性能工具与性能分析

1. Fio

a. 最简单的 fio 命令

```
# fio -filename=/dev/nvme0n2 -name=mytest
```

```
root@ubuntu:/home/king/share/7.1.2_PA# fio -filename=/dev/nvme0n2 -name=mytest
mytest: (g=0): rw=read, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=psync, iodepth=1
fio-3.30-58-ge4d38
Starting 1 process
Jobs: 1 (f=1): [f(1)][100.0%][eta 00m:00s]
mytest: (groupid=0, jobs=1): err= 0: pid=1907: Mon Feb 13 09:15:46 2023
  read: IOPS=77.2k, BW=301MiB/s (316MB/s)(20.0GiB/67929msec)
    clat (nsec): min=1510, max=82979k, avg=12680.68, stdev=153058.09
     lat (nsec): min=1536, max=82979k, avg=12715.88, stdev=153058.21
    clat percentiles (nsec):
     |  1.00th=[   1576],  5.00th=[   1576], 10.00th=[   1592],
     | 20.00th=[   1608], 30.00th=[   1624], 40.00th=[   1624],
     | 50.00th=[   1640], 60.00th=[   1656], 70.00th=[   1672],
     | 80.00th=[   1704], 90.00th=[   2040], 95.00th=[   2544],
     | 99.00th=[ 183296], 99.50th=[ 407552], 99.90th=[2310144],
     | 99.95th=[2506752], 99.99th=[3194880]
   bw (  KiB/s): min=32423, max=824320, per=99.47%, avg=307082.94, stdev=292113.76, samples=135
   iops        : min= 8105, max=206080, avg=76770.45, stdev=73028.54, samples=135
  lat (usec)   : 2=89.65%, 4=7.97%, 10=0.25%, 20=0.43%, 50=0.11%
  lat (usec)   : 100=0.01%, 250=0.89%, 500=0.29%, 750=0.03%, 1000=0.01%
  lat (msec)   : 2=0.12%, 4=0.23%, 10=0.01%, 20=0.01%, 50=0.01%
  lat (msec)   : 100=0.01%
  cpu          : usr=0.83%, sys=99.02%, ctx=758, majf=0, minf=11
  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 rwts: total=5242880,0,0,0 short=0,0,0,0 dropped=0,0,0,0
     latency   : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
   READ: bw=301MiB/s (316MB/s), 301MiB/s-301MiB/s (316MB/s-316MB/s), io=20.0GiB (21.5GB), run=67929-67929msec
```

b. 4 个读写流程，块大小 4k，随机写，文件大小 1G，运行时间 60S，io 方式是 aio

```
# fio -numjobs=4 -bs=4k -rw=randwrite -size=1G -name=test -group_reporting -filename=./io.tmp -runtime=60 --ioengine=libaio
```

```
root@ubuntu:/home/king/share/7.1.2_PA# fio -direct=1 -iodepth=128 -rw=randwrite -ioengine=libaio -bs=4k -size=5G -numjobs=1 -runtime=300 -group_rep
orting -name=mytest
mytest: (g=0): rw=randwrite, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=libaio, iodepth=128
fio-3.30-58-ge4d38
Starting 1 process
mytest: Laying out IO file (1 file / 5120MiB)
Jobs: 1 (f=1): [w(1)][12.7%][w=4KiB/s][w=1 IOPS][eta 34m:36s]
mytest: (groupid=0, jobs=1): err= 0: pid=2062: Mon Feb 13 09:23:35 2023
  write: IOPS=551, BW=2207KiB/s (2260kB/s)(649MiB/301056msec); 0 zone resets
    slat (usec): min=13, max=2646.8k, avg=395.99, stdev=21530.01
    clat (usec): min=4, max=8171.8k, avg=231517.41, stdev=509181.89
     lat (usec): min=745, max=8171.8k, avg=231913.41, stdev=509605.65
    clat percentiles (msec):
     |  1.00th=[    6],  5.00th=[    9], 10.00th=[   13], 20.00th=[   32],
     | 30.00th=[   48], 40.00th=[   69], 50.00th=[   93], 60.00th=[  122],
     | 70.00th=[  161], 80.00th=[  230], 90.00th=[  409], 95.00th=[ 1003],
     | 99.00th=[ 2836], 99.50th=[ 3272], 99.90th=[ 4799], 99.95th=[ 5470],
     | 99.99th=[ 6342]
   bw (  KiB/s): min=    6, max=13045, per=100.00%, avg=2701.68, stdev=2593.83, samples=488
   iops        : min=    1, max= 3261, avg=675.16, stdev=648.49, samples=488
  lat (usec)   : 10=0.02%, 100=0.01%, 250=0.01%, 500=0.01%, 750=0.01%
  lat (msec)   : 2=0.01%, 4=0.05%, 10=6.02%, 20=8.21%, 50=16.52%
  lat (msec)   : 100=21.80%, 250=29.67%, 500=9.49%, 750=2.13%, 1000=1.07%
  lat (msec)   : 2000=2.71%, >=2000=2.31%
  cpu          : usr=0.14%, sys=4.39%, ctx=6933, majf=0, minf=13
  IO depths    : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
     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=0.1%
     issued rwts: total=0,166088,0,0 short=0,0,0,0 dropped=0,0,0,0
     latency   : target=0, window=0, percentile=100.00%, depth=128
```

