Project-1

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1. Configurations of Native system
    - 2 vCPU
    - 4 GB memory
    - 30 GB disk size
    - Ubuntu 18.04 LTS

2. Tools for Measurement
    - Iostat to measure the CPU and Disk performance
    - Sysbench to measure the performance of Docker

3. Task-1

Docker

Installation-

- Install the Docker container in repository.
- Steps to enable the container:
    1. sudo docker run csminpp/ubuntu-sysbench
    2. sudo docker run -itd csminpp/ubuntu-sysbench
    3. sudo docker attach <first three chars from output of output>

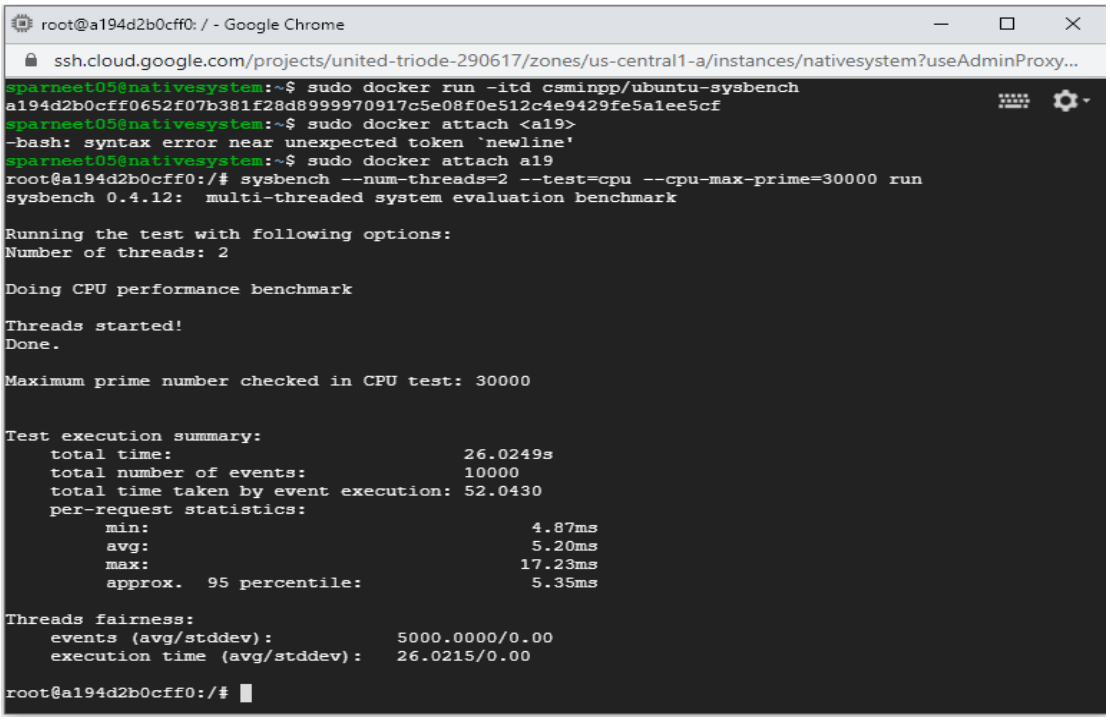
Measurement-

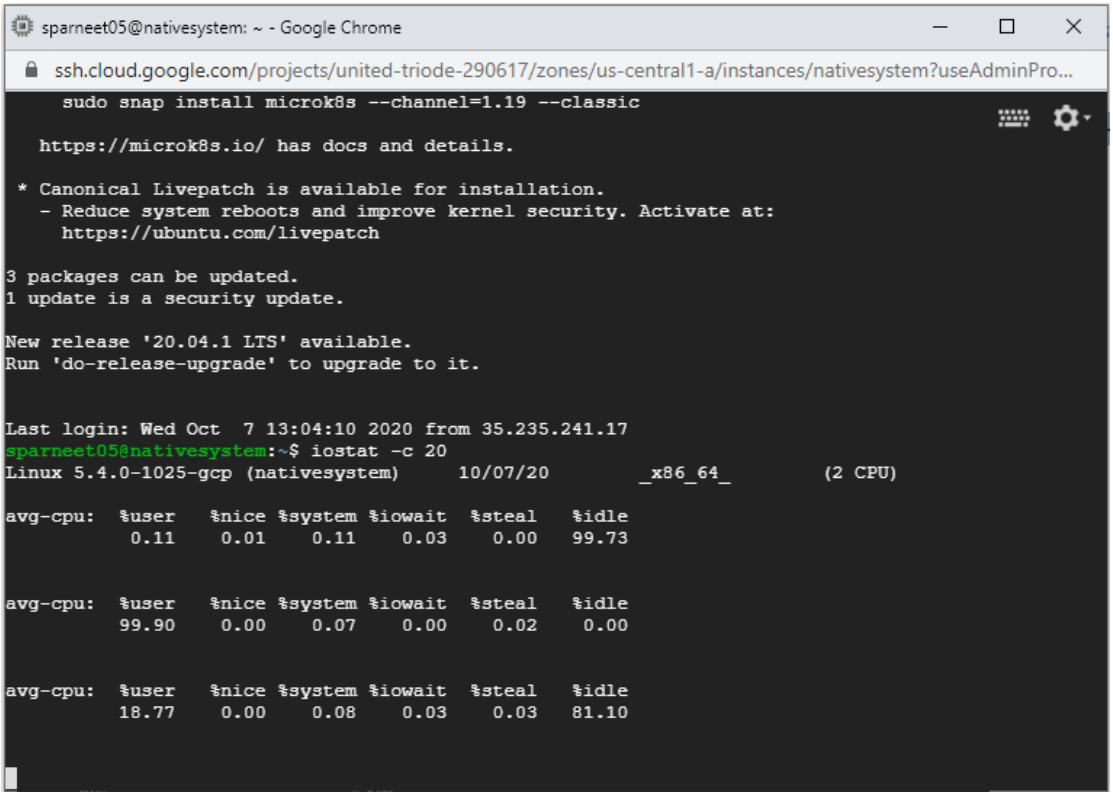
1. CPU Test Mode

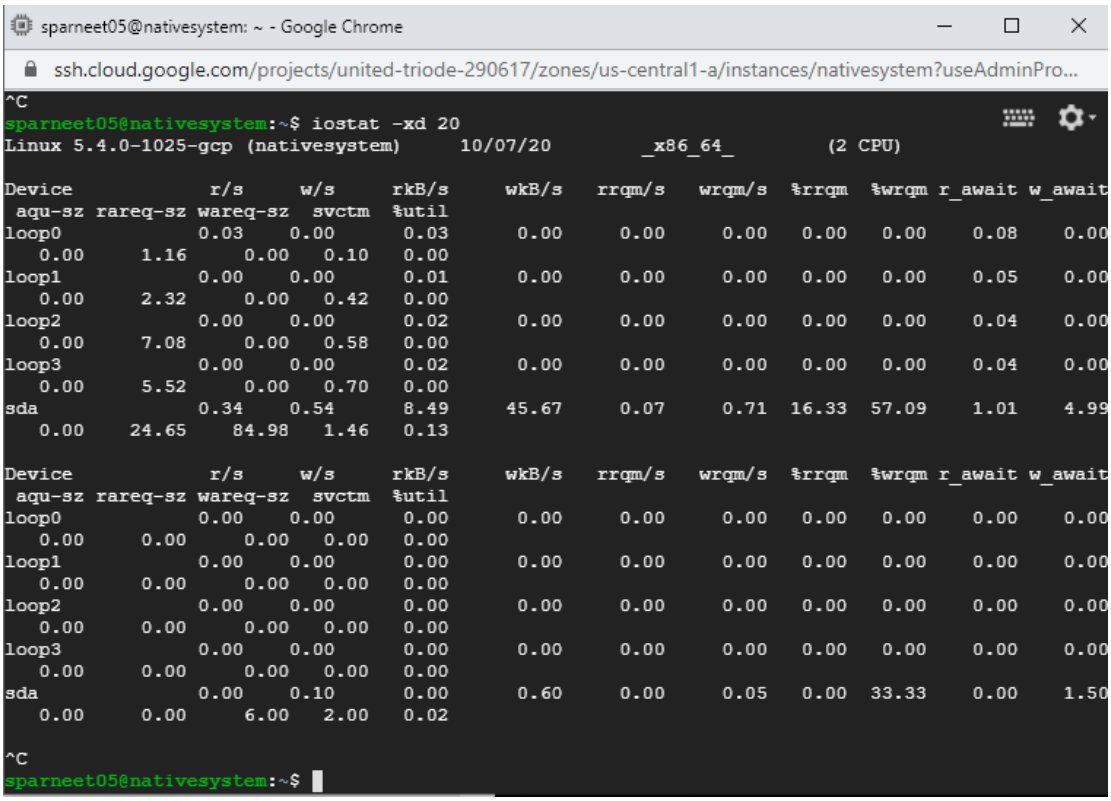
Test Case 1

Command - sysbench --num-threads=2 --test=cpu --cpu-max-prime=30000 run
CPU measurement - iostat -c 20
Disk Measurement – iostat -xd 20
Total Time – 26.0249 sec

