -ioengine=libaio -bs=4M -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=rw, bs=4M-4M/4M-4M/4M-4M, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 1 (f=1): [\_(2),M(1),\_(27)] [100.0% done] [891.2MB/647.4MB/0KB /s] [222/161/0 iops] [eta 00m:00s] s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=1220: Tue Jan 16 15:13:14 2018

read : io=17280MB, bw=980534KB/s, iops=239, runt= 18046msec

slat (usec): min=328, max=437663, avg=58992.25, stdev=66315.88

clat (usec): min=2, max=137801, avg=10681.00, stdev=12378.44

lat (msec): min=1, max=465, avg=69.67, stdev=66.54

clat percentiles (usec):

| 1.00th=[ 1384], 5.00th=[ 1704], 10.00th=[ 2384], 20.00th=[ 3344],

| 30.00th=[ 4256], 40.00th=[ 5152], 50.00th=[ 5984], 60.00th=[ 7264],

| 70.00th=[ 9408], 80.00th=[15168], 90.00th=[27776], 95.00th=[35584],

| 99.00th=[59136], 99.50th=[70144], 99.90th=[103936], 99.95th=[113152],

| 99.99th=[138240]

bw (KB /s): min= 5333, max=106496, per=3.46%, avg=33881.20, stdev=15479.85

write: io=13440MB, bw=762638KB/s, iops=186, runt= 18046msec

slat (usec): min=462, max=443741, avg=50250.17, stdev=69529.56

clat (usec): min=378, max=175843, avg=15969.00, stdev=14417.80

lat (msec): min=2, max=477, avg=66.22, stdev=71.78

clat percentiles (usec):

| 1.00th=[ 1512], 5.00th=[ 1768], 10.00th=[ 2224], 20.00th=[ 3536],

| 30.00th=[ 4640], 40.00th=[ 6240], 50.00th=[10304], 60.00th=[18816],

| 70.00th=[24704], 80.00th=[29824], 90.00th=[35072], 95.00th=[39168],

| 99.00th=[46848], 99.50th=[50432], 99.90th=[162816], 99.95th=[175104],

| 99.99th=[175104]

bw (KB /s): min= 4708, max=89932, per=3.52%, avg=26814.32, stdev=13250.05

lat (usec) : 4=0.01%, 250=0.01%, 500=0.01%, 750=0.04%, 1000=0.14%

lat (msec) : 2=7.30%, 4=18.29%, 10=36.30%, 20=12.47%, 50=24.34%

lat (msec) : 100=0.91%, 250=0.16%

cpu : usr=0.17%, sys=0.88%, ctx=21190, majf=0, minf=49

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=4320/w=3360/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=17280MB, aggrb=980534KB/s, minb=980534KB/s, maxb=980534KB/s, mint=18046msec, maxt=18046msec

WRITE: io=13440MB, aggrb=762637KB/s, minb=762637KB/s, maxb=762637KB/s, mint=18046msec, maxt=18046msec

Disk stats (read/write):

nbd0: ios=138078/107366, merge=0/3, ticks=1045037/1365373, in\_queue=2410297, util=99.42%

**2.3.5 随机读写(block size 4M)**

//block size是4M, 30个线程并发，持续时间200s  
测试结果：30线程并发，  
读（带宽：512 MB/s 平均IOPS： 125 耗时：110.69ms）  
写（带宽：398 MB/s 平均IOPS： 97 耗时：160.91ms）

fio -filename=/mnt/test/xxxxxx3 -direct=1 -iodepth 1 -thread -rw=randrw -ioengine=libaio -bs=4M -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=randrw, bs=4M-4M/4M-4M/4M-4M, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 18 (f=18): [m(4),\_(2),m(1),\_(2),m(1),\_(2),m(4),\_(4),m(2),\_(1),m(1),\_(1),m(5)] [94.6% done] [651.4MB/423.6MB/0KB /s] [162/105/0 iops] [eta 00m:02s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=2998: Tue Jan 16 15:19:09 2018

read : io=17280MB, bw=512653KB/s, iops=125, runt= 34516msec

slat (usec): min=330, max=1534.7K, avg=86957.58, stdev=113303.64

clat (msec): min=1, max=1063, avg=23.73, stdev=24.36

lat (msec): min=1, max=1552, avg=110.69, stdev=115.99

clat percentiles (usec):