c. 4 个读写流程，块大小 4k，随机写，文件大小 1G，运行时间 60S，io 方式是 psync

```
# fio -numjobs=4 -bs=4k -rw=randwrite -size=1G -name=test -group_reporting -filename=./io.tmp -runtime=60 --ioengine=psync
```

```
root@ubuntu:/home/king/share/7.1.2_PA# fio -numjobs=4 -bs=4k -rw=randwrite -size=1G -name=test -group_reporting -filename=./io.tmp -runtime=60 --io
engine=psync
test: (g=0): rw=randwrite, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=psync, iodepth=1
...
fio-3.30-58-ge4d38
Starting 4 processes
Jobs: 1 (f=1): [_(1),w(1),_(2)][100.0%][w=184MiB/s][w=47.0k IOPS][eta 00m:00s]
test: (groupid=0, jobs=4): err= 0: pid=2851: Mon Feb 13 09:37:49 2023
  write: IOPS=106k, BW=414MiB/s (434MB/s)(4096MiB/9905msec); 0 zone resets
    clat (usec): min=2, max=649185, avg=34.38, stdev=1462.88
     lat (usec): min=2, max=649185, avg=34.47, stdev=1462.89
    clat percentiles (usec):
     |  1.00th=[    4],  5.00th=[    4], 10.00th=[    5], 20.00th=[    7],
     | 30.00th=[    8], 40.00th=[    9], 50.00th=[    9], 60.00th=[   10],
     | 70.00th=[   11], 80.00th=[   13], 90.00th=[   17], 95.00th=[   20],
     | 99.00th=[   48], 99.50th=[   82], 99.90th=[ 5211], 99.95th=[15533],
     | 99.99th=[34341]
   bw (  KiB/s): min=190305, max=875381, per=100.00%, avg=474176.05, stdev=55748.99, samples=69
   iops        : min=47574, max=218844, avg=118543.41, stdev=13937.23, samples=69
  lat (usec)   : 4=5.87%, 10=61.10%, 20=28.35%, 50=3.76%, 100=0.53%
  lat (usec)   : 250=0.12%, 500=0.05%, 750=0.04%, 1000=0.02%
  lat (msec)   : 2=0.03%, 4=0.02%, 10=0.04%, 20=0.03%, 50=0.04%
  lat (msec)   : 100=0.01%, 250=0.01%, 750=0.01%
  cpu          : usr=3.22%, sys=31.80%, ctx=108141, majf=0, minf=51
  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 rwts: total=0,1048576,0,0 short=0,0,0,0 dropped=0,0,0,0
     latency   : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
  WRITE: bw=414MiB/s (434MB/s), 414MiB/s-414MiB/s (434MB/s-434MB/s), io=4096MiB (4295MB), run=9905-9905msec
```

d. 4 个读写流程，块大小 4k，随机写，文件大小 1G，运行时间 60S，io 方式是 io_uring

```
# fio -numjobs=4 -bs=4k -rw=randwrite -size=1G -name=test -group_reporting -filename=./io.tmp -runtime=60 --ioengine=io_uring
```

