

Project Report

1.Configurations



2.Enable QEMU VM

1.Install QEMU

```
brew install qemu
```

2. qcow2 image

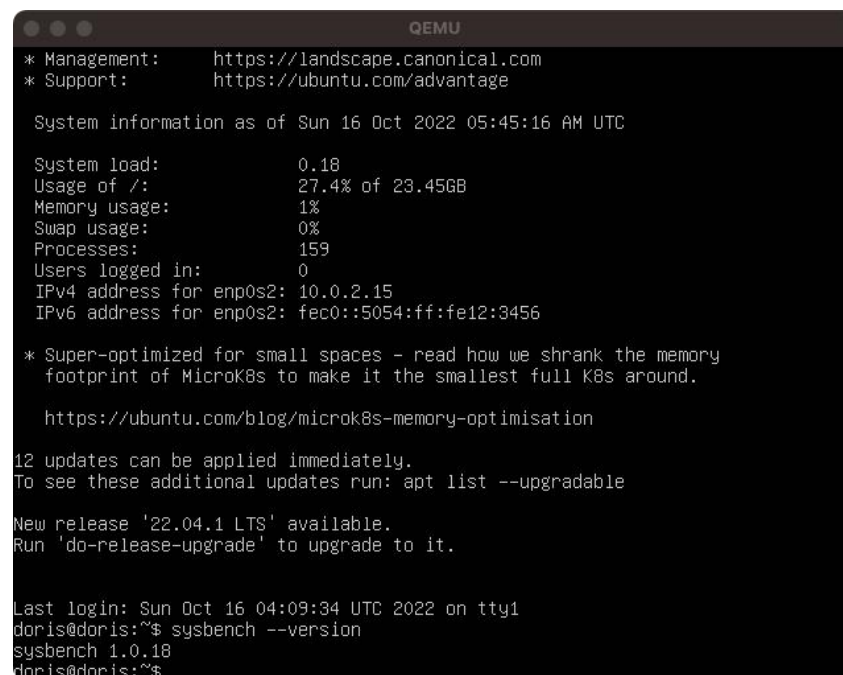
```
qemu-img create -f qcow2 ubuntu20.qcow2 50G
```

3. Install VM:ubuntu server

```
qemu-system-x86_64 \
    -machine type=q35,accel=hvf \
    -smp 6 \
    -cpu host \
    -hda ubuntu20.qcow2 \
    -m 16G \
    -vga virtio \
    -usb \
    -device usb-tablet \
    -display default,show-cursor=on -cdrom ./ubuntu-20.04.5-live-server-
amd64.iso
```

4. Start Ubuntu

```
qemu-system-x86_64 \
-machine type=q35,accel=hvf \
-smp 6 \
-cpu host \
-hda ubuntu20.qcow2 \
-m 16G \
-vga virtio \
-usb \
-device usb-tablet \
-display default,show-cursor=on -net user,hostfwd=tcp::2222-:22 -net nic
```



```
QEMU
* Management:   https://landscape.canonical.com
* Support:      https://ubuntu.com/advantage

System information as of Sun 16 Oct 2022 05:45:16 AM UTC

System load:            0.18
Usage of /:              27.4% of 23.45GB
Memory usage:           1%
Swap usage:             0%
Processes:              159
Users logged in:        0
IPv4 address for enp0s2: 10.0.2.15
IPv6 address for enp0s2: fec0::5054:ff:fe12:3456

* Super-optimized for small spaces - read how we shrank the memory
  footprint of MicroK8s to make it the smallest full K8s around.

  https://ubuntu.com/blog/microk8s-memory-optimisation

12 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

New release '22.04.1 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Sun Oct 16 04:09:34 UTC 2022 on tty1
doris@doris:~$ sysbench --version
sysbench 1.0.18
doris@doris:~$
```

3. Enable Docker image

1.start docker

```
$ sudo service docker start
```

2.install sysbench

```
$ docker rm -f sysbench
```

```
$ docker run -d --name zcdsysbench -h zcdsysbench \ -p 3222:22 -p
33389:3389 \ --privileged=true centos:7.6.1810 \ /usr/sbin/init
```

```
[root@zcdsysbench /]# docker exec -it zcdsysbench bash
```

```
[root@zcdsysbench /]# cat /etc/redhat-release
```

CentOS Linux release 7.6.1810 (Core)

```
[root@zcdsysbench /]# curl -s
https://packagecloud.io/install/repositories/akopytov/sysbench/script.rpm.sh
| sudo bash

[root@zcdsysbench /]# sudo yum -y install sysbench

[root@zcdsysbench /]# sysbench --version

sysbench 1.0.20
```

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli - docker exec -it zcdsy...

-device usb-tablet \
-display default,show-cursor=on -net user,hostfwd=tcp::2222::22 -net nic

^Cqemu-system-x86_64: terminating on signal 2 from pid 98205 (<unknown process>)
zhouchuandi@zhouchundideMBP ~ % docker rm -f sysbench
Error: No such container: sysbench
zhouchuandi@zhouchundideMBP ~ % docker run -d --name zcdsysbench -h zcdsysench \
-p 3222:22 -p 33389:33389 \
--privi
zhouchuandi@zhouchundideMBP ~ % docker run -d --name zcdsysbench -h zcdsysbench
\
-p 3222:22 -p 33389:33389 \
--privileged=true centos:7.6.1810 \
/usr/sbin/init
Unable to find image 'centos:7.6.1810' locally
7.6.1810: Pulling from library/centos
ac9208207ada: Pull complete
Digest: sha256:62d9e1c2daa91166139b51577fe4f4f6b4cc41a3a2c7fc36bd895e2a17a3e4e6
Status: Downloaded newer image for centos:7.6.1810
bf7cf9d975f07da2cc3e06d442d2a9e9dc203c24ec22faf4f34fa01fd5e16a90
zhouchuandi@zhouchundideMBP ~ % docker exec -it zcdsysbench bash
[root@zcdsysbench /]# cat /etc/redhat-release
CentOS Linux release 7.6.1810 (Core)
[root@zcdsysbench /]#
```

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli - docker exec -it zcdsy...

Verifying : 1:mariadb-libs-5.5.68-1.el7.x86_64 4/4

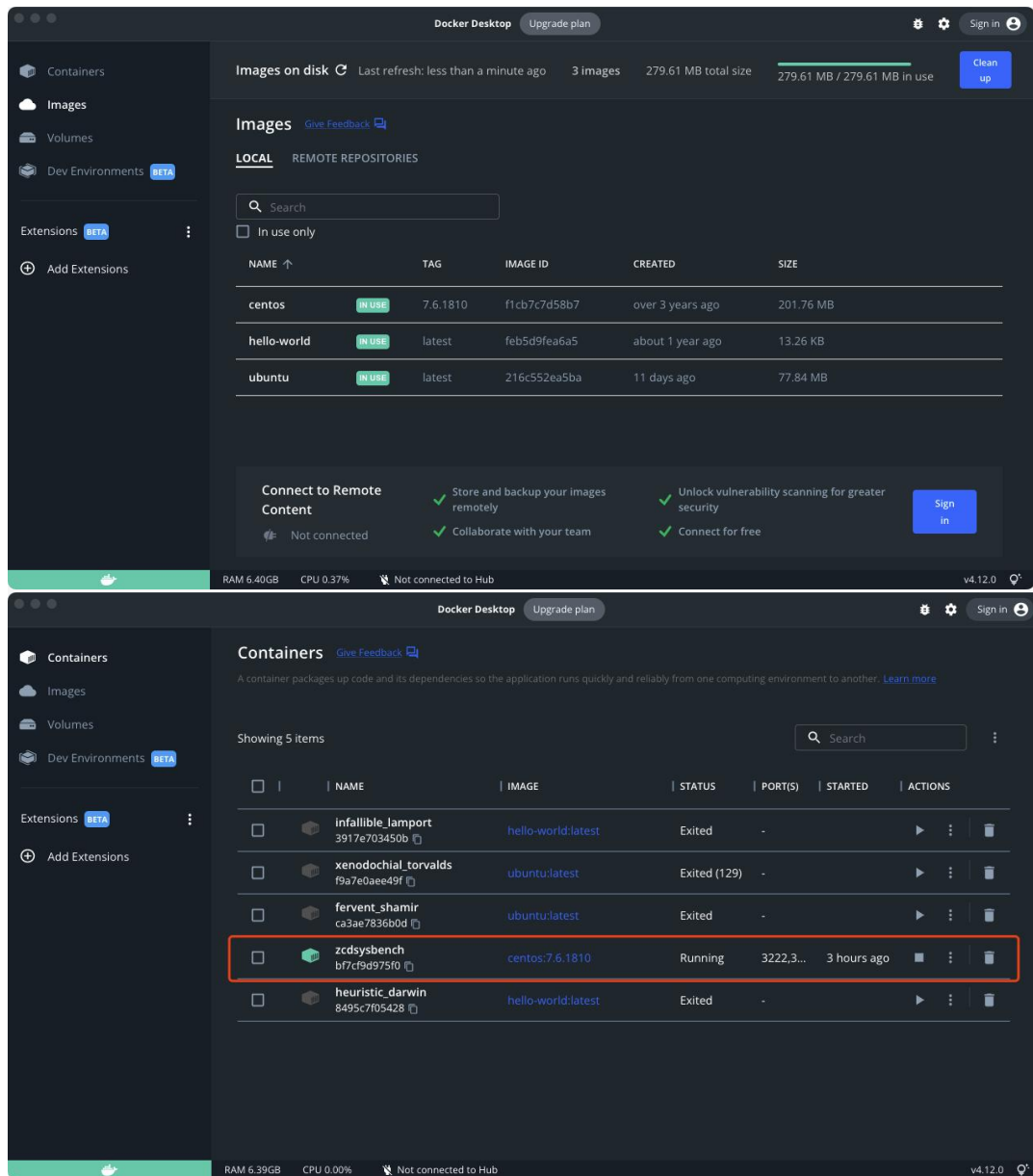
Installed:
sysbench.x86_64 0:1.0.20-1.el7

Dependency Installed:
libaio.x86_64 0:0.3.109-13.el7 mariadb-libs.x86_64 1:5.5.68-1.el7
postgresql-libs.x86_64 0:9.2.24-8.el7_9

Complete!
[root@zcdsysbench /]# sysbench --version
sysbench 1.0.20
[root@zcdsysbench /]# sysbench --help
Usage:
sysbench [options]... [testname] [command]

Commands implemented by most tests: prepare run cleanup help

General options:
--threads=N          number of threads to use [1]
--events=N           limit for total number of events [0]
--time=N             limit for total execution time in seconds [10]
--forced-shutdown=STRING number of seconds to wait after the --time lim
it before forcing shutdown, or 'off' to disable [off]
```



