

Fio

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1 Installing Fio

1.1 As A Package

Without **OFED** on some systems installation from package works

```
aptitude install fio
```

CentOS (and Red Hat Enterprise Linux) have rather limited main repositories than most distributions. If you haven't already, you'll need to add the **EPEL** repository to **CentOS/RHEL** to get **fio**. However it might clash if you are using **Infiniband** with **OFED**. For this, use installation from source.

```
yum install epel-release -y
yum install fio
```

1.2 From Source

For older setups download the 2.0.14 `tar` version from 2013, because **RPM** might clash with **OFED** stack:

```
# As user:
tar xvf fio-2.0.14.tar
cd fio-2.0.14
./configure
make
# As root:
make install
install -m 755 -d /usr/local/bin
install fio fio_generate_plots /usr/local/bin
install -m 755 -d /usr/local/man/man1
install -m 644 fio.1 /usr/local/man/man1
install -m 644 fio_generate_plots.1 /usr/local/man/man1
```

The version 3.19 of 2020 already contains more scripts and man pages:

```
# As user:
wget https://github.com/axboe/fio/archive/fio-3.19.tar.gz
tar xvzf fio-3.19.tar.gz
cd fio-fio-3.19/
./configure
make
# As root:
make install
install -m 755 -d /usr/local/bin
install fio t/fio-genzipf t/fio-btrace2fio t/fio-dedupe t/fio-verify-state \
↳ \
./tools/fio_generate_plots ./tools/plot/fio2gnuplot ./tools/genfio \
./tools/fiologparser.py ./tools/hist/fiologparser_hist.py \
./tools/fio_jsonplus_clat2csv /usr/local/bin
install -m 755 -d /usr/local/man/man1
install -m 644 ./fio.1 /usr/local/man/man1
install -m 644 ./tools/fio_generate_plots.1 /usr/local/man/man1
install -m 644 ./tools/plot/fio2gnuplot.1 /usr/local/man/man1
install -m 644 ./tools/hist/fiologparser_hist.py.1 /usr/local/man/man1
install -m 755 -d /usr/local/share/fio
install -m 644 ./tools/plot/*gpm /usr/local/share/fio/
```

(The above wget URL changed, see github repository tags for new (2022-05-19))

The latest version 3.30 as of 2022-05-19:

```
# As user:
cd /tmp
wget https://github.com/axboe/fio/archive/refs/tags/fio-3.30.tar.gz
tar xvzf fio-3.30.tar.gz
cd fio-fio-3.30
./configure
make
# As root:
make install
install -m 755 -d /usr/local/bin
install fio t/fio-genzipf t/fio-btrace2fio t/fio-verify-state \
./tools/fio_generate_plots ./tools/plot/fio2gnuplot ./tools/genfio \
./tools/fiologparser.py ./tools/hist/fiologparser_hist.py \
./tools/hist/fio-histo-log-pctiles.py ./tools/fio_jsonplus_clat2csv \
/usr/local/bin
install -m 755 -d /usr/local/man/man1
install -m 644 ./fio.1 /usr/local/man/man1
install -m 644 ./tools/fio_generate_plots.1 /usr/local/man/man1
install -m 644 ./tools/plot/fio2gnuplot.1 /usr/local/man/man1
install -m 644 ./tools/hist/fiologparser_hist.py.1 /usr/local/man/man1
install -m 755 -d /usr/local/share/fio
install -m 644 ./tools/plot/*gpm /usr/local/share/fio/
```

Read the [documentation](#) for details

2 Running Fio

```
fio --name=random-write --ioengine=posixaio --rw=randwrite --bs=4k \
--numjobs=1 --size=4g --iodepth=1 --runtime=60 --time_based --end_fsync=1
```

The has a huge output, but most important is the write speed

```
1 [...]
2 Run status group 0 (all jobs):
3   WRITE: bw=127MiB/s (133MB/s), 127MiB/s-127MiB/s (133MB/s-133MB/s), \
4   io=8192MiB (8590MB), run=64602-64602msec
5 [...]
```

Reminder: MiB = Mebibyte (basis 1014), MB = Megabyte (basis 1000)

As we can see here the disk was fast, we requested 4g and it was able to run though its approximately 2 times in 60 seconds. The most interesting value is **bw=127MiB/s**.

If you have the CPU core number and the bandwidth to the storage subsystem, use more jobs in parallel. After this repeat with different block sizes, like 1m.