| 1.00th=[ 1592], 5.00th=[ 3504], 10.00th=[ 7456], 20.00th=[10432],

| 30.00th=[12992], 40.00th=[16064], 50.00th=[19328], 60.00th=[22912],

| 70.00th=[28032], 80.00th=[34048], 90.00th=[43264], 95.00th=[55040],

| 99.00th=[86528], 99.50th=[101888], 99.90th=[216064], 99.95th=[246784],

| 99.99th=[1056768]

bw (KB /s): min= 2161, max=68776, per=3.84%, avg=19673.38, stdev=10392.27

write: io=13440MB, bw=398730KB/s, iops=97, runt= 34516msec

slat (usec): min=404, max=1522.5K, avg=128656.15, stdev=193442.37

clat (msec): min=1, max=1261, avg=32.25, stdev=68.96

lat (msec): min=2, max=1554, avg=160.91, stdev=211.14

clat percentiles (usec):

| 1.00th=[ 1704], 5.00th=[ 1912], 10.00th=[ 2352], 20.00th=[ 6048],

| 30.00th=[16768], 40.00th=[23680], 50.00th=[28288], 60.00th=[32128],

| 70.00th=[35584], 80.00th=[39168], 90.00th=[44800], 95.00th=[50432],

| 99.00th=[415744], 99.50th=[544768], 99.90th=[1236992], 99.95th=[1253376],

| 99.99th=[1253376]

bw (KB /s): min= 2210, max=44441, per=3.97%, avg=15818.67, stdev=8092.93

lat (msec) : 2=4.05%, 4=6.25%, 10=10.43%, 20=22.85%, 50=50.48%

lat (msec) : 100=5.07%, 250=0.39%, 500=0.21%, 750=0.20%, 2000=0.08%

cpu : usr=0.10%, sys=0.44%, ctx=21453, majf=0, minf=54

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=4320/w=3360/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=17280MB, aggrb=512652KB/s, minb=512652KB/s, maxb=512652KB/s, mint=34516msec, maxt=34516msec

WRITE: io=13440MB, aggrb=398729KB/s, minb=398729KB/s, maxb=398729KB/s, mint=34516msec, maxt=34516msec

Disk stats (read/write):

nbd0: ios=138208/107507, merge=0/16, ticks=2145787/2611698, in\_queue=4757309, util=99.75%

**2.3.6 顺序读(block size 4k)**

//block size是4k, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：231 MB/s 平均IOPS： 57839 耗时：0.518ms

fio -filename=/mnt/test/xxxxxx5 -direct=1 -iodepth 1 -thread -rw=read -ioengine=libaio -bs=4k -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=read, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [R(30)] [100.0% done] [211.8MB/0KB/0KB /s] [54.3K/0/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=6145: Tue Jan 16 15:28:45 2018

read : io=30720MB, bw=231356KB/s, iops=57839, runt=135969msec

slat (usec): min=2, max=1476, avg= 5.39, stdev= 2.81

clat (usec): min=2, max=31844, avg=512.62, stdev=367.96

lat (usec): min=53, max=31848, avg=518.07, stdev=367.95

clat percentiles (usec):

| 1.00th=[ 346], 5.00th=[ 374], 10.00th=[ 394], 20.00th=[ 422],

| 30.00th=[ 446], 40.00th=[ 474], 50.00th=[ 498], 60.00th=[ 532],

| 70.00th=[ 556], 80.00th=[ 580], 90.00th=[ 620], 95.00th=[ 644],

| 99.00th=[ 780], 99.50th=[ 852], 99.90th=[ 1528], 99.95th=[ 1928],

| 99.99th=[24704]

bw (KB /s): min= 6376, max= 8792, per=3.34%, avg=7719.35, stdev=404.15

lat (usec) : 4=0.01%, 50=0.01%, 100=0.01%, 250=0.01%, 500=50.03%

lat (usec) : 750=48.60%, 1000=1.09%

lat (msec) : 2=0.23%, 4=0.01%, 10=0.01%, 20=0.01%, 50=0.02%

cpu : usr=0.23%, sys=1.65%, ctx=7865037, majf=0, minf=81

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=7864320/w=0/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=30720MB, aggrb=231356KB/s, minb=231356KB/s, maxb=231356KB/s, mint=135969msec, maxt=135969msec