针对 SSD 的性能测试 /dev/nvme0n2

创建 nvme0n2 创建一个文件系统

```
# mkfs.xfs /dev/nvme0n2
# mount /dev/nvme0n2 /mnt/
```

2. Mysqlslab

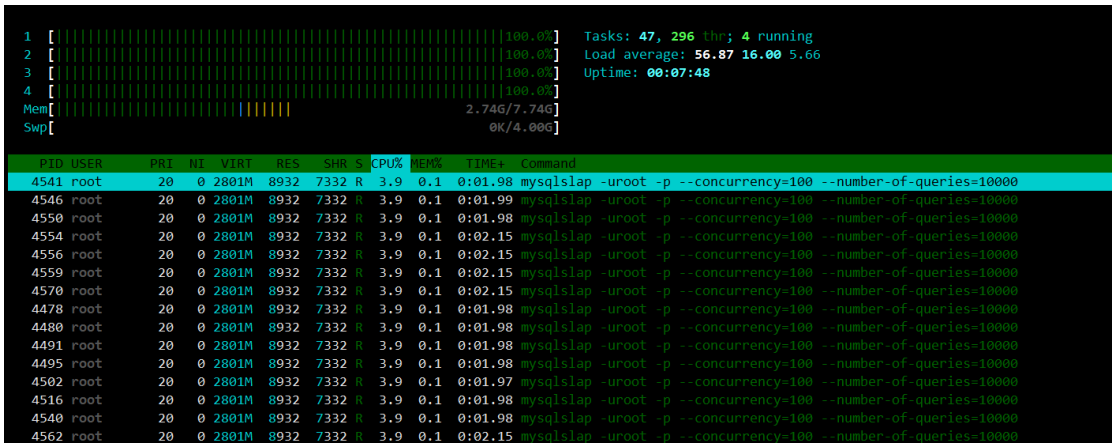
```
# mysqlslap -a -u root -p 123456 --concurrency=100 --number-of-queries=100
```

```
root@ubuntu:/home/king/share# mysqlslap -a -u root -p 123456 --concurrency=100 --number-of-queries=100
Enter password:
Benchmark
        Average number of seconds to run all queries: 3.434 seconds
        Minimum number of seconds to run all queries: 3.434 seconds
        Maximum number of seconds to run all queries: 3.434 seconds
        Number of clients running queries: 100
        Average number of queries per client: 1

root@ubuntu:/home/king/share# mysql
```

```
# mysqlslap -uroot -p123456 --delimiter=';' --create="create table a(b int); insert into a values(23)" --query="select * from a;" --concurrency=100 --iterations=100
```

```
# mysqlslap -uroot -p --concurrency=10 --number-of-queries=100
```




```
# mysqlslap --create='create table user(uname varchar(50), age int);' -q "select * from user" -c 2 --number-of-queries=100 -uroot -p
```

```
root@ubuntu:/home/king# mysqlslap --create='create table user(uname varchar(50), age int);' -q "select * from user" -c 2 --number-of-queries=100 -u
root -p
Enter password:
Benchmark
        Average number of seconds to run all queries: 0.010 seconds
        Minimum number of seconds to run all queries: 0.010 seconds
        Maximum number of seconds to run all queries: 0.010 seconds
        Number of clients running queries: 2
        Average number of queries per client: 50

root@ubuntu:/home/king#
```

```
# mysqlslap --create='create table user(uname varchar(50), age int);' -q "insert into user values('aaa', '22')" -c 2 --number-of-queries=100 -uroot -p
```

```
root@ubuntu:/home/king# mysqlslap --create='create table user(uname varchar(50), age int);' -q "insert into user values('aaa', '22')" -c 2 --number
-of-queries=100 -uroot -p
Enter password:
Benchmark
        Average number of seconds to run all queries: 0.063 seconds
        Minimum number of seconds to run all queries: 0.063 seconds
        Maximum number of seconds to run all queries: 0.063 seconds
        Number of clients running queries: 2
        Average number of queries per client: 50

root@ubuntu:/home/king#
```