2. operations

```
$ docker run +image
```

(Before running a container, docker will see if there is a local image that the container needs, and if not, it will go to the remote end to download it.)

```
$ docker ps
```

(View the running docker containers)

```
$ docker ps -a
```

(View all containers)

```
$ docker stop + container id
```

(Stop the container)

```
$ docker rm + container id
```

(Remove container)

```
$ docker images
```

(View all the images)

```
$ docker rmi + image id
```

(Remove image)

4.Experiments

Environment:

QEMU configuration:

```
QEMU
Topology: 6-Core model: 06/7e bits: 64 type: MCP arch: Ice Lake rev: 5
L2 cache: 16.0 MiB
flags: avx avx2 lm nx pae sse sse2 sse3 sse4_1 sse4_2 ssse3
bogomips: 23961
Speed: 1997 MHz min/max: N/A Core speeds (MHz): 1: 1997 2: 1997 3: 1997
4: 1997 5: 1997 6: 1997
Graphics:
Device-1: Red Hat Virtio GPU driver: virtio-pci v: 1 bus ID: 00:01.0
Display: server: No display server data found. Headless machine?
tty: 80x30
Message: Advanced graphics data unavailable in console. Try -G --display
Audio:
Message: No Device data found.
Network:
Device-1: Intel 82574L Gigabit Network driver: e1000e v: 3.2.6-k
port: c040 bus ID: 00:02.0
IF: enp0s2 state: up speed: 1000 Mbps duplex: full mac: <filter>
Drives:
Local Storage: total: 50.00 GiB used: 6.72 GiB (13.4%)
ID-1: /dev/sda vendor: QEMU model: HARDDISK size: 50.00 GiB
Partition:
ID-1: / size: 23.45 GiB used: 6.62 GiB (28.2%) fs: ext4 dev: /dev/dm-0
ID-2: /boot size: 1.90 GiB used: 105.7 MiB (5.4%) fs: ext4 dev: /dev/sda2
Sensors:
Message: No sensors data was found. Is sensors configured?
Info:
Processes: 149 Uptime: 4h 53m Memory: 15.63 GiB used: 276.9 MiB (1.7%)
Init: systemd runlevel: 5 Compilers: gcc: N/A Shell: bash v: 5.0.17
inxi: 3.0.38
doris@doris:~$
```

docker information

```
zhouchuandi — root@5513c7180d3b: / — -zsh — 80x24
...c -it zcdsysbench bash | ...p::2222--22 -net nic | ...180d3b: / — -zsh | +
zhouchuandi@zhouchundideMBP ~ % docker info
Client:
Context:      default
Debug Mode: false
Plugins:
buildx: Docker Buildx (Docker Inc., v0.9.1)
compose: Docker Compose (Docker Inc., v2.10.2)
extension: Manages Docker extensions (Docker Inc., v0.2.9)
sbom: View the packaged-based Software Bill Of Materials (SBOM) for an image (
Anchore Inc., 0.6.0)
scan: Docker Scan (Docker Inc., v0.19.0)

Server:
Containers: 2
Running: 1
Paused: 0
Stopped: 1
Images: 5
Server Version: 20.10.17
Storage Driver: overlay2
Backing Filesystem: extfs
Supports d_type: true
Native Overlay Diff: true
userxattr: false

yslog
Swarm: inactive
Runtimes: io.containerd.runc.v2 io.containerd.runtime.v1.linux runc
Default Runtime: runc
Init Binary: docker-init
containerd version: 9cd3357b7fd7218e4aec3eae239db1f68a5a6ec6
runc version: v1.1.4-0-g5fd4c4d
init version: de40ad0
Security Options:
seccomp
Profile: default
cgroupns
Kernel Version: 5.10.124-linuxkit
Operating System: Docker Desktop
OSType: linux
Architecture: x86_64
CPUs: 4
Total Memory: 7.676GiB
Name: docker-desktop
ID: WSXF:5BC3:XCU3:XFZH:6MR2:OFVV:QRBZ:OEL5:BTZI:L7CH:YRYR:ZK45
Docker Root Dir: /var/lib/docker
Debug Mode: false
HTTP Proxy: http.docker.internal:3128
HTTPS Proxy: http.docker.internal:3128
```

1. CPU test (parameter:prime=10000)

```
$ sysbench --test=cpu --cpu-max-prime=10000 run
```

1a]QEMU test run 1

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 10000
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 2324.07

General statistics:
  total time:          10.0006s
  total number of events: 23246

Latency (ms):
  min:                0.33
  avg:                0.40
  max:                5.42
  95th percentile:   0.57
  sum:                9319.07

Threads fairness:
  events (avg/stddev): 23246.0000/0.00
  execution time (avg/stddev): 9.3191/0.00
doris@doris:~$
```

QEMU test run 2

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 10000
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 2291.90

General statistics:
  total time:          10.0004s
  total number of events: 22924

Latency (ms):
  min:                0.34
  avg:                0.41
  max:                6.06
  95th percentile:   0.58
  sum:                9320.98

Threads fairness:
  events (avg/stddev): 22924.0000/0.00
  execution time (avg/stddev): 9.3210/0.00
doris@doris:~$
```

QEMU test run 3

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 10000

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2241.58

General statistics:
  total time:          10.0006s
  total number of events: 22421

Latency (ms):
  min:                 0.36
  avg:                 0.41
  max:                 4.05
  95th percentile:    0.61
  sum:                 9304.73

Threads fairness:
  events (avg/stddev): 22421.0000/0.00
  execution time (avg/stddev): 9.3047/0.00

doris@doris:~$
```

QEMU test run 4

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 10000

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2268.84

General statistics:
  total time:          10.0008s
  total number of events: 22694

Latency (ms):
  min:                 0.35
  avg:                 0.41
  max:                 7.42
  95th percentile:    0.59
  sum:                 9302.97

Threads fairness:
  events (avg/stddev): 22694.0000/0.00
  execution time (avg/stddev): 9.3030/0.00

doris@doris:~$
```


QEMU test run 5

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 10000
Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2192.39

General statistics:
  total time: 10.0006s
  total number of events: 21929

Latency (ms):
  min: 0.34
  avg: 0.42
  max: 29.71
  95th percentile: 0.63
  sum: 9305.15

Threads fairness:
  events (avg/stddev): 21929.0000/0.00
  execution time (avg/stddev): 9.3051/0.00
doris@doris:~$
```

1b] Docker test run1

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +
Prime numbers limit: 10000
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 2667.81
General statistics:
  total time: 10.0003s
  total number of events: 26684
Latency (ms):
  min: 0.32
  avg: 0.37
  max: 1.15
  95th percentile: 0.44
  sum: 9977.13
Threads fairness:
  events (avg/stddev): 26684.0000/0.00
  execution time (avg/stddev): 9.9771/0.00
```

Docker test run 2

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2486.32

General statistics:
  total time:                10.0002s
  total number of events:    24869

Latency (ms):
  min:                       0.33
  avg:                       0.40
  max:                       13.08
  95th percentile:          0.54
  sum:                       9954.88

Threads fairness:
  events (avg/stddev):       24869.0000/0.00
  execution time (avg/stddev): 9.9549/0.00

[root@zcdsysbench /]#
```

Docker test run 3

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2487.69

General statistics:
  total time:                10.0004s
  total number of events:    24883

Latency (ms):
  min:                       0.33
  avg:                       0.40
  max:                       8.00
  95th percentile:          0.54
  sum:                       9953.20

Threads fairness:
  events (avg/stddev):       24883.0000/0.00
  execution time (avg/stddev): 9.9532/0.00

[root@zcdsysbench /]#
```