In contrast the version 3.19 from 2020 on a laptop from 2008:

```
fio --name=random-write --ioengine=posixaio --rw=randwrite --bs=4k \
--numjobs=1 --size=4g --iodepth=1 --runtime=60 --time_based --end_fsync=1
random-write: (g=0): rw=randwrite, bs=(R) 4096B-4096B, (W) 4096B-4096B,
↳ (T) \
4096B-4096B, ioengine=posixaio, iodepth=1
fio-3.19
Starting 1 process
random-write: Laying out IO file (1 file / 4096MiB)
Jobs: 1 (f=1): [F(1)][100.0%][w=23.4MiB/s][w=5992 IOPS][eta 00m:00s]
random-write: (groupid=0, jobs=1): err= 0: pid=2427: Tue May 19 11:55:53
↳ 2020
write: IOPS=10.1k, BW=39.3MiB/s (41.2MB/s)(2411MiB/61288msec); 0 zone
↳ resets
slat (usec): min=2, max=118728, avg=14.89, stdev=369.70
clat (nsec): min=1327, max=245121k, avg=71777.23, stdev=1507737.18
lat (usec): min=19, max=250225, avg=86.66, stdev=1556.20
clat percentiles (usec):
| 1.00th=[ 3], 5.00th=[ 3], 10.00th=[ 3], 20.00th=[ 23],
| 30.00th=[ 26], 40.00th=[ 29], 50.00th=[ 30], 60.00th=[ 30],
| 70.00th=[ 30], 80.00th=[ 37], 90.00th=[ 63], 95.00th=[ 91],
| 99.00th=[ 326], 99.50th=[ 799], 99.90th=[ 5866], 99.95th=[ 8717],
| 99.99th=[82314]
bw ( KiB/s): min=16406, max=66802, per=100.00%, avg=41176.64, \
stdev=8856.09, samples=118
iops      : min= 4101, max=16700, avg=10293.88, stdev=2214.04,
↳ samples=118
lat (usec) : 2=0.09%, 4=11.76%, 10=0.01%, 20=0.28%, 50=74.46%
lat (usec) : 100=8.98%, 250=3.08%, 500=0.64%, 750=0.18%, 1000=0.09%
lat (msec) : 2=0.16%, 4=0.12%, 10=0.12%, 20=0.02%, 50=0.01%
lat (msec) : 100=0.01%, 250=0.01%
cpu       : usr=10.78%, sys=15.06%, ctx=775939, majf=5, minf=29
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=0,617184,0,0 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=39.3MiB/s (41.2MB/s), 39.3MiB/s-39.3MiB/s (41.2MB/s-41.2MB/s), \
    ↪ \
io=2411MiB (2528MB), run=61288-61288msec

Disk stats (read/write):
  dm-1: ios=2381/631516, merge=0/0, ticks=9376/82883752,
    ↪ in_queue=82929236, \
util=80.66%, aggrios=3246/655729, aggrmerge=0/0, aggrticks=10692/87229256,
    ↪ \
aggrin_queue=87239968, aggrutil=81.29%
  dm-0: ios=3246/655729, merge=0/0, ticks=10692/87229256,
    ↪ in_queue=87239968, \
util=81.29%, aggrios=3235/653548, aggrmerge=11/2181,
    ↪ aggrticks=1945/108056, \
aggrin_queue=62344, aggrutil=31.25%
  sda: ios=3235/653548, merge=11/2181, ticks=1945/108056, in_queue=62344,
    ↪ \
util=31.25%
```

And again the line with the most interest:

```
1  WRITE: bw=39.3MiB/s (41.2MB/s), 39.3MiB/s-39.3MiB/s (41.2MB/s-41.2MB/s), \
2  io=2411MiB (2528MB), run=61288-61288msec
```

The laptop is much slower with **bw=39.3MiB/s** for 1 job

```
1  WRITE: bw=52.6MiB/s (55.2MB/s), 24.6MiB/s-28.0MiB/s (25.8MB/s-29.4MB/s), \
2  io=3232MiB (3389MB), run=61428-61428msec
```

And for 2 jobs **bw=52.6MiB/s**. Comparing the laptop from 2008 with a desktop from 2013, it holds quite well:

```
1  WRITE: bw=26.8MiB/s (28.1MB/s), 26.8MiB/s-26.8MiB/s (28.1MB/s-28.1MB/s), \
2  io=2581MiB (2706MB), run=96397-96397msec
```

As the desktop freezes when `fio` is run on one core, and the performance is bad, it is a matter of system design, not of age in some cases.