3. Redis-benchmark

```
# ./src/redis-benchmark -h 127.0.0.1 -p 6379 -c 20 -n 10000 -q

# ./src/redis-benchmark -h 127.0.0.1 -p 6379 -c 20 -n 10000 -q script load "redis.call('set', 'zvoice', 'king')"

# ./src/redis-benchmark -h 127.0.0.1 -p 6379 -c 20 -n 10000 -q script load "redis.call('zrange', 'zvoice', '0', '10')"
```

```
king@ubuntu:~/share/redis-7.0.8$ ./src/redis-benchmark -h 127.0.0.1 -p 6379 -c 20 -n 10000 -q script load "redis.call('zrange', 'zvoice', '0', '10'
)"
script load redis.call('zrange', 'zvoice', '0', '10'): 43103.45 requests per second, p50=0.239 msec
king@ubuntu:~/share/redis-7.0.8$
```

```
king@ubuntu:~/share/redis-7.0.8$ netstat -anop | grep 6379
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
tcp        0      0 127.0.0.1:6379          0.0.0.0:*               LISTEN      11164/./src/redis-s  off (0.00/0/0)
king@ubuntu:~/share/redis-7.0.8$ ./src/redis-benchmark -h 127.0.0.1 -p 6379 -c 20 -n 10000 -q
PING_INLINE: 39062.50 requests per second, p50=0.263 msec
PING_MBULK: 40160.64 requests per second, p50=0.255 msec
SET: 39525.69 requests per second, p50=0.255 msec
GET: 40322.58 requests per second, p50=0.255 msec
INCR: 39370.08 requests per second, p50=0.263 msec
LPUSH: 41666.67 requests per second, p50=0.247 msec
RPUSH: 39062.50 requests per second, p50=0.255 msec
LPOP: 39525.69 requests per second, p50=0.263 msec
RPOP: 40322.58 requests per second, p50=0.255 msec
SADD: 39215.69 requests per second, p50=0.263 msec
HSET: 39525.69 requests per second, p50=0.255 msec
SPOP: 40322.58 requests per second, p50=0.255 msec
ZADD: 41322.31 requests per second, p50=0.255 msec
ZPOPMIN: 43859.65 requests per second, p50=0.239 msec
LPUSH (needed to benchmark LRANGE): 40983.61 requests per second, p50=0.247 msec
LRANGE_100 (first 100 elements): 28248.59 requests per second, p50=0.351 msec
LRANGE_300 (first 300 elements): 11682.24 requests per second, p50=0.615 msec
LRANGE_500 (first 500 elements): 7593.01 requests per second, p50=0.719 msec
LRANGE_600 (first 600 elements): 6321.11 requests per second, p50=0.783 msec
MSET (10 keys): 43668.12 requests per second, p50=0.239 msec
```

4. Wrk

```
# ./wrk -t 20 -c 50 -d30s https://www.0voice.com/
```

```
king@ubuntu:~/share/wrk$ ./wrk -t 20 -c 50 -d30s https://www.0voice.com/
Running 30s test @ https://www.0voice.com/
  20 threads and 50 connections
  Thread Stats   Avg      Stdev     Max   +/- Stdev
    Latency   864.80ms  446.52ms   1.99s    64.25%
    Req/Sec     1.97      2.58    10.00     88.72%
  733 requests in 30.10s, 45.67MB read
  Socket errors: connect 0, read 0, write 0, timeout 182
Requests/sec:     24.35
Transfer/sec:      1.52MB
king@ubuntu:~/share/wrk$
```