Docker test run 4

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...-it zcdsysbench bash ...    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2543.31

General statistics:
  total time:                10.0003s
  total number of events:    25439

Latency (ms):
  min:                        0.33
  avg:                        0.39
  max:                        6.48
  95th percentile:          0.51
  sum:                        9958.21

Threads fairness:
  events (avg/stddev):       25439.0000/0.00
  execution time (avg/stddev): 9.9582/0.00

[root@zcdsysbench /]#
```

Docker test run 5

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 2501.03

General statistics:
  total time:                10.0010s
  total number of events:    25018

Latency (ms):
  min:                        0.35
  avg:                        0.40
  max:                        4.63
  95th percentile:          0.53
  sum:                        9952.71

Threads fairness:
  events (avg/stddev):       25018.0000/0.00
  execution time (avg/stddev): 9.9527/0.00

[root@zcdsysbench /]#
```

2. CPU test (parameter:prime=20000)

```
$ sysbench --test=cpu --cpu-max-prime=20000 run
```

2a] QEMU test run 1

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   969.58

General statistics:
  total time:          10.0006s
  total number of events: 9698

Latency (ms):
  min:                 0.85
  avg:                 1.00
  max:                 2.39
  95th percentile:    1.23
  sum:                 9718.99

Threads fairness:
  events (avg/stddev): 9698.0000/0.00
  execution time (avg/stddev): 9.7190/0.00
doris@doris:~$
```

QEMU test run 2

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   975.80

General statistics:
  total time:          10.0007s
  total number of events: 9761

Latency (ms):
  min:                 0.85
  avg:                 1.00
  max:                 20.04
  95th percentile:    1.18
  sum:                 9725.10

Threads fairness:
  events (avg/stddev): 9761.0000/0.00
  execution time (avg/stddev): 9.7251/0.00
doris@doris:~$
```

QEMU test run 3

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
  events per second:  977.86

General statistics:
  total time:          10.0012s
  total number of events: 9782

Latency (ms):
  min:                 0.85
  avg:                 0.99
  max:                 2.73
  95th percentile:    1.21
  sum:                 9728.04

Threads fairness:
  events (avg/stddev):  9782.0000/0.00
  execution time (avg/stddev): 9.7280/0.00

doris@doris:~$
```

QEMU test run 4

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
  events per second:  942.51

General statistics:
  total time:          10.0009s
  total number of events: 9428

Latency (ms):
  min:                 0.85
  avg:                 1.03
  max:                 3.65
  95th percentile:    1.30
  sum:                 9706.01

Threads fairness:
  events (avg/stddev):  9428.0000/0.00
  execution time (avg/stddev): 9.7060/0.00

doris@doris:~$
```

QEMU test run 5

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 930.17

General statistics:
  total time: 10.0008s
  total number of events: 9304

Latency (ms):
  min: 0.85
  avg: 1.04
  max: 13.22
  95th percentile: 1.32
  sum: 9693.91

Threads fairness:
  events (avg/stddev): 9304.0000/0.00
  execution time (avg/stddev): 9.6939/0.00

doris@doris:~$
```

2b] Docker test run1

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 1019.52

General statistics:
  total time: 10.0009s
  total number of events: 10198

Latency (ms):
  min: 0.84
  avg: 0.98
  max: 2.34
  95th percentile: 1.16
  sum: 9985.12

Threads fairness:
  events (avg/stddev): 10198.0000/0.00
  execution time (avg/stddev): 9.9851/0.00

[root@zcdsysbench /]#
```

Docker test run 2

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli - docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   979.94

General statistics:
  total time:          10.0003s
  total number of events: 9802

Latency (ms):
  min:                 0.92
  avg:                 1.02
  max:                 8.23
  95th percentile:    1.25
  sum:                 9977.30

Threads fairness:
  events (avg/stddev):   9802.0000/0.00
  execution time (avg/stddev): 9.9773/0.00

[root@zcdsysbench /]#
```

Docker test run 3

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli - docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   978.96

General statistics:
  total time:          10.0004s
  total number of events: 9792

Latency (ms):
  min:                 0.92
  avg:                 1.02
  max:                 8.71
  95th percentile:    1.21
  sum:                 9978.99

Threads fairness:
  events (avg/stddev):   9792.0000/0.00
  execution time (avg/stddev): 9.9790/0.00

[root@zcdsysbench /]#
```

Docker test run 4

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 981.79

General statistics:
  total time: 10.0008s
  total number of events: 9821

Latency (ms):
  min: 0.92
  avg: 1.02
  max: 11.40
  95th percentile: 1.23
  sum: 9979.62

Threads fairness:
  events (avg/stddev): 9821.0000/0.00
  execution time (avg/stddev): 9.9796/0.00

[root@zcdsysbench /]#
```

Docker test run 5

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 995.33

General statistics:
  total time: 10.0009s
  total number of events: 9956

Latency (ms):
  min: 0.84
  avg: 1.00
  max: 8.84
  95th percentile: 1.21
  sum: 9978.82

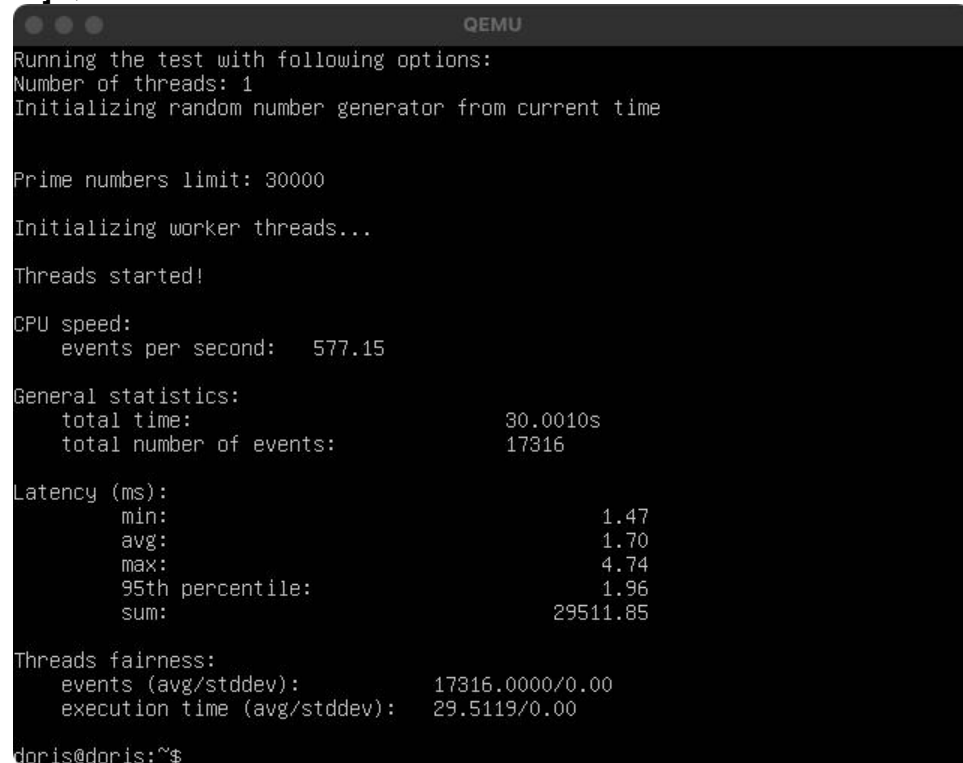
Threads fairness:
  events (avg/stddev): 9956.0000/0.00
  execution time (avg/stddev): 9.9788/0.00

[root@zcdsysbench /]#
```


3.CPU test (parameter: prime=30000 limit time=30s)

```
$ sysbench --test=cpu --cpu-max-prime=30000 --max-time=30 run
```

3a] QEMU test run 1



```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 30000
Initializing worker threads...
Threads started!

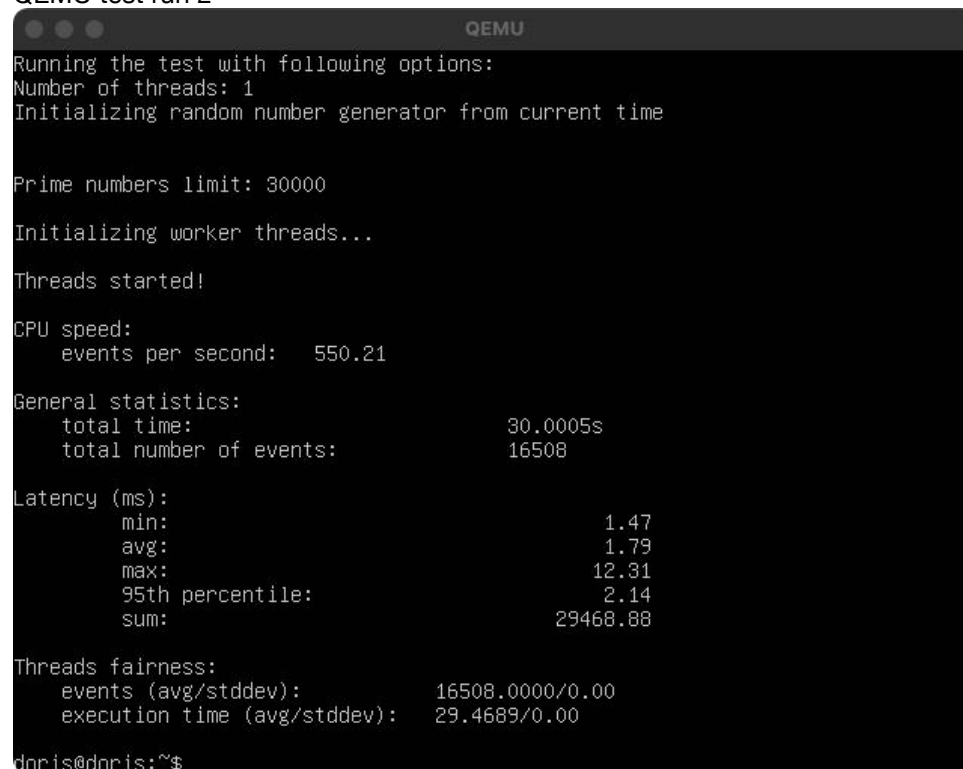
CPU speed:
  events per second:   577.15

General statistics:
  total time:          30.0010s
  total number of events: 17316

Latency (ms):
  min:                 1.47
  avg:                 1.70
  max:                 4.74
  95th percentile:    1.96
  sum:                 29511.85

Threads fairness:
  events (avg/stddev): 17316.0000/0.00
  execution time (avg/stddev): 29.5119/0.00
doris@doris:~$
```