In contrast the version 3.30 from 2022 on a laptop from 2008:

```
fio --name=random-write --ioengine=posixaio --rw=randwrite --bs=4k \
--numjobs=1 --size=4g --iodepth=1 --runtime=60 --time_based --end_fsync=1
random-write: (g=0): rw=randwrite, bs=(R) 4096B-4096B, (W) 4096B-4096B,
    ↪ (T) \
```

```

4096B-4096B, ioengine=posixaio, iodepth=1
fio-3.30
Starting 1 process
random-write: Laying out IO file (1 file / 4096MiB)
Jobs: 1 (f=1): [F(1)][100.0%][eta 00m:00s]
random-write: (groupid=0, jobs=1): err= 0: pid=28278: Thu May 19 15:19:14
↪ 2022
write: IOPS=3861, BW=15.1MiB/s (15.8MB/s)(1183MiB/78401msec); 0 zone
↪ resets
slat (usec): min=3, max=9870, avg= 7.60, stdev=59.69
clat (nsec): min=1257, max=21055M, avg=185432.51, stdev=39838405.45
lat (usec): min=22, max=21055k, avg=193.03, stdev=39838.46
clat percentiles (nsec):
| 1.00th=[ 1816], 5.00th=[ 20608], 10.00th=[ 21632],
| 20.00th=[ 22912], 30.00th=[ 24192], 40.00th=[ 24960],
| 50.00th=[ 25984], 60.00th=[ 27264], 70.00th=[ 28544],
| 80.00th=[ 30592], 90.00th=[ 34048], 95.00th=[ 64256],
| 99.00th=[ 978944], 99.50th=[ 5799936], 99.90th=[ 7634944],
| 99.95th=[ 8355840], 99.99th=[53215232]
bw ( KiB/s): min= 80, max=106970, per=100.00%, avg=36142.76, \
stdev=27917.69, samples=67
iops      : min= 20, max=26742, avg=9035.67, stdev=6979.41,
↪ samples=67
lat (usec) : 2=1.11%, 4=0.02%, 10=0.01%, 20=0.93%, 50=91.75%
lat (usec) : 100=2.75%, 250=1.98%, 500=0.28%, 750=0.10%, 1000=0.08%
lat (msec) : 2=0.22%, 4=0.20%, 10=0.55%, 20=0.02%, 50=0.01%
lat (msec) : 100=0.01%, 250=0.01%, 500=0.01%, 2000=0.01%, >=2000=0.01%
cpu        : usr=5.23%, sys=2.26%, ctx=380587, majf=0, minf=18
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=0,302771,0,0 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=15.1MiB/s (15.8MB/s), 15.1MiB/s-15.1MiB/s (15.8MB/s-15.8MB/s),
↪ \
io=1183MiB (1240MB), run=78401-78401msec

```

```
Disk stats (read/write):
  dm-1: ios=88/278258, merge=0/0, ticks=325796/2519395188, \
in_queue=2521065440, util=97.99%, aggrios=91/279033, aggrmerge=0/0, \
aggrticks=325808/2519396324, aggrin_queue=2520489288, aggrutil=97.98%
  dm-0: ios=91/279033, merge=0/0, ticks=325808/2519396324, \
in_queue=2520489288, util=97.98%, aggrios=90/276897, aggrmerge=0/2133, \
aggrticks=1604/10742808, aggrin_queue=10744248, aggrutil=95.21%
  sda: ios=90/276897, merge=0/2133, ticks=1604/10742808,
    in_queue=10744248, \
util=95.21%
```

Compare `fio 3.19` with `fio 3.30` (2 years later) on the same 2008 hardware:

```
1 # fio 3.19 (redone 2022-05-19)
2 WRITE: bw=12.3MiB/s (12.9MB/s), 12.3MiB/s-12.3MiB/s (12.9MB/s-12.9MB/s), \
3 io=926MiB (971MB), run=75132-75132msec
4
5 # fio 3.30 (done 2022-05-19)
6 WRITE: bw=15.1MiB/s (15.8MB/s), 15.1MiB/s-15.1MiB/s (15.8MB/s-15.8MB/s), \
7 io=1183MiB (1240MB), run=78401-78401msec
```

So it seems that the newer version is faster. This has to be taken with a pinch of salt. However, it is recommended to calculate an average over several runs and stick to the same version of `fio`.

3 History

Version	Date	Notes
0.1.1	2022-05-19	Change code blocks, +history, fio-3.30, comparison
0.1.0	2020-05-19	Initial release

4 Disclaimer of Warranty

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