Disk stats (read/write):

nbd0: ios=7860030/37, merge=0/16, ticks=4014182/80, in\_queue=4012440, util=99.98%

**2.3.7 随机读(block size 4k)**

//block size是4k, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：69 MB/s 平均IOPS： 17491 耗时：1.714ms

fio -filename=/mnt/test/xxxxxx6 -direct=1 -iodepth 1 -thread -rw=randread -ioengine=libaio -bs=4k -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=randread, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [r(30)] [100.0% done] [81256KB/0KB/0KB /s] [20.4K/0/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=8166: Tue Jan 16 15:35:15 2018

read : io=13665MB, bw=69966KB/s, iops=17491, runt=200002msec

slat (usec): min=2, max=328, avg= 5.04, stdev= 2.22

clat (usec): min=37, max=2512.8K, avg=1709.01, stdev=15457.78

lat (usec): min=41, max=2512.8K, avg=1714.11, stdev=15457.78

clat percentiles (usec):

| 1.00th=[ 532], 5.00th=[ 1032], 10.00th=[ 1240], 20.00th=[ 1352],

| 30.00th=[ 1416], 40.00th=[ 1464], 50.00th=[ 1496], 60.00th=[ 1544],

| 70.00th=[ 1592], 80.00th=[ 1656], 90.00th=[ 1736], 95.00th=[ 1816],

| 99.00th=[ 2128], 99.50th=[ 4128], 99.90th=[17280], 99.95th=[29312],

| 99.99th=[765952]

bw (KB /s): min= 2, max= 3696, per=3.57%, avg=2494.55, stdev=507.53

lat (usec) : 50=0.02%, 100=0.05%, 250=0.01%, 500=0.57%, 750=1.72%

lat (usec) : 1000=2.09%

lat (msec) : 2=93.94%, 4=1.08%, 10=0.30%, 20=0.13%, 50=0.05%

lat (msec) : 100=0.01%, 250=0.01%, 500=0.01%, 750=0.01%, 1000=0.01%

lat (msec) : 2000=0.01%, >=2000=0.01%

cpu : usr=0.11%, sys=0.48%, ctx=3498696, majf=0, minf=85

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=3498327/w=0/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=13665MB, aggrb=69965KB/s, minb=69965KB/s, maxb=69965KB/s, mint=200002msec, maxt=200002msec

Disk stats (read/write):

nbd0: ios=3498053/50, merge=0/16, ticks=5969304/9480, in\_queue=5978090, util=100.00%

**2.3.8 顺序写(block size 4k)**

//block size是4k, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：51 MB/s 平均IOPS： 12991 耗时：2.308ms

fio -filename=/mnt/test/xxxxxx7 -direct=1 -iodepth 1 -thread -rw=write -ioengine=libaio -bs=4k -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=write, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [W(30)] [100.0% done] [0KB/30488KB/0KB /s] [0/7622/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=11056: Tue Jan 16 15:45:24 2018

write: io=10150MB, bw=51965KB/s, iops=12991, runt=200003msec

slat (usec): min=3, max=4307, avg= 6.44, stdev=34.00

clat (usec): min=121, max=10589, avg=2302.09, stdev=1246.93

lat (usec): min=130, max=10596, avg=2308.58, stdev=1247.30

clat percentiles (usec):

| 1.00th=[ 486], 5.00th=[ 588], 10.00th=[ 692], 20.00th=[ 1032],

| 30.00th=[ 1368], 40.00th=[ 1752], 50.00th=[ 2160], 60.00th=[ 2608],

| 70.00th=[ 3088], 80.00th=[ 3568], 90.00th=[ 4128], 95.00th=[ 4448],

| 99.00th=[ 4768], 99.50th=[ 4896], 99.90th=[ 5152], 99.95th=[ 5920],

| 99.99th=[ 7328]

bw (KB /s): min= 842, max= 4464, per=3.34%, avg=1734.14, stdev=778.17

lat (usec) : 250=0.01%, 500=1.53%, 750=10.32%, 1000=7.19%

lat (msec) : 2=26.99%, 4=41.87%, 10=12.09%, 20=0.01%

cpu : usr=0.06%, sys=0.39%, ctx=2603560, majf=0, minf=55

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=0/w=2598273/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