QEMU test run 2



```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 30000
Initializing worker threads...
Threads started!

CPU speed:
  events per second:   550.21

General statistics:
  total time:          30.0005s
  total number of events: 16508

Latency (ms):
  min:                 1.47
  avg:                 1.79
  max:                 12.31
  95th percentile:    2.14
  sum:                 29468.88

Threads fairness:
  events (avg/stddev): 16508.0000/0.00
  execution time (avg/stddev): 29.4689/0.00
doris@doris:~$
```

QEMU test run 3

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 30000

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   543.35

General statistics:
  total time:          30.0011s
  total number of events: 16302

Latency (ms):
  min:                 1.47
  avg:                 1.81
  max:                 11.05
  95th percentile:    2.14
  sum:                 29458.41

Threads fairness:
  events (avg/stddev): 16302.0000/0.00
  execution time (avg/stddev): 29.4584/0.00

doris@doris:~$
```

QEMU test run 4

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 30000

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   546.03

General statistics:
  total time:          30.0010s
  total number of events: 16383

Latency (ms):
  min:                 1.47
  avg:                 1.80
  max:                 13.57
  95th percentile:    2.14
  sum:                 29469.29

Threads fairness:
  events (avg/stddev): 16383.0000/0.00
  execution time (avg/stddev): 29.4693/0.00

doris@doris:~$
```

QEMU test run 5

```
QEMU
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

Prime numbers limit: 30000
Initializing worker threads...
Threads started!

CPU speed:
  events per second:   549.36

General statistics:
  total time:          30.0013s
  total number of events: 16483

Latency (ms):
  min:                 1.47
  avg:                 1.79
  max:                 47.54
  95th percentile:    2.14
  sum:                 29466.85

Threads fairness:
  events (avg/stddev): 16483.0000/0.00
  execution time (avg/stddev): 29.4668/0.00
doris@doris:~$
```

3b] Docker test run 1

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222::22 -net nic | ...180d3b: / — -zsh |
Initializing worker threads...
Threads started!

CPU speed:
  events per second:   578.35

General statistics:
  total time:          30.0009s
  total number of events: 17352

Latency (ms):
  min:                 1.49
  avg:                 1.73
  max:                 17.63
  95th percentile:    1.96
  sum:                 29964.44

Threads fairness:
  events (avg/stddev): 17352.0000/0.00
  execution time (avg/stddev): 29.9644/0.00
[root@zcdsysbench /]#
```

Docker test run 2

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 560.19

General statistics:
  total time: 30.0004s
  total number of events: 16807

Latency (ms):
  min: 1.62
  avg: 1.78
  max: 13.65
  95th percentile: 2.07
  sum: 29947.91

Threads fairness:
  events (avg/stddev): 16807.0000/0.00
  execution time (avg/stddev): 29.9479/0.00

[root@zcdsysbench /]#
```

Docker test run 3

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 549.72

General statistics:
  total time: 30.0018s
  total number of events: 16494

Latency (ms):
  min: 1.61
  avg: 1.82
  max: 21.54
  95th percentile: 2.14
  sum: 29945.73

Threads fairness:
  events (avg/stddev): 16494.0000/0.00
  execution time (avg/stddev): 29.9457/0.00

[root@zcdsysbench /]#
```

Docker test run 4

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...-it zcdsysbench bash ...    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   564.89

General statistics:
  total time:          30.0003s
  total number of events: 16948

Latency (ms):
  min:                 1.57
  avg:                 1.77
  max:                 11.03
  95th percentile:    2.07
  sum:                 29956.38

Threads fairness:
  events (avg/stddev): 16948.0000/0.00
  execution time (avg/stddev): 29.9564/0.00

[root@zcdsysbench /]#
```

Docker test run 5

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

Initializing worker threads...

Threads started!

CPU speed:
  events per second:   563.30

General statistics:
  total time:          30.0018s
  total number of events: 16901

Latency (ms):
  min:                 1.62
  avg:                 1.77
  max:                 11.67
  95th percentile:    2.03
  sum:                 29955.35

Threads fairness:
  events (avg/stddev): 16901.0000/0.00
  execution time (avg/stddev): 29.9554/0.00

[root@zcdsysbench /]#
```

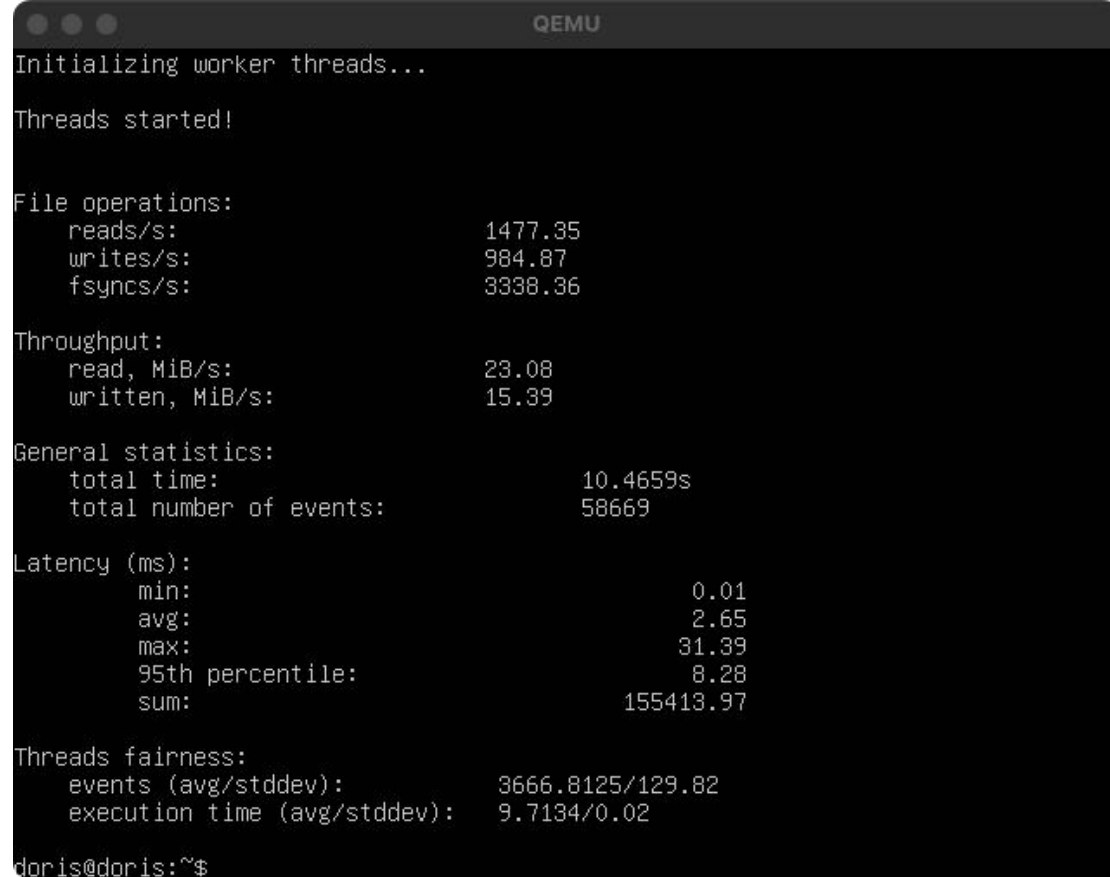
4.Fileio Test (parameter:file size=1G)

```
$ sysbench fileio --threads=16 --file-total-size=1G --file-test-mode=rndrw prepare

$ sysbench fileio --threads=16 --file-total-size=1G --file-test-mode=rndrw run

$ sysbench fileio --threads=16 --file-total-size=1G --file-test-mode=rndrw cleanup
```

4a] QEMU test run1

A screenshot of a terminal window titled "QEMU". The terminal displays the output of a sysbench fileio test. The output is organized into several sections: "File operations:", "Throughput:", "General statistics:", "Latency (ms):", and "Threads fairness:". Each section contains specific performance metrics such as reads/writes/fsyncs per second, MiB/s throughput, total time, number of events, latency in milliseconds, and thread fairness statistics. The terminal ends with a shell prompt "doris@doris:~\$".