ScreenShots-



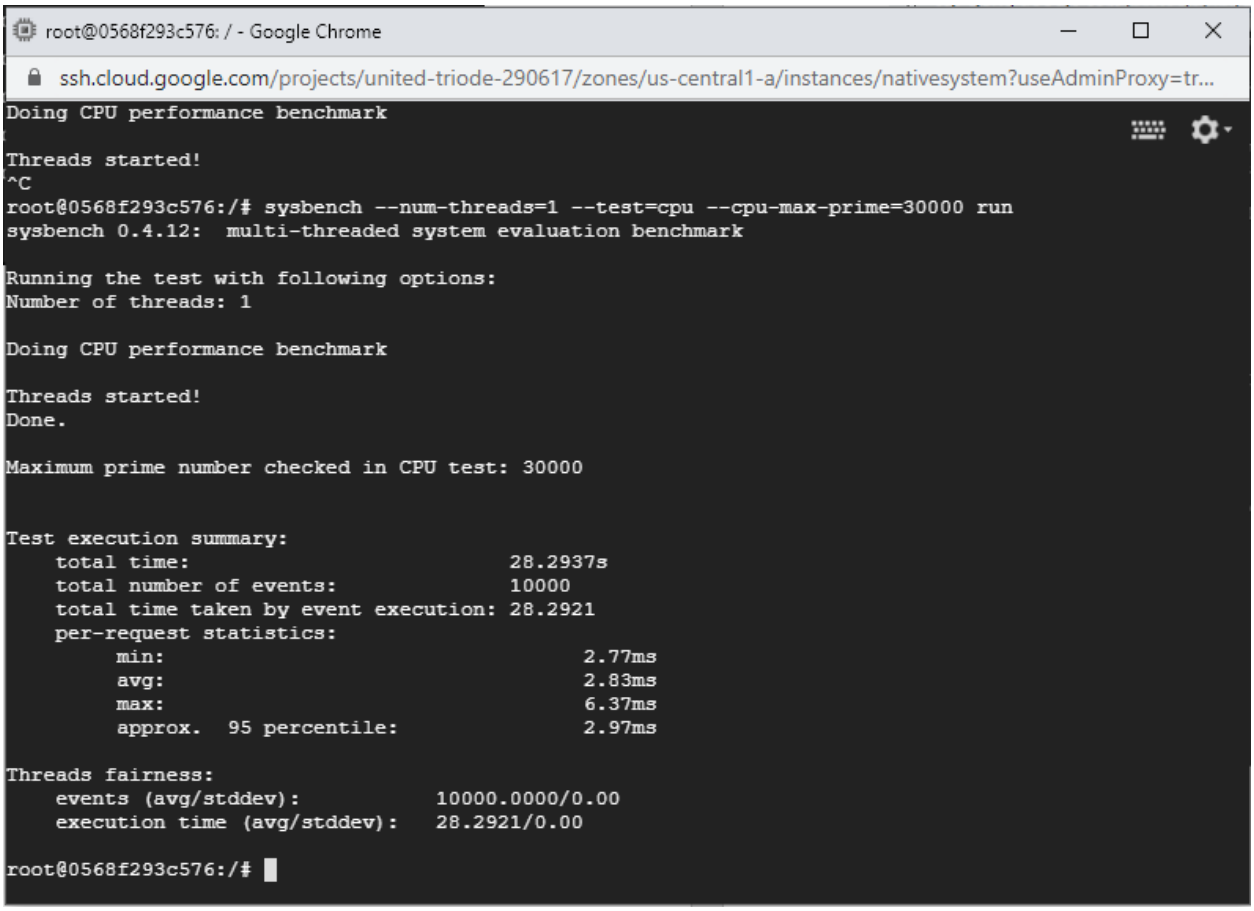


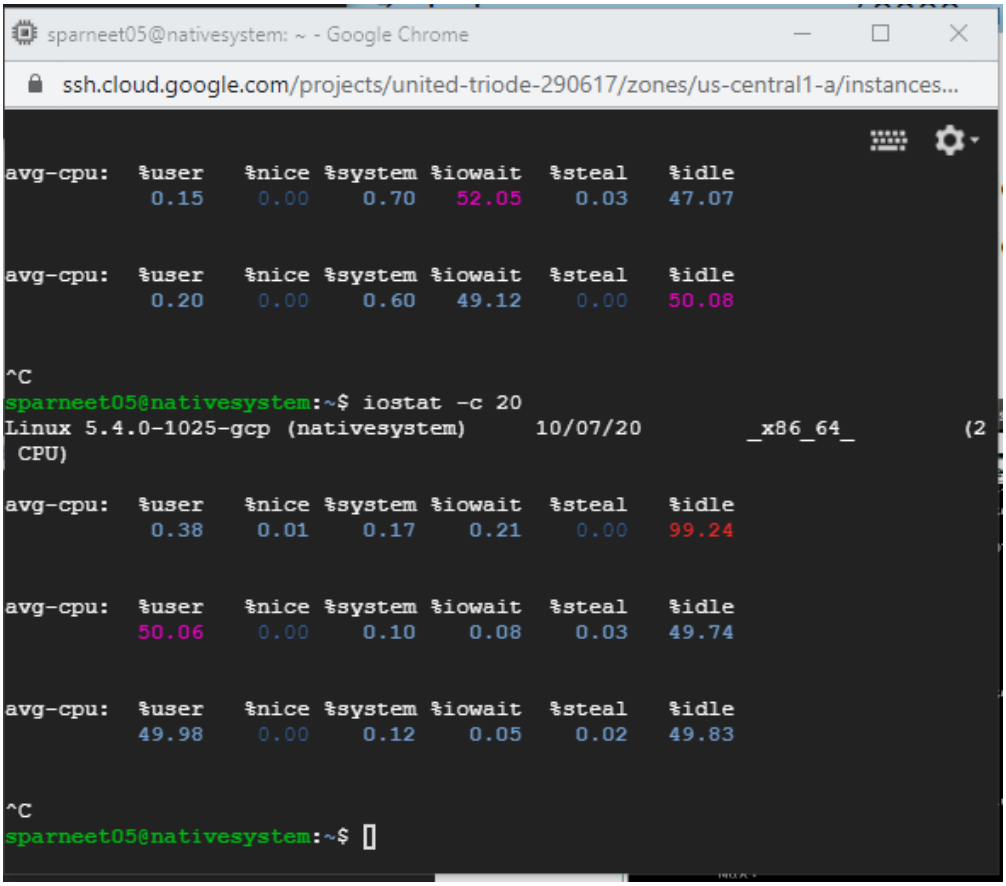

sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesystem?useAdminPro...
^C
sparneet05@nativesystem:~$ iostat -xd 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_await w_await
aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.03 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.08 0.00
0.00 1.16 0.00 0.10 0.00
loop1 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.05 0.00
0.00 2.32 0.00 0.42 0.00
loop2 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.04 0.00
0.00 7.08 0.00 0.58 0.00
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.04 0.00
0.00 5.52 0.00 0.70 0.00
sda 0.34 0.54 8.49 45.67 0.07 0.71 16.33 57.09 1.01 4.99
0.00 24.65 84.98 1.46 0.13
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_await w_await
aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
sda 0.00 0.10 0.00 0.60 0.00 0.05 0.00 33.33 0.00 1.50
0.00 0.00 6.00 2.00 0.02
^C
sparneet05@nativesystem:~$