WRITE: io=10150MB, aggrb=51964KB/s, minb=51964KB/s, maxb=51964KB/s, mint=200003msec, maxt=200003msec

Disk stats (read/write):

nbd0: ios=0/2595504, merge=0/109, ticks=0/5967580, in\_queue=5967134, util=99.99%

2.3.9 随机写(block size 4k)  
//block size是4k, 30个线程并发，持续时间200s  
测试结果：30线程并发，带宽：64 MB/s 平均IOPS： 16108 耗时：1.861ms

fio -filename=/mnt/test/xxxxxx8 -direct=1 -iodepth 1 -thread -rw=randwrite -ioengine=libaio -bs=4k -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=randwrite, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [w(30)] [100.0% done] [0KB/63904KB/0KB /s] [0/15.1K/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=12970: Tue Jan 16 15:51:49 2018

write: io=12585MB, bw=64433KB/s, iops=16108, runt=200002msec

slat (usec): min=3, max=30770, avg= 9.15, stdev=162.50

clat (usec): min=71, max=237287, avg=1852.00, stdev=3475.88

lat (usec): min=96, max=237298, avg=1861.23, stdev=3483.81

clat percentiles (usec):

| 1.00th=[ 382], 5.00th=[ 548], 10.00th=[ 1400], 20.00th=[ 1608],

| 30.00th=[ 1704], 40.00th=[ 1784], 50.00th=[ 1832], 60.00th=[ 1896],

| 70.00th=[ 1960], 80.00th=[ 2024], 90.00th=[ 2128], 95.00th=[ 2224],

| 99.00th=[ 2448], 99.50th=[ 2576], 99.90th=[12992], 99.95th=[119296],

| 99.99th=[150528]

bw (KB /s): min= 1048, max= 3121, per=3.34%, avg=2151.39, stdev=252.21

lat (usec) : 100=0.01%, 250=0.01%, 500=3.60%, 750=3.56%, 1000=0.83%

lat (msec) : 2=67.91%, 4=23.94%, 10=0.05%, 20=0.01%, 50=0.02%

lat (msec) : 100=0.01%, 250=0.06%

cpu : usr=0.12%, sys=0.59%, ctx=3244801, majf=0, minf=43

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=0/w=3221693/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

WRITE: io=12585MB, aggrb=64433KB/s, minb=64433KB/s, maxb=64433KB/s, mint=200002msec, maxt=200002msec

Disk stats (read/write):

nbd0: ios=0/3220841, merge=0/13128, ticks=0/6009641, in\_queue=6008914, util=100.00%

**2.4.0 顺序读写(block size 4k)**

//block size是4k, 30个线程并发，持续时间200s  
测试结果：30线程并发  
读：（带宽：48 MB/s 平均IOPS： 12075 耗时：1.046ms）  
写：（带宽：48 MB/s 平均IOPS： 12069 耗时：1.437ms）

fio -filename=/mnt/test/xxxxxx9 -direct=1 -iodepth 1 -thread -rw=rw -ioengine=libaio -bs=4k -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=rw, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [M(30)] [100.0% done] [45720KB/42072KB/0KB /s] [11.5K/10.6K/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=19624: Tue Jan 16 16:11:06 2018

read : io=9433.8MB, bw=48300KB/s, iops=12075, runt=200001msec

slat (usec): min=2, max=2412, avg= 5.37, stdev=12.36

clat (usec): min=5, max=287292, avg=1041.16, stdev=2820.85

lat (usec): min=72, max=287299, avg=1046.59, stdev=2820.94

clat percentiles (usec):

| 1.00th=[ 278], 5.00th=[ 362], 10.00th=[ 398], 20.00th=[ 454],

| 30.00th=[ 532], 40.00th=[ 636], 50.00th=[ 772], 60.00th=[ 948],

| 70.00th=[ 1176], 80.00th=[ 1480], 90.00th=[ 1960], 95.00th=[ 2384],

| 99.00th=[ 3344], 99.50th=[ 3792], 99.90th=[ 5216], 99.95th=[14016],

| 99.99th=[209920]