```
QEMU
Initializing worker threads...
Threads started!

File operations:
  reads/s:          1477.35
  writes/s:         984.87
  fsyncs/s:        3338.36

Throughput:
  read, MiB/s:      23.08
  written, MiB/s:   15.39

General statistics:
  total time:       10.4659s
  total number of events: 58669

Latency (ms):
  min:              0.01
  avg:              2.65
  max:              31.39
  95th percentile: 8.28
  sum:              155413.97

Threads fairness:
  events (avg/stddev): 3666.8125/129.82
  execution time (avg/stddev): 9.7134/0.02

doris@doris:~$
```

QEMU test run2

```
QEMU
Initializing worker threads...
Threads started!

File operations:
  reads/s:          1504.31
  writes/s:         1002.88
  fsyncs/s:         3399.83

Throughput:
  read, MiB/s:      23.50
  written, MiB/s:   15.67

General statistics:
  total time:       10.4484s
  total number of events: 59680

Latency (ms):
  min:              0.00
  avg:              2.61
  max:              24.64
  95th percentile: 7.98
  sum:              155682.78

Threads fairness:
  events (avg/stddev): 3730.0000/116.17
  execution time (avg/stddev): 9.7302/0.02
doris@doris:~$
```

QEMU test run3

```
QEMU
Initializing worker threads...
Threads started!

File operations:
  reads/s:          1315.63
  writes/s:         877.09
  fsyncs/s:         2993.43

Throughput:
  read, MiB/s:      20.56
  written, MiB/s:   13.70

General statistics:
  total time:       10.7608s
  total number of events: 53770

Latency (ms):
  min:              0.01
  avg:              2.90
  max:              56.83
  95th percentile: 8.90
  sum:              156045.39

Threads fairness:
  events (avg/stddev): 3360.6250/128.60
  execution time (avg/stddev): 9.7528/0.02
doris@doris:~$
```

QEMU test run4

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1092.69
  writes/s:         728.30
  fsyncs/s:        2525.85

Throughput:
  read, MiB/s:      17.07
  written, MiB/s:   11.38

General statistics:
  total time:              10.4869s
  total number of events:  43545

Latency (ms):
  min:                   0.01
  avg:                   3.58
  max:                   74.64
  95th percentile:      11.24
  sum:                   155829.76

Threads fairness:
  events (avg/stddev):    2721.5625/95.46
  execution time (avg/stddev): 9.7394/0.02

doris@doris:~$
```

QEMU test run5

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1140.60
  writes/s:         760.72
  fsyncs/s:        2617.07

Throughput:
  read, MiB/s:      17.82
  written, MiB/s:   11.89

General statistics:
  total time:              10.5174s
  total number of events:  45481

Latency (ms):
  min:                   0.00
  avg:                   3.43
  max:                   189.72
  95th percentile:      10.27
  sum:                   155839.24

Threads fairness:
  events (avg/stddev):    2842.5625/108.29
  execution time (avg/stddev): 9.7400/0.02

doris@doris:~$
```


4b] Docker test run1

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

File operations:
  reads/s:                8701.43
  writes/s:               5800.95
  fsyncs/s:              18740.60

Throughput:
  read, MiB/s:           135.96
  written, MiB/s:        90.64

General statistics:
  total time:             11.0650s
  total number of events: 365857

Latency (ms):
  min:                    0.00
  avg:                     0.44
  max:                    451.94
  95th percentile:       1.16
  sum:                    159677.85

Threads fairness:
  events (avg/stddev):    22866.0625/569.50
  execution time (avg/stddev): 9.9799/0.00
```

Docker test run2

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

  reads/s:                9195.89
  writes/s:               6130.59
  fsyncs/s:              19820.96

Throughput:
  read, MiB/s:           143.69
  written, MiB/s:        95.79

General statistics:
  total time:             10.0397s
  total number of events: 350883

Latency (ms):
  min:                    0.00
  avg:                     0.46
  max:                    1007.41
  95th percentile:       1.10
  sum:                    159714.10

Threads fairness:
  events (avg/stddev):    21930.1875/392.65
  execution time (avg/stddev): 9.9821/0.00

[root@zcdsysbench /]#
```

Docker test run3

```

zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash ...p::2222-:22 -net nic ...180d3b: / — -zsh +

reads/s:          9911.96
writes/s:         6607.94
fsyncs/s:         21347.62

Throughput:
  read, MiB/s:     154.87
  written, MiB/s:  103.25

General statistics:
  total time:      10.0467s
  total number of events: 378493

Latency (ms):
  min:             0.00
  avg:             0.42
  max:             175.91
  95th percentile: 1.16
  sum:             159653.98

Threads fairness:
  events (avg/stddev): 23655.8125/507.92
  execution time (avg/stddev): 9.9784/0.00

[root@zcdsysbench /]#

```

Docker test run4

```

zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...-it zcdsysbench bash ...p::2222-:22 -net nic ...180d3b: / — -zsh +

reads/s:          9006.39
writes/s:         6004.43
fsyncs/s:         19407.17

Throughput:
  read, MiB/s:     140.72
  written, MiB/s:  93.82

General statistics:
  total time:      10.0644s
  total number of events: 344406

Latency (ms):
  min:             0.00
  avg:             0.46
  max:             43.46
  95th percentile: 1.32
  sum:             159658.99

Threads fairness:
  events (avg/stddev): 21525.3750/520.95
  execution time (avg/stddev): 9.9787/0.00

[root@zcdsysbench /]#

```

Docker test run5

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli - docker exec -it zcdsy...
...c -it zcdisysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +
reads/s: 7942.96
writes/s: 5295.14
fsyncs/s: 17142.19

Throughput:
read, MiB/s: 124.11
written, MiB/s: 82.74

General statistics:
total time: 10.0525s
total number of events: 303405

Latency (ms):
min: 0.00
avg: 0.53
max: 864.99
95th percentile: 1.37
sum: 159661.07

Threads fairness:
events (avg/stddev): 18962.8125/566.15
execution time (avg/stddev): 9.9788/0.00

[root@zcdisysbench /]#
```

5.Fileio test (parameter: file size=2G, limit time=30s)

```
$ sysbench fileio --threads=16 --file-total-size=2G --time=30 --file-test-mode=rndrw prepare

$ sysbench fileio --threads=16 --file-total-size=2G --time=30 --file-test-mode=rndrw run

$ sysbench fileio --threads=16 --file-total-size=2G --time=30 --file-test-mode=rndrw cleanup
```

5a] QEMU test run 1

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1185.74
  writes/s:         790.60
  fsyncs/s:        2595.18

Throughput:
  read, MiB/s:      18.53
  written, MiB/s:   12.35

General statistics:
  total time:       30.6100s
  total number of events: 137896

Latency (ms):
  min:              0.00
  avg:              3.39
  max:              57.34
  95th percentile: 10.27
  sum:              467355.58

Threads fairness:
  events (avg/stddev): 8618.5000/213.90
  execution time (avg/stddev): 29.2097/0.03

doris@doris:~$
```

QEMU test run 2

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1322.87
  writes/s:         882.02
  fsyncs/s:        2887.17

Throughput:
  read, MiB/s:      20.67
  written, MiB/s:   13.78

General statistics:
  total time:       30.4759s
  total number of events: 153146

Latency (ms):
  min:              0.01
  avg:              3.05
  max:              75.98
  95th percentile: 9.39
  sum:              467391.31

Threads fairness:
  events (avg/stddev): 9571.6250/220.13
  execution time (avg/stddev): 29.2120/0.03

doris@doris:~$
```

QEMU test run 3

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1233.13
  writes/s:         822.19
  fsyncs/s:        2695.46

Throughput:
  read, MiB/s:      19.27
  written, MiB/s:   12.85

General statistics:
  total time:              30.6991s
  total number of events:  143805

Latency (ms):
  min:                   0.01
  avg:                   3.25
  max:                   104.89
  95th percentile:      10.09
  sum:                   467598.71

Threads fairness:
  events (avg/stddev):    8987.8125/277.59
  execution time (avg/stddev): 29.2249/0.03

doris@doris:~$
```

QEMU test run 4

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1331.23
  writes/s:         887.49
  fsyncs/s:        2906.65

Throughput:
  read, MiB/s:      20.80
  written, MiB/s:   13.87

General statistics:
  total time:              30.4213s
  total number of events:  153881

Latency (ms):
  min:                   0.01
  avg:                   3.04
  max:                   184.73
  95th percentile:      9.22
  sum:                   468072.28

Threads fairness:
  events (avg/stddev):    9617.5625/225.20
  execution time (avg/stddev): 29.2545/0.02

doris@doris:~$
```

QEMU test run 5

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1346.42
  writes/s:         897.56
  fsyncs/s:        2938.11

Throughput:
  read, MiB/s:      21.04
  written, MiB/s:   14.02

General statistics:
  total time:       30.4797s
  total number of events: 155910