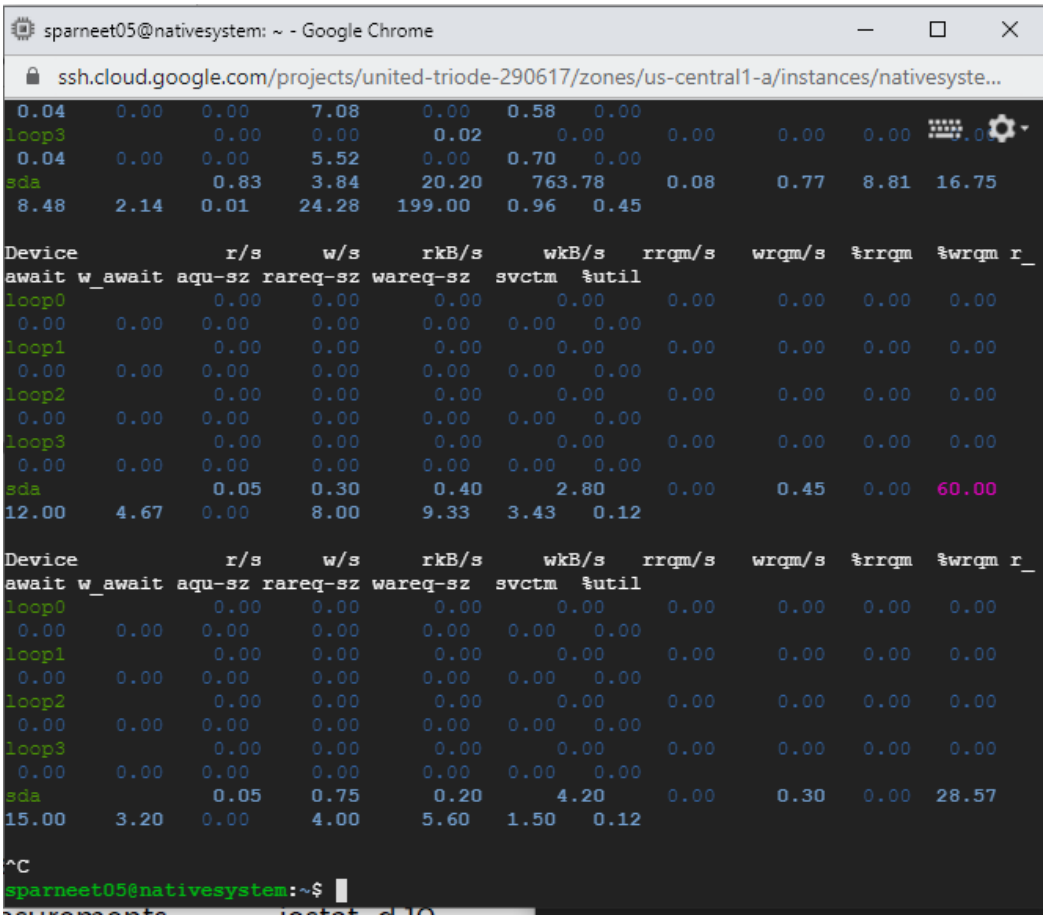
Test Case 2

Command - sysbench --num-threads=1 --test=cpu --cpu-max-prime=30000 run
CPU measurement - iostat -c 20
Disk Measurement – iostat -xd 20
Total Time –28.2937 sec