bw (KB /s): min= 45, max= 3800, per=3.34%, avg=1613.92, stdev=654.35

write: io=9429.4MB, bw=48278KB/s, iops=12069, runt=200001msec

slat (usec): min=3, max=2720, avg= 6.09, stdev=15.34

clat (usec): min=44, max=9849, avg=1431.03, stdev=946.09

lat (usec): min=51, max=9854, avg=1437.17, stdev=946.08

clat percentiles (usec):

| 1.00th=[ 161], 5.00th=[ 358], 10.00th=[ 462], 20.00th=[ 612],

| 30.00th=[ 780], 40.00th=[ 972], 50.00th=[ 1192], 60.00th=[ 1448],

| 70.00th=[ 1752], 80.00th=[ 2160], 90.00th=[ 2800], 95.00th=[ 3344],

| 99.00th=[ 4320], 99.50th=[ 4512], 99.90th=[ 4704], 99.95th=[ 4832],

| 99.99th=[ 4960]

bw (KB /s): min= 15, max= 3480, per=3.34%, avg=1612.75, stdev=639.39

lat (usec) : 10=0.01%, 50=0.01%, 100=0.17%, 250=1.26%, 500=18.03%

lat (usec) : 750=19.06%, 1000=13.40%

lat (msec) : 2=31.55%, 4=15.34%, 10=1.16%, 20=0.02%, 50=0.01%

lat (msec) : 250=0.01%, 500=0.01%

cpu : usr=0.11%, sys=0.69%, ctx=4830416, majf=0, minf=78

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=2415036/w=2413920/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=9433.8MB, aggrb=48300KB/s, minb=48300KB/s, maxb=48300KB/s, mint=200001msec, maxt=200001msec

WRITE: io=9429.4MB, aggrb=48278KB/s, minb=48278KB/s, maxb=48278KB/s, mint=200001msec, maxt=200001msec

Disk stats (read/write):

nbd0: ios=2413583/2412391, merge=0/39, ticks=2508070/3446958, in\_queue=5954029, util=100.00%

**2.4.1 随机读写(block size 4k)**

//block size是4k, 30个线程并发，持续时间200s  
读：（带宽：29 MB/s 平均IOPS： 7347 耗时：2.919ms）  
写：（带宽：29 MB/s 平均IOPS： 7325 耗时：1.164ms）

fio -filename=/mnt/test/xxxxxx10 -direct=1 -iodepth 1 -thread -rw=randrw -ioengine=libaio -bs=4k -size=1G -numjobs=30 -runtime=200 -group\_reporting -name=read-libaio

read-libaio: (g=0): rw=randrw, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=1

...

fio-2.2.8

Starting 30 threads

read-libaio: Laying out IO file(s) (1 file(s) / 1024MB)

Jobs: 30 (f=30): [m(30)] [100.0% done] [34044KB/33808KB/0KB /s] [8511/8452/0 iops] [eta 00m:00s]

read-libaio: (groupid=0, jobs=30): err= 0: pid=21889: Tue Jan 16 16:19:14 2018

read : io=5740.4MB, bw=29390KB/s, iops=7347, runt=200003msec

slat (usec): min=2, max=1655, avg= 6.17, stdev= 9.07

clat (usec): min=35, max=1221.7K, avg=2912.79, stdev=14872.43

lat (usec): min=39, max=1221.7K, avg=2919.05, stdev=14872.92

clat percentiles (usec):

| 1.00th=[ 370], 5.00th=[ 516], 10.00th=[ 740], 20.00th=[ 1192],

| 30.00th=[ 1496], 40.00th=[ 1752], 50.00th=[ 1880], 60.00th=[ 1976],

| 70.00th=[ 2064], 80.00th=[ 2192], 90.00th=[ 2448], 95.00th=[ 4192],

| 99.00th=[20608], 99.50th=[42752], 99.90th=[214016], 99.95th=[305152],

| 99.99th=[593920]

bw (KB /s): min= 5, max= 2424, per=3.40%, avg=1000.66, stdev=276.02

write: io=5722.9MB, bw=29301KB/s, iops=7325, runt=200003msec

slat (usec): min=3, max=1660, avg= 6.93, stdev= 9.13

clat (usec): min=37, max=161642, avg=1157.90, stdev=2459.66

lat (usec): min=42, max=162186, avg=1164.92, stdev=2461.31

clat percentiles (usec):