Latency (ms):
  min:              0.01
  avg:              3.00
  max:              119.06
  95th percentile: 9.22
  sum:              467122.18

Threads fairness:
  events (avg/stddev): 9744.3750/212.82
  execution time (avg/stddev): 29.1951/0.03

doris@doris:~$
```

5a] Docker test run 1

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli - docker exec -it zcdsy...
...c -it zcdsysbench bash  ...p::2222-:22 -net nic  ...180d3b: / — -zsh  +

  reads/s:          8395.29
  writes/s:         5596.83
  fsyncs/s:        17975.79

Throughput:
  read, MiB/s:      131.18
  written, MiB/s:   87.45

General statistics:
  total time:       30.0404s
  total number of events: 958338

Latency (ms):
  min:              0.00
  avg:              0.50
  max:              1009.80
  95th percentile: 1.14
  sum:              479191.08

Threads fairness:
  events (avg/stddev): 59896.1250/714.26
  execution time (avg/stddev): 29.9494/0.00

[root@zcdsysbench /]#
```

Docker test run 2

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash  ...p::2222-:22 -net nic  ...180d3b: / — -zsh  +

reads/s:      8318.35
writes/s:     5545.56
fsyncs/s:     17812.28

Throughput:
read, MiB/s:  129.97
written, MiB/s: 86.65

General statistics:
total time:    30.0402s
total number of events: 949569

Latency (ms):
min:          0.00
avg:          0.50
max:          590.79
95th percentile: 1.37
sum:          478966.59

Threads fairness:
events (avg/stddev): 59348.0625/971.79
execution time (avg/stddev): 29.9354/0.00

[root@zcdsysbench /]#
```

Docker test run 3

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash  ...p::2222-:22 -net nic  ...180d3b: / — -zsh  +

reads/s:      8556.21
writes/s:     5704.14
fsyncs/s:     18318.92

Throughput:
read, MiB/s:  133.69
written, MiB/s: 89.13

General statistics:
total time:    30.0396s
total number of events: 976677

Latency (ms):
min:          0.00
avg:          0.49
max:          1006.28
95th percentile: 1.27
sum:          479086.57

Threads fairness:
events (avg/stddev): 61042.3125/853.04
execution time (avg/stddev): 29.9429/0.00

[root@zcdsysbench /]#
```


Docker test run 4

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

reads/s:      8353.35
writes/s:     5568.90
fsyncs/s:     17886.45

Throughput:
  read, MiB/s:    130.52
  written, MiB/s:  87.01

General statistics:
  total time:      30.0438s
  total number of events: 953658

Latency (ms):
  min:              0.00
  avg:              0.50
  max:              475.71
  95th percentile: 1.39
  sum:              478868.53

Threads fairness:
  events (avg/stddev): 59603.6250/1017.29
  execution time (avg/stddev): 29.9293/0.01

[root@zcdsysbench /]#
```

Docker test run 5

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

reads/s:      9031.45
writes/s:     6020.91
fsyncs/s:     19332.58

Throughput:
  read, MiB/s:    141.12
  written, MiB/s:  94.08

General statistics:
  total time:      30.0467s
  total number of events: 1031166

Latency (ms):
  min:              0.00
  avg:              0.46
  max:              486.46
  95th percentile: 1.30
  sum:              478974.08

Threads fairness:
  events (avg/stddev): 64447.8750/646.14
  execution time (avg/stddev): 29.9359/0.00

[root@zcdsysbench /]#
```

6. Fileio test (parameter: file size=3G, limit time=30s)

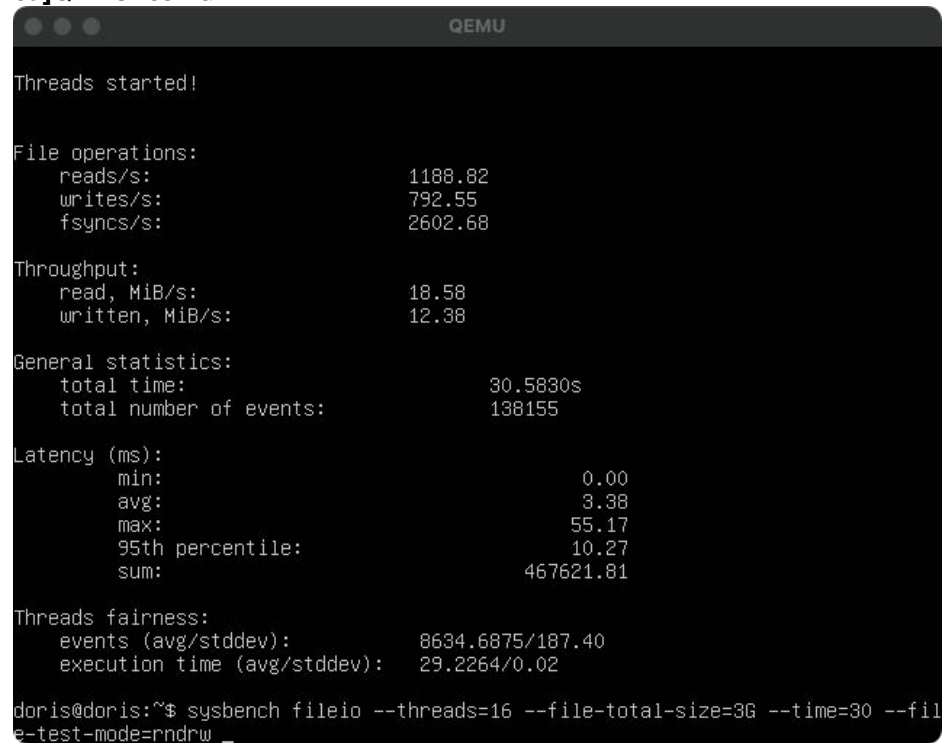
```
$ sysbench fileio --threads=16 --file-total-size=3G --time=30 --file-test-mode=rndrw prepare
```



```
$ sysbench fileio --threads=16 --file-total-size=3G --time=30 --file-test-mode=rndrw run

$ sysbench fileio --threads=16 --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
```

6a]QEMU test run 1



The screenshot shows a terminal window titled "QEMU" with the following output from the sysbench fileio test:

```
Threads started!

File operations:
  reads/s:          1188.82
  writes/s:         792.55
  fsyncs/s:        2602.68

Throughput:
  read, MiB/s:      18.58
  written, MiB/s:   12.38

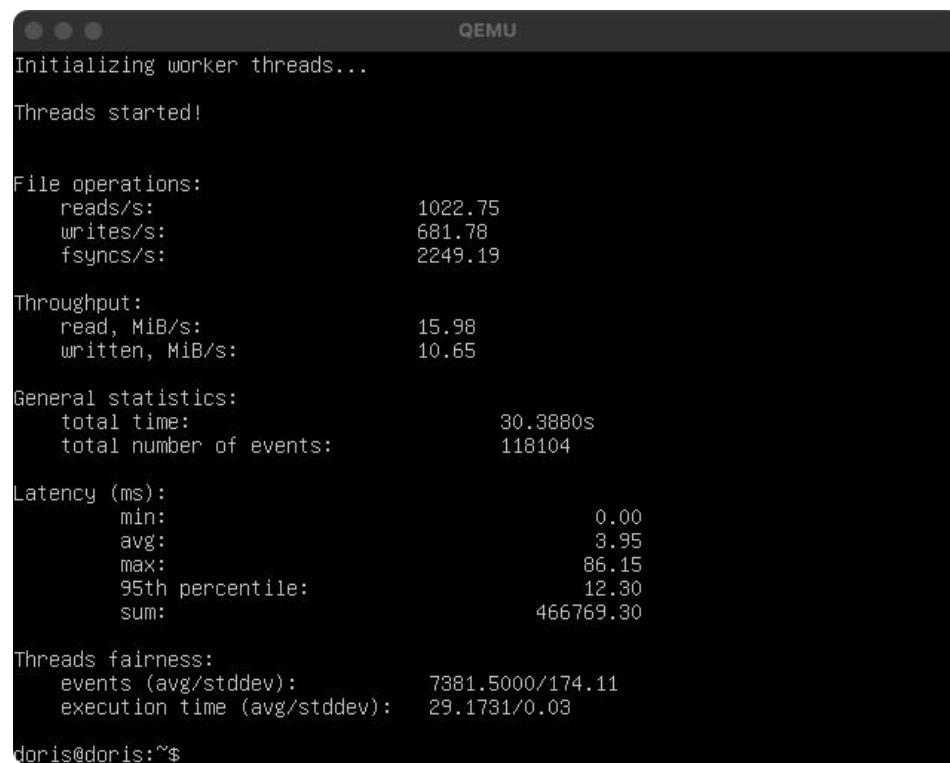
General statistics:
  total time:       30.5830s
  total number of events: 138155

Latency (ms):
  min:              0.00
  avg:              3.38
  max:              55.17
  95th percentile: 10.27
  sum:              467621.81

Threads fairness:
  events (avg/stddev): 8634.6875/187.40
  execution time (avg/stddev): 29.2264/0.02

doris@doris:~$ sysbench fileio --threads=16 --file-total-size=3G --time=30 --file-test-mode=rndrw
```