5. Tcpdump

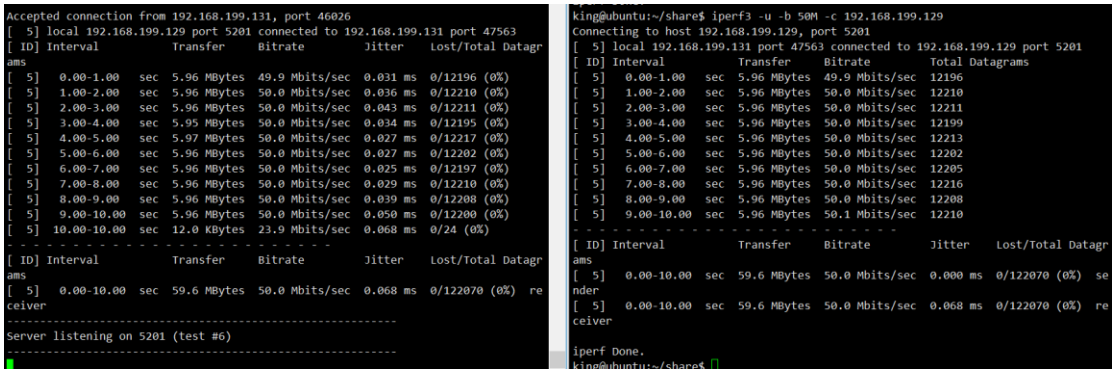
```
# tcpdump tcp port 80  -nn -i eth0
```

```
root@ubuntu:/home/king/share/wrk# tcpdump tcp port 80  -nn -i eth0
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
07:12:41.762591 IP 192.168.1.4.51030 > 42.81.178.226.80: Flags [P.], seq 930028682:930028908, ack 3883328852, win 261, length 226: HTTP: POST /cgi-
bin/httpconn?htcmd=0x6ff0082&uin=3147964070 HTTP/1.1
07:12:41.820651 IP 42.81.178.226.80 > 192.168.1.4.51030: Flags [.], ack 226, win 499, length 0
07:12:41.820651 IP 192.168.1.4.51030 > 42.81.178.226.80: Flags [P.], seq 226:281, ack 1, win 261, length 55: HTTP
07:12:41.880547 IP 42.81.178.226.80 > 192.168.1.4.51030: Flags [.], ack 281, win 499, length 0
07:12:41.880889 IP 42.81.178.226.80 > 192.168.1.4.51030: Flags [P.], seq 1:58, ack 281, win 499, length 57: HTTP: HTTP/1.1 200 OK
07:12:41.932422 IP 192.168.1.4.51030 > 42.81.178.226.80: Flags [.], ack 58, win 260, length 0
```

6. Iperf3

测试 udp

```
# ./src/iperf3 -s
# iperf3 -u -b 50M -c 192.168.199.129
```



```
Accepted connection from 192.168.199.131, port 46026
[  5] local 192.168.199.129 port 5201 connected to 192.168.199.131 port 47563
[ ID] Interval           Transfer     Bitrate         Jitter    Lost/Total Datagr
ams
[  5]   0.00-1.00   sec  5.96 MBytes  49.9 Mbits/sec  0.031 ms  0/12196 (0%)
[  5]   1.00-2.00   sec  5.96 MBytes  50.0 Mbits/sec  0.036 ms  0/12210 (0%)
[  5]   2.00-3.00   sec  5.96 MBytes  50.0 Mbits/sec  0.043 ms  0/12211 (0%)
[  5]   3.00-4.00   sec  5.95 MBytes  50.0 Mbits/sec  0.034 ms  0/12195 (0%)
[  5]   4.00-5.00   sec  5.97 MBytes  50.0 Mbits/sec  0.027 ms  0/12217 (0%)
[  5]   5.00-6.00   sec  5.96 MBytes  50.0 Mbits/sec  0.027 ms  0/12202 (0%)
[  5]   6.00-7.00   sec  5.96 MBytes  50.0 Mbits/sec  0.025 ms  0/12197 (0%)
[  5]   7.00-8.00   sec  5.96 MBytes  50.0 Mbits/sec  0.029 ms  0/12210 (0%)
[  5]   8.00-9.00   sec  5.96 MBytes  50.0 Mbits/sec  0.039 ms  0/12208 (0%)
[  5]   9.00-10.00  sec  5.96 MBytes  50.0 Mbits/sec  0.050 ms  0/12200 (0%)
[  5]  10.00-10.00  sec  12.0 KBytes  23.9 Mbits/sec  0.068 ms  0/24 (0%)
- - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Jitter    Lost/Total Datagr
ams
[  5]   0.00-10.00  sec  59.6 MBytes  50.0 Mbits/sec  0.068 ms  0/122070 (0%)  re
ceiver
-----------------------------------------------------------
Server listening on 5201 (test #6)
-----------------------------------------------------------
```

```
king@ubuntu:~/share$ iperf3 -u -b 50M -c 192.168.199.129
Connecting to host 192.168.199.129, port 5201
[  5] local 192.168.199.131 port 47563 connected to 192.168.199.129 port 5201
[ ID] Interval           Transfer     Bitrate         Total Datagrams
[  5]   0.00-1.00   sec  5.96 MBytes  49.9 Mbits/sec  12196
[  5]   1.00-2.00   sec  5.96 MBytes  50.0 Mbits/sec  12210
[  5]   2.00-3.00   sec  5.96 MBytes  50.0 Mbits/sec  12211
[  5]   3.00-4.00   sec  5.96 MBytes  50.0 Mbits/sec  12199
[  5]   4.00-5.00   sec  5.96 MBytes  50.0 Mbits/sec  12213
[  5]   5.00-6.00   sec  5.96 MBytes  50.0 Mbits/sec  12202
[  5]   6.00-7.00   sec  5.96 MBytes  50.0 Mbits/sec  12205
[  5]   7.00-8.00   sec  5.96 MBytes  50.0 Mbits/sec  12216
[  5]   8.00-9.00   sec  5.96 MBytes  50.0 Mbits/sec  12208
[  5]   9.00-10.00  sec  5.96 MBytes  50.1 Mbits/sec  12210
- - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Jitter    Lost/Total Datagr
ams
[  5]   0.00-10.00  sec  59.6 MBytes  50.0 Mbits/sec  0.000 ms  0/122070 (0%)  se
nder
[  5]   0.00-10.00  sec  59.6 MBytes  50.0 Mbits/sec  0.068 ms  0/122070 (0%)  re
ceiver

iperf Done.
king@ubuntu:~/share$
```