| 1.00th=[ 54], 5.00th=[ 69], 10.00th=[ 151], 20.00th=[ 540],

| 30.00th=[ 860], 40.00th=[ 1176], 50.00th=[ 1336], 60.00th=[ 1416],

| 70.00th=[ 1496], 80.00th=[ 1576], 90.00th=[ 1672], 95.00th=[ 1736],

| 99.00th=[ 1896], 99.50th=[ 1944], 99.90th=[ 2160], 99.95th=[ 4256],

| 99.99th=[146432]

bw (KB /s): min= 4, max= 2235, per=3.40%, avg=997.39, stdev=278.86

lat (usec) : 50=0.16%, 100=3.53%, 250=3.21%, 500=4.87%, 750=6.24%

lat (usec) : 1000=6.61%

lat (msec) : 2=56.37%, 4=16.42%, 10=1.35%, 20=0.70%, 50=0.30%

lat (msec) : 100=0.08%, 250=0.12%, 500=0.03%, 750=0.01%, 1000=0.01%

lat (msec) : 2000=0.01%

cpu : usr=0.12%, sys=0.47%, ctx=2935214, majf=0, minf=37

IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%

submit : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%

issued : total=r=1469532/w=1465052/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0

latency : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):

READ: io=5740.4MB, aggrb=29390KB/s, minb=29390KB/s, maxb=29390KB/s, mint=200003msec, maxt=200003msec

WRITE: io=5722.9MB, aggrb=29300KB/s, minb=29300KB/s, maxb=29300KB/s, mint=200003msec, maxt=200003msec

Disk stats (read/write):

nbd0: ios=1467674/1463306, merge=0/53, ticks=4274517/1703752, in\_queue=5977476, util=100.00%

**三、 总结**

**3.1 测试工具小结**

| **工具** | **用途** | **语法** | **说明** |
| --- | --- | --- | --- |
| rados bench | RADOS 性能测试工具 | rados bench -p <pool\_name> <seconds> <write,seq,rand> -b <block size> -t --no-cleanup | Ceph 自带的 RADOS 性能测试工具 |
| rbd bench-write | ceph 自带的 rbd 性能测试工具 | rbd bench-write <RBD image name> --io-size：单位 byte，默认 4M --io-threads：线程数，默认 16 --io-total：总写入字节，默认 1024M --io-pattern <seq,rand>：写模式，默认为 seq 即顺序写 | 只能对块设备做写测试 |
| fio + libaio | fio 结合IO 引擎的性能测试工具测试rbd | 参考 fio --help | 1. Linux 平台上做 IO 性能测试的瑞士军刀 2. 可以对使用内核内 rbd 和用户空间 librados 进行比较 3. 标准规则 - 顺序和随机 IO 4. 块大小 - 4k，16k，64k，256k 5. 模式 - 读和写 6. 支持混合模式 |

**3.2 测试结果比较**

**3.2.1 rados bench测试结果**

| **客户端数** | **并发数** | **块大小** | **写测试** | **顺序读** | **随机读** |
| --- | --- | --- | --- | --- | --- |
| 单个客户端 | 30 | 4M | 带宽：1119.68 MB/s  平均IOPS：279  平均耗时：0.107s | 带宽：1121.07 MB/s 平均IOPS：280 平均耗时：0.106s | 带宽：1109.64 MB/s  平均IOPS：279  平均耗时：0.106s |
| 两个客户端 | 30/个 | 4M | 带宽：1630.81MB/s  平均IOPS：406  平均耗时：0.293s | 带宽：2238.71MB/s  平均IOPS：558  平均耗时：0.212s | 带宽：2237.01MB/s  平均IOPS：558  平均耗时：0.212s |

**3.2.2 rbd测试结果**

| **客户端数** | **并发数** | **块大小** | **顺序读写** | **随机读写** |
| --- | --- | --- | --- | --- |
| 单个客户端 | 30 | 4k | 带宽：297 MB/s  平均IOPS：72681.76 | 带宽：36 MB/s  平均IOPS：8925.40 |
| 单个客户端 | 30 | 4M | 带宽：844MB/s  平均IOPS：206.16 | 带宽：860 MB/s 平均IOPS： 210.18 |