QEMU test run 2



The screenshot shows a terminal window titled "QEMU" with the following output from the sysbench fileio test:

```
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1022.75
  writes/s:         681.78
  fsyncs/s:        2249.19

Throughput:
  read, MiB/s:      15.98
  written, MiB/s:   10.65

General statistics:
  total time:       30.3880s
  total number of events: 118104

Latency (ms):
  min:              0.00
  avg:              3.95
  max:              86.15
  95th percentile: 12.30
  sum:              466769.30

Threads fairness:
  events (avg/stddev): 7381.5000/174.11
  execution time (avg/stddev): 29.1731/0.03

doris@doris:~$
```

QEMU test run 3

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1139.91
  writes/s:         760.05
  fsyncs/s:         2495.70

Throughput:
  read, MiB/s:      17.81
  written, MiB/s:    11.88

General statistics:
  total time:        30.4728s
  total number of events: 131907

Latency (ms):
  min:               0.01
  avg:               3.54
  max:               66.57
  95th percentile:  10.84
  sum:               467357.21

Threads fairness:
  events (avg/stddev): 8244.1875/170.63
  execution time (avg/stddev): 29.2098/0.03

doris@doris:~$
```

QEMU test run 4

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1162.34
  writes/s:         774.90
  fsyncs/s:         2545.64

Throughput:
  read, MiB/s:      18.16
  written, MiB/s:    12.11

General statistics:
  total time:        30.4026s
  total number of events: 134250

Latency (ms):
  min:               0.01
  avg:               3.48
  max:               84.11
  95th percentile:  10.65
  sum:               467247.33

Threads fairness:
  events (avg/stddev): 8390.6250/272.48
  execution time (avg/stddev): 29.2030/0.03

doris@doris:~$
```

QEMU test run 5

```
QEMU
Initializing worker threads...

Threads started!

File operations:
  reads/s:          1394.79
  writes/s:         929.86
  fsyncs/s:        3040.00

Throughput:
  read, MiB/s:      21.79
  written, MiB/s:   14.53

General statistics:
  total time:       30.4541s
  total number of events: 161339

Latency (ms):
  min:              0.00
  avg:              2.89
  max:              108.20
  95th percentile: 8.90
  sum:              466757.08

Threads fairness:
  events (avg/stddev): 10083.6875/201.21
  execution time (avg/stddev): 29.1723/0.04

doris@doris:~$
```

6b] Docker test run 1

```
zhouchuandi — @zcdisysbench:/ — com.docker.cli - docker exec -it zcdsy...
...c -it zcdsysbench bash  ...p::2222-:22 -net nic  ...180d3b: / — -zsh  +

  reads/s:          7126.27
  writes/s:         4750.85
  fsyncs/s:        15269.37

Throughput:
  read, MiB/s:      111.35
  written, MiB/s:   74.23

General statistics:
  total time:       30.0477s
  total number of events: 813687

Latency (ms):
  min:              0.00
  avg:              0.59
  max:              366.83
  95th percentile: 1.61
  sum:              478974.24

Threads fairness:
  events (avg/stddev): 50855.4375/677.55
  execution time (avg/stddev): 29.9359/0.01

[root@zcdisysbench /]#
```

Docker test run 2

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...-it zcdsysbench bash ...    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

reads/s:                7763.35
writes/s:               5175.62
fsyncs/s:              16629.85

Throughput:
  read, MiB/s:          121.30
  written, MiB/s:        80.87

General statistics:
  total time:            30.0392s
  total number of events: 886230

Latency (ms):
  min:                   0.00
  avg:                   0.54
  max:                   1005.52
  95th percentile:      1.42
  sum:                   479030.17

Threads fairness:
  events (avg/stddev):    55389.3750/971.94
  execution time (avg/stddev): 29.9394/0.00

[root@zcdsysbench /]#
```

Docker test run 3

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash    ...p::2222-:22 -net nic    ...180d3b: / — -zsh    +

reads/s:                7278.56
writes/s:               4852.39
fsyncs/s:              15595.57

Throughput:
  read, MiB/s:          113.73
  written, MiB/s:        75.82

General statistics:
  total time:            30.0619s
  total number of events: 831520

Latency (ms):
  min:                   0.00
  avg:                   0.58
  max:                   1006.09
  95th percentile:      1.64
  sum:                   478999.74

Threads fairness:
  events (avg/stddev):    51970.0000/969.72
  execution time (avg/stddev): 29.9375/0.00

[root@zcdsysbench /]#
```

Docker test run 4

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +
reads/s: 6604.38
writes/s: 4402.86
fsyncs/s: 14155.24

Throughput:
read, MiB/s: 103.19
written, MiB/s: 68.79

General statistics:
total time: 30.0693s
total number of events: 754616

Latency (ms):
min: 0.00
avg: 0.63
max: 1009.82
95th percentile: 1.50
sum: 479151.89

Threads fairness:
events (avg/stddev): 47163.5000/624.86
execution time (avg/stddev): 29.9470/0.01

[root@zcdsysbench /]#
```

Docker test run 5

```
zhouchuandi — @zcdsysbench:/ — com.docker.cli • docker exec -it zcdsy...
...c -it zcdsysbench bash | ...p::2222-:22 -net nic | ...180d3b: / — -zsh | +
reads/s: 7848.32
writes/s: 5232.16
fsyncs/s: 16809.44

Throughput:
read, MiB/s: 122.63
written, MiB/s: 81.75

General statistics:
total time: 30.0507s
total number of events: 896216

Latency (ms):
min: 0.00
avg: 0.53
max: 425.82
95th percentile: 1.50
sum: 478979.87

Threads fairness:
events (avg/stddev): 56013.5000/779.98
execution time (avg/stddev): 29.9362/0.00