测试 tcp

```
# ./src/iperf3 -s
# iperf3 -c 192.168.199.129
```

```
Server listening on 5201 (test #6)
-----------------------------------------------------------
Accepted connection from 192.168.199.131, port 51616
[  5] local 192.168.199.129 port 5201 connected to 192.168.199.131 port 51624
[ ID] Interval           Transfer     Bitrate
[  5]   0.00-1.00   sec  1.96 MBytes  16.4 Mbits/sec
[  5]   1.00-2.00   sec  1.91 MBytes  16.0 Mbits/sec
[  5]   2.00-3.00   sec  1.90 MBytes  16.0 Mbits/sec
[  5]   3.00-4.00   sec  1.89 MBytes  15.9 Mbits/sec
[  5]   4.00-5.00   sec  1.81 MBytes  15.2 Mbits/sec
[  5]   5.00-6.00   sec  1.85 MBytes  15.5 Mbits/sec
[  5]   6.00-7.00   sec  1.89 MBytes  15.9 Mbits/sec
[  5]   7.00-8.00   sec  1.86 MBytes  15.6 Mbits/sec
[  5]   8.00-9.00   sec  1.94 MBytes  16.3 Mbits/sec
[  5]   9.00-10.00  sec  1.92 MBytes  16.1 Mbits/sec
[  5]  10.00-10.00  sec  1.00 KBytes  3.12 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate
[  5]   0.00-10.00  sec  18.9 MBytes  15.9 Mbits/sec                  receiver
-----------------------------------------------------------
Server listening on 5201 (test #7)
-----------------------------------------------------------
```

```
iperf Done.
king@ubuntu:~/share$ iperf3 -c 192.168.199.129
Connecting to host 192.168.199.129, port 5201
[  5] local 192.168.199.131 port 51624 connected to 192.168.199.129 port 5201
[ ID] Interval           Transfer     Bitrate         Retr  Cwnd
[  5]   0.00-1.00   sec  1.98 MBytes  16.6 Mbits/sec    0   5.00 KBytes
[  5]   1.00-2.00   sec  1.91 MBytes  16.0 Mbits/sec    0   5.00 KBytes
[  5]   2.00-3.00   sec  1.91 MBytes  16.0 Mbits/sec    1   5.00 KBytes
[  5]   3.00-4.00   sec  1.89 MBytes  15.9 Mbits/sec    0   5.00 KBytes
[  5]   4.00-5.00   sec  1.81 MBytes  15.2 Mbits/sec    1   5.00 KBytes
[  5]   5.00-6.00   sec  1.85 MBytes  15.6 Mbits/sec    0   5.00 KBytes
[  5]   6.00-7.00   sec  1.89 MBytes  15.9 Mbits/sec    0   5.00 KBytes
[  5]   7.00-8.00   sec  1.86 MBytes  15.6 Mbits/sec    0   5.00 KBytes
[  5]   8.00-9.00   sec  1.93 MBytes  16.2 Mbits/sec    0   5.00 KBytes
[  5]   9.00-10.00  sec  1.92 MBytes  16.1 Mbits/sec    0   5.00 KBytes
- - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Retr
[  5]   0.00-10.00  sec  19.0 MBytes  15.9 Mbits/sec    2             sender
[  5]   0.00-10.00  sec  18.9 MBytes  15.9 Mbits/sec                  receiver

iperf Done.
```