ScreenShots-



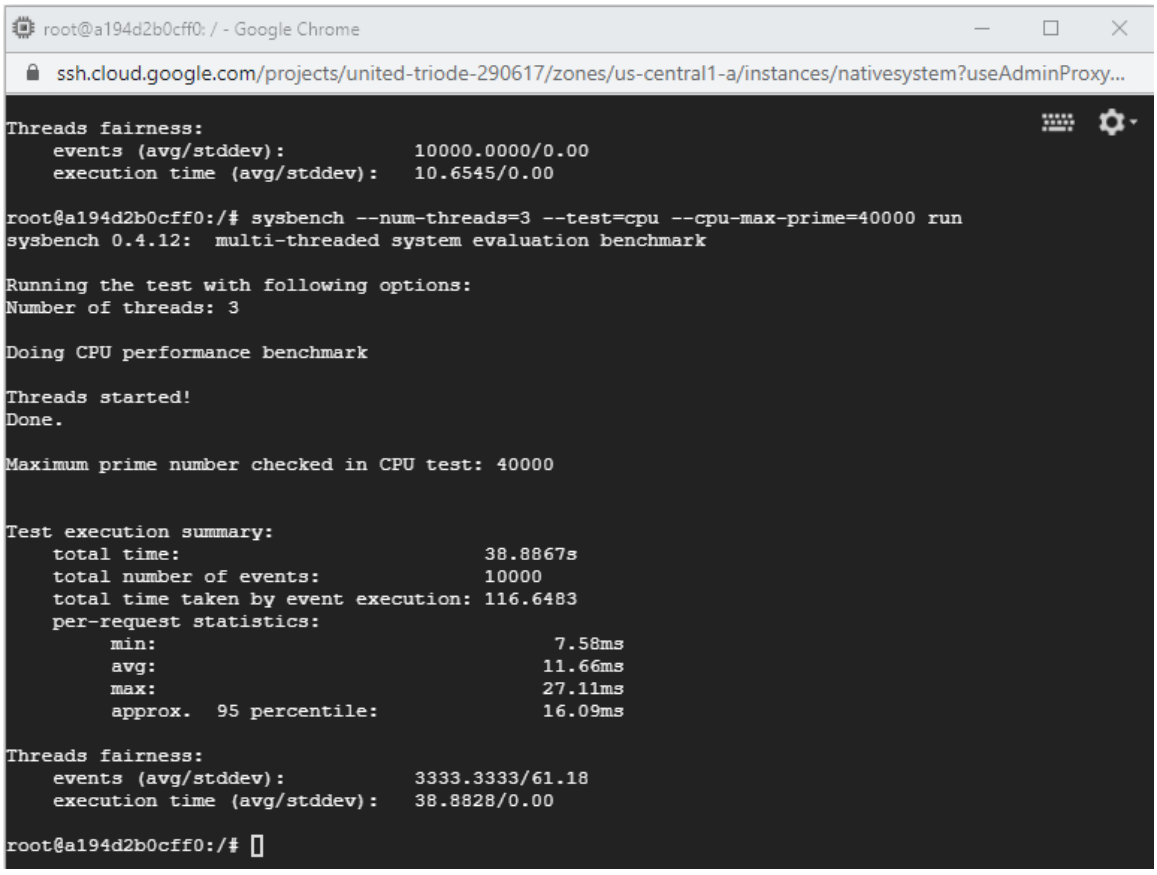

sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances...
avg-cpu: %user %nice %system %iowait %steal %idle
0.15 0.00 0.70 52.05 0.03 47.07
avg-cpu: %user %nice %system %iowait %steal %idle
0.20 0.00 0.60 49.12 0.00 50.08
^C
sparneet05@nativesystem:~$ iostat -c 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2
CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.38 0.01 0.17 0.21 0.00 99.24
avg-cpu: %user %nice %system %iowait %steal %idle
50.06 0.00 0.10 0.08 0.03 49.74
avg-cpu: %user %nice %system %iowait %steal %idle
49.98 0.00 0.12 0.05 0.02 49.83
^C
sparneet05@nativesystem:~$

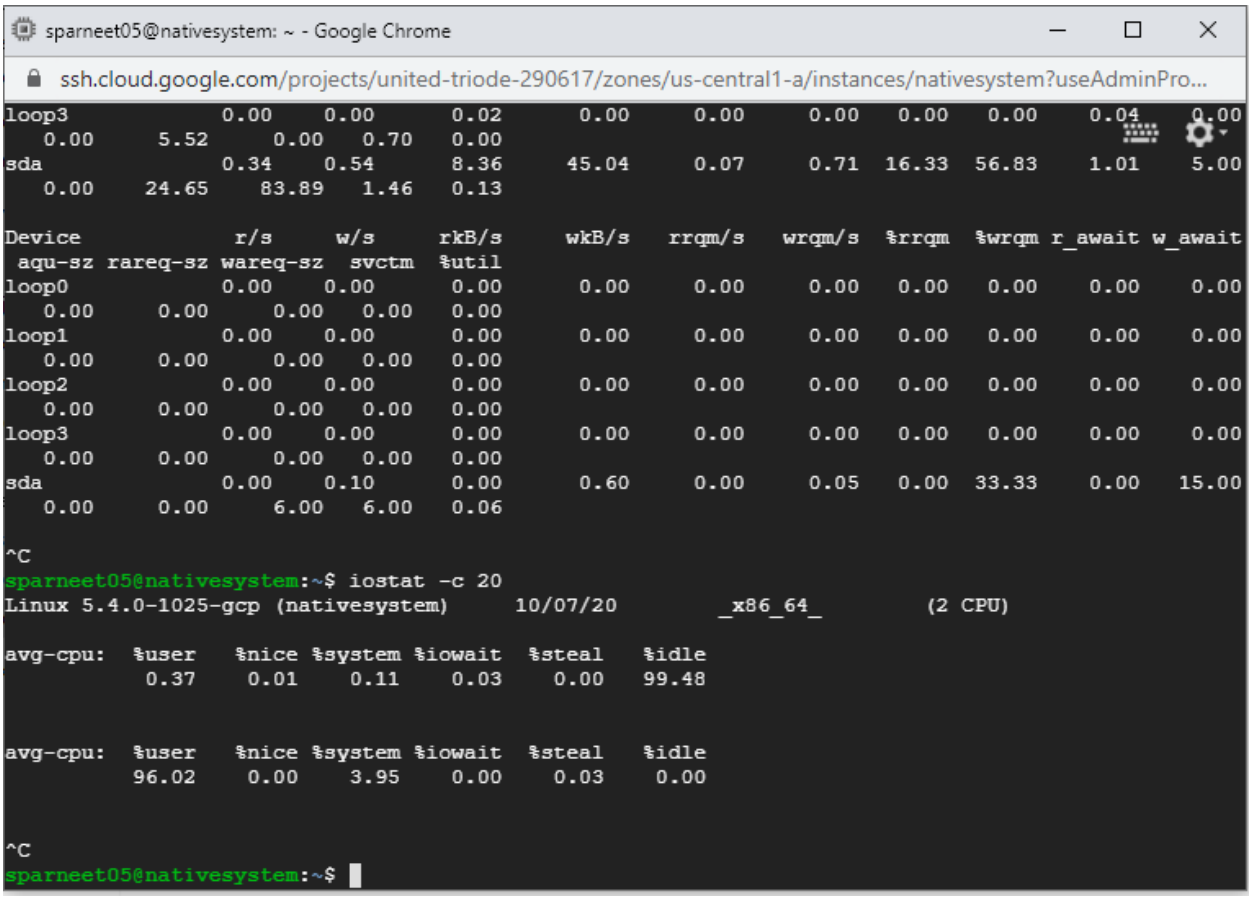

sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesyste...
0.04 0.00 0.00 7.08 0.00 0.58 0.00
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 5.52 0.00 0.70 0.00
sda 0.83 3.84 20.20 763.78 0.08 0.77 8.81 16.75
8.48 2.14 0.01 24.28 199.00 0.96 0.45
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 0.05 0.30 0.40 2.80 0.00 0.45 0.00 60.00
12.00 4.67 0.00 8.00 9.33 3.43 0.12
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 0.05 0.75 0.20 4.20 0.00 0.30 0.00 28.57
15.00 3.20 0.00 4.00 5.60 1.50 0.12
^C
sparneet05@nativesystem:~$

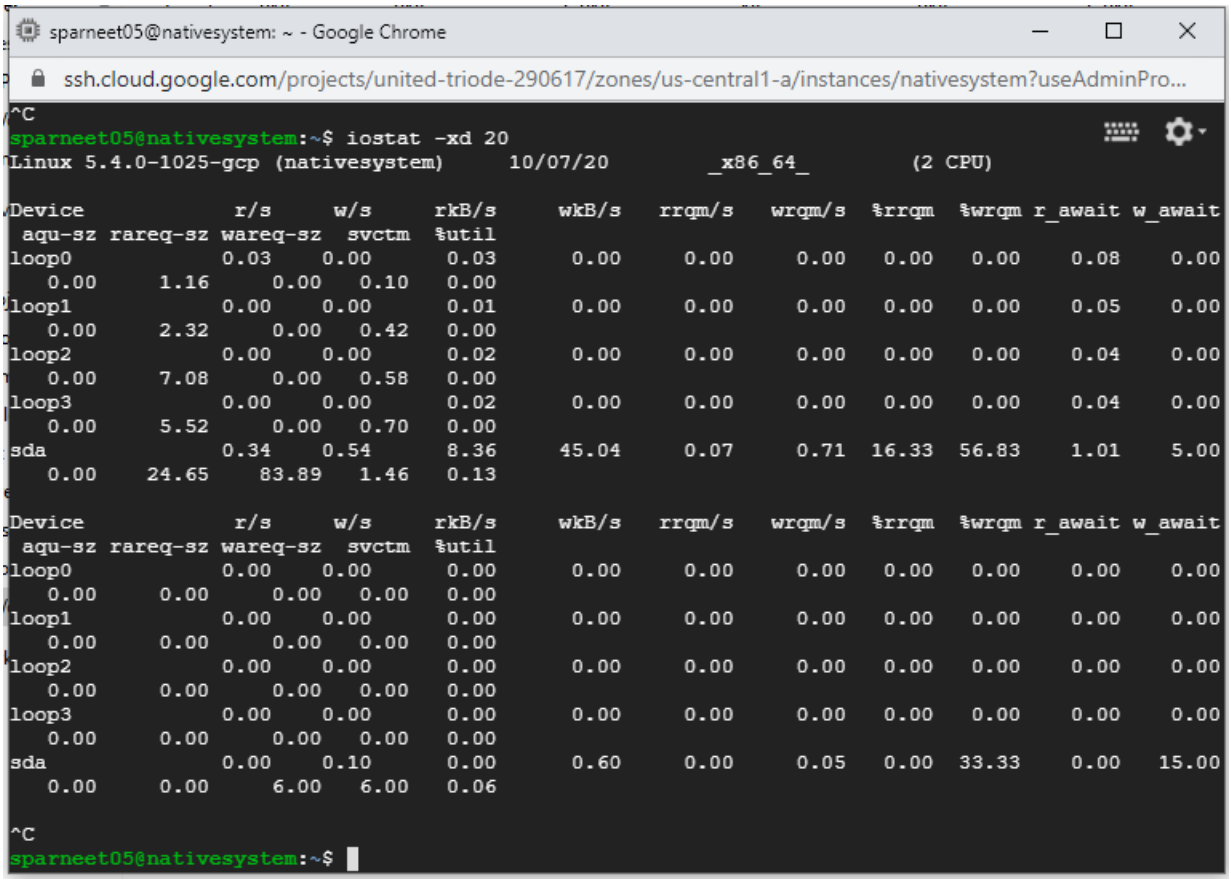
Test Case 3

Command - sysbench --num-threads=3 --test=cpu --cpu-max-prime=40000 run
CPU measurement - iostat -c 20
Disk Measurement – iostat -xd 20
Total Time – 38.8867 sec

ScreenShots-




sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesystem?useAdminPro...
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.04 0.00
0.00 5.52 0.00 0.70 0.00
sda 0.34 0.54 8.36 45.04 0.07 0.71 16.33 56.83 1.01 5.00
0.00 24.65 83.89 1.46 0.13
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_await w_await
aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
sda 0.00 0.10 0.00 0.60 0.00 0.05 0.00 33.33 0.00 15.00
0.00 0.00 6.00 6.00 0.06
^C
sparneet05@nativesystem:~$ iostat -c 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.37 0.01 0.11 0.03 0.00 99.48
avg-cpu: %user %nice %system %iowait %steal %idle
96.02 0.00 3.95 0.00 0.03 0.00
^C
sparneet05@nativesystem:~$


sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesystem?useAdminPro...
^C
sparneet05@nativesystem:~$ iostat -xd 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_await w_await
aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.03 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.08 0.00
0.00 1.16 0.00 0.10 0.00
loop1 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.05 0.00
0.00 2.32 0.00 0.42 0.00
loop2 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.04 0.00
0.00 7.08 0.00 0.58 0.00
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.04 0.00
0.00 5.52 0.00 0.70 0.00
sda 0.34 0.54 8.36 45.04 0.07 0.71 16.33 56.83 1.01 5.00
0.00 24.65 83.89 1.46 0.13
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_await w_await
aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00
sda 0.00 0.10 0.00 0.60 0.00 0.05 0.00 33.33 0.00 15.00
0.00 0.00 6.00 6.00 0.06
^C
sparneet05@nativesystem:~$

2. IO Test Mode

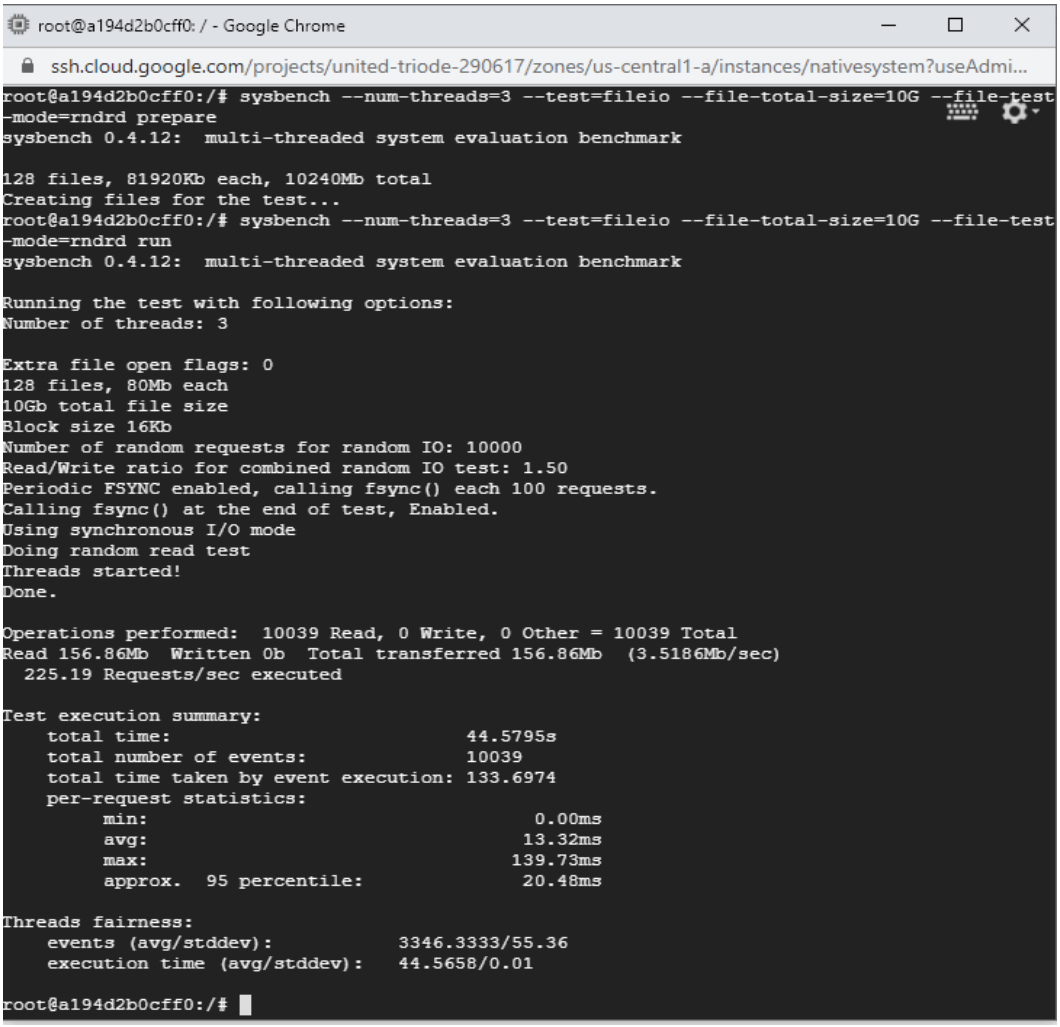
Test Case 1