[root@zcdsysbench /]#
```

4. Compare System Virtualization (QEMU) and OS Virtualization (Docker)

1. CPU test (parameter: prime=10000)

QEMU

	1	2	3	4	5
CPU Speed (events/s)	2324.07	2291.90	2241.58	2268.84	2192.39
total time (s)	10.0006	10.0004	10.0006	10.0008	10.0006
latency min (ms)	0.33	0.34	0.36	0.35	0.34
latency avg (ms)	0.40	0.41	0.41	0.41	0.42
latency max (ms)	5.42	6.06	4.05	7.42	29.71
threads events(avg/stddev)	23246.000/0.00	22924.0000/0.00	22421.0000/0.00	22694.0000/0.00	21929.0000/0.00
execution time(avg/stddev)	9.3191/0.00	9.3210/0.00	9.3047/0.00	9.3030/0.00	9.3051/0.00

Docker

	1	2	3	4	5
CPU Speed (events/s)	2667.81	2486.32	2487.69	2543.31	2501.03
total time (s)	10.0003	10.0002	10.0004	10.0003	10.0010
latency min (ms)	0.32	0.33	0.33	0.33	0.35
latency avg (ms)	0.37	0.48	0.40	0.39	0.40
latency max (ms)	1.15	13.08	8.00	6.48	4.63
threads events(avg/stddev)	26684.0000/0.00	24869.0000/0.00	24883.0000/0.00	25439.0000/0.00	25018.0000/0.00
execution time(avg/stddev)	9.9771/0.00	9.9549/0.00	9.9532/0.00	9.9582/0.00	9.9527/0.00

2. CPU test (parameter: prime=20000)

QEMU

	1	2	3	4	5
CPU Speed (events/s)	969.58	975.80	977.86	942.51	930.17
total time (s)	10.0006	10.0007	10.0012	10.0009	10.0008
latency min (ms)	0.85	0.85	0.85	0.85	0.85
latency avg (ms)	1.00	1.00	0.99	1.03	1.04
latency max (ms)	2.39	20.04	2.73	3.65	13.22
threads events(avg/stddev)	9698.0000/0.00	9761.0000/0.00	9782.0000/0.00	9428.0000/0.00	9304.0000/0.00
execution time(avg/stddev)	9.7190/0.00	9.7251/0.00	9.7280/0.00	9.7060/0.00	9.6939/0.00

Docker

	1	2	3	4	5
CPU Speed (events/s)	1019.52	979.94	978.96	981.79	995.38
total time (s)	10.0009	10.0003	10.0004	10.0008	10.0009
latency min (ms)	0.84	0.92	0.92	0.92	0.84
latency avg (ms)	0.98	1.02	1.02	1.02	1.00
latency max (ms)	2.34	8.23	8.71	11.40	8.84

threads events(avg/stddev)	10198.0000/ 0.00	9802.0000/ 0.00	9792.0000/ 0.00	9821.0000/0.0 0	9956.0000/0.00
execution time(avg/stddev)	9.9851/0.00	9.9773/0.00	9.9790/0.00	9.9796/0.00	9.9788/0.00

3. CPU test (parameter: prime=30000, limit time=30s)

QEMU

	1	2	3	4	5
CPU Speed (events/s)	577.15	550.21	543.35	546.03	549.36
total time (s)	30.0010	30.0005	30.0011	30.0010	30.0013
latency min (ms)	1.47	1.47	1.47	1.47	1.47
latency avg (ms)	1.70	1.79	1.81	1.80	1.79
latency max (ms)	4.74	12.31	11.05	13.57	47.54
threads events(avg/stddev)	17316.0000/ 0.00	16508.0000 /0.00	16302.0000 /0.00	16383.0000/0. 00	16483.0000/0.0 0
execution time(avg/stddev)	29.5119/0.00	29.4689/0.0 0	29.4584/0.0 0	29.4693/0.00	29.4668/0.00

Docker

	1	2	3	4	5
CPU Speed (events/s)	578.35	560.19	549.72	564.89	563.30
total time (s)	30.0009	30.0004	30.0018	30.0003	30.0018
latency min (ms)	1.49	1.62	1.61	1.57	1.62
latency avg (ms)	1.73	1.78	1.82	1.77	1.77
latency max (ms)	17.63	13.65	21.54	11.03	11.67
threads events(avg/stddev)	17352.0000/ 0.00	16807.0000 /0.00	16494.0000 /0.00	16948.0000/0. 00	16901.0000/0.0 0
execution time(avg/stddev)	29.9644/0.00	29.9479/0.0 0	29.9457/0.0 0	29.9564/0.00	29.9554/0.00

4. Fileio test(parameter: file size = 1G)

QEMU

	1	2	3	4	5
total time (s)	10.4659	10.4484	10.7608	10.4869	10.5174
read throughput(MiB/s)	23.08	23.50	20.56	17.07	17.82
written throughput(MiB/s)	15.39	15.67	13.70	11.38	11.89
latency min (ms)	0.01	0.00	0.01	0.01	0.00
latency avg (ms)	2.65	2.61	2.90	3.58	3.43
latency max (ms)	31.39	7.98	56.83	74.64	189.72

Docker

	1	2	3	4	5
total time (s)	11.0650	10.0397	10.0467	10.0644	10.0525
read throughput(MiB/s)	135.96	143.69	154.87	140.72	124.11
written throughput(MiB/s)	90.64	95.79	103.25	93.82	82.74
latency min (ms)	0.00	0.00	0.00	0.00	0.00

latency avg (ms)	0.44	0.46	0.42	0.46	0.53
latency max (ms)	451.94	1007.41	175.91	43.46	864.99

5. Fileio test(parameter: file size = 2G, limit time=30s)

QEMU

	1	2	3	4	5
total time (s)	30.6100	30.4759	30.6991	30.4213	30.4797
read throughput(MiB/s)	18.53	20.67	19.27	20.80	21.04
written throughput(MiB/s)	12.35	13.78	12.85	13.87	14.02
latency min (ms)	0.00	0.01	0.01	0.01	0.01
latency avg (ms)	3.39	3.05	3.25	3.04	3.00
latency max (ms)	57.34	75.98	104.89	184.73	119.06

Docker

	1	2	3	4	5
total time (s)	30.0404	30.0402	30.0396	30.0438	30.0467
read throughput(MiB/s)	131.18	129.97	133.69	130.52	141.12
written throughput(MiB/s)	87.45	86.65	89.13	87.01	94.08
latency min (ms)	0.00	0.00	0.00	0.00	0.00
latency avg (ms)	0.50	0.50	0.49	0.50	0.46
latency max (ms)	1009.80	590.79	1006.28	475.71	486.46

6. Fileio test(parameter: file size = 3G, limit time=30s)

QEMU

	1	2	3	4	5
total time (s)	30.5830	30.3880	30.4728	30.4026	30.4541
read throughput(MiB/s)	18.58	15.98	17.81	18.16	21.79
written throughput(MiB/s)	12.38	10.65	11.88	12.11	14.53
latency min (ms)	0.00	0.00	0.01	0.01	0.00
latency avg (ms)	3.38	3.95	3.54	3.48	2.89
latency max (ms)	55.17	86.15	66.57	84.11	108.20

Docker

	1	2	3	4	5
total time (s)	30.0477	30.0392	30.0619	30.0693	30.0507
read throughput(MiB/s)	111.35	121.38	113.73	103.19	122.63
written throughput(MiB/s)	74.23	80.87	75.82	68.79	81.75
latency min (ms)	0.00	0.00	0.00	0.00	0.00
latency avg (ms)	0.59	0.54	0.58	0.63	0.53
latency max (ms)	366.83	1005.52	1006.09	1009.82	425.82

CPU Utilization

CPU test

```
zhouchuandi — top — 80x24
...c -it zcdsysbench bash  ...p::2222-:22 -net nic  ~ -- top  ... +

Processes: 721 total, 5 running, 716 sleeping, 3309 threads      18:12:44
Load Avg: 8.60, 7.28, 6.51  CPU usage: 7.78% user, 28.52% sys, 63.68% idle
SharedLibs: 493M resident, 94M data, 104M linkedit.
MemRegions: 358801 total, 2225M resident, 105M private, 7027M shared.
PhysMem: 16G used (3087M wired), 128M unused.
VM: 46T vsize, 3152M framework vsize, 17946872(0) swapins, 19543432(0) swapouts.
Networks: packets: 17120496/15G in, 6223548/1186M out.
Disks: 12420081/195G read, 14528875/334G written.

PID    COMMAND      %CPU    TIME    #TH    #WQ    #PORT  MEM    PURG    CMPRS    PGRP
1575   qemu-system- 99.3    53:03.59 14/2    3      235    7947M  32M     2604M   1575
14881  com.docker.h 97.4    78:13.04 13/1    0       36     14G    0B      8342M   13775
13532  WeChat       22.0    01:59:32 46/1    11     2361+  468M-  9664K+  311M-   13532
161    WindowServer 15.2    11:23:19 17       7     3720+  563M-  6936K+  129M+   161
40464  top          7.9     00:01.33 1/1     0       26     6328K  0B      0B      40464
0      kernel_task  7.9     05:15:21 222/8    0       0      182M-  0B      0B      0
42340  PerfPowerSer 3.6     01:09.76 5        3     339+   10M+   16K     2988K   42340
411    Google Chrom 3.5     02:50:06 33       3     1890   261M-  44K     145M-   411
40385  mdworker_sha 2.2     00:00.44 4        1      49     1304K+ 0B      0B      40385
40459  mdworker_sha 2.0     00:00.17 4        1      49     1300K  0B      0B      40459
164    loginwindow  1.7     06:06:13 14       2      757    57M    0B      23M     164
393    distnoted   1.5     14:09.18 2        1     960+   17M    0B      3232K-  393
67649  com.apple.We 1.2     02:33.02 8        2      96     47M    0B      37M-   67649
444    wpsoffice   1.2     02:20:43 69       4      734    1303M  4096B   634M    444
```

fileio test

```
zhouchuandi — top — 80x24
...c -it zcdsysbench bash  ...p::2222-:22 -net nic  ~ -- top  ... +

Processes: 721 total, 4 running, 1 stuck, 716 sleeping, 3303 threads  18:14:31
Load Avg: 5.89, 6.72, 6.38  CPU usage: 17.34% user, 63.31% sys, 19.33% idle
SharedLibs: 493M resident, 94M data, 104M linkedit.
MemRegions: 358880 total, 2227M resident, 105M private, 7028M shared.
PhysMem: 16G used (3104M wired), 404M unused.
VM: 46T vsize, 3153M framework vsize, 18042944(3312) swapins, 19680161(5798) swa
Networks: packets: 17120976/15G in, 6223977/1187M out.
Disks: 12426915/196G read, 14612583/340G written.

PID    COMMAND      %CPU    TIME    #TH    #WQ    #PORT  MEM    PURG    CMPRS    PGRP
1575   qemu-system- 296.2   54:26.92 19/4    3     241+   7948M+ 33M+   1360M-  1575
14881  com.docker.h 192.4   79:07.66 13/2    0       36     14G    0B      6819M-  13775
0      kernel_task  33.7    05:15:32 222/8    0       0      202M+  0B      0B      0
13532  WeChat       27.4    01:59:36 41       7     2345+  500M+  9524K+  391M+   13532
161    WindowServer 22.9    11:23:36 17       7     3735+  571M+  2688K+  150M+   161
40464  top          10.0    00:12.37 1/1     0       32     6780K  0B      1424K+  40464
444    wpsoffice    5.2     02:20:46 68       3     732+   1308M+ 0B      1208M+  444
152    sandboxd    2.9     00:53.80 5        3      72+    2756K+ 0B      980K-   152
40471  mdworker_sha 2.6     00:00.43 4        1      49     1332K- 0B      452K    40471
363    TouchBarServ 2.4     26:01.93 7        3     1908-  39M+   2688K   19M     363
462    ContextStore 2.3     02:39.37 5        4      90+    5040K- 704K+   1448K-  462
67649  com.apple.We 2.2     02:35.34 10       2      99+    47M+   0B      41M-   67649
189    runningboard 2.2     08:24.46 7        6     858+   6948K- 0B      1384K+  189
40469  mdworker_sha 2.1     00:00.41 4        1      49     1316K- 0B      436K    40469
```

5.Conclusion

When experimenting with CPU Performance, Dockers behave similarly to VM. However,since Dockers are light weighted than Virtual Machines, Dockers are better. In Fileio tests, Dockers clearly performed much better than VM. In a conclusion, Dockers are always better than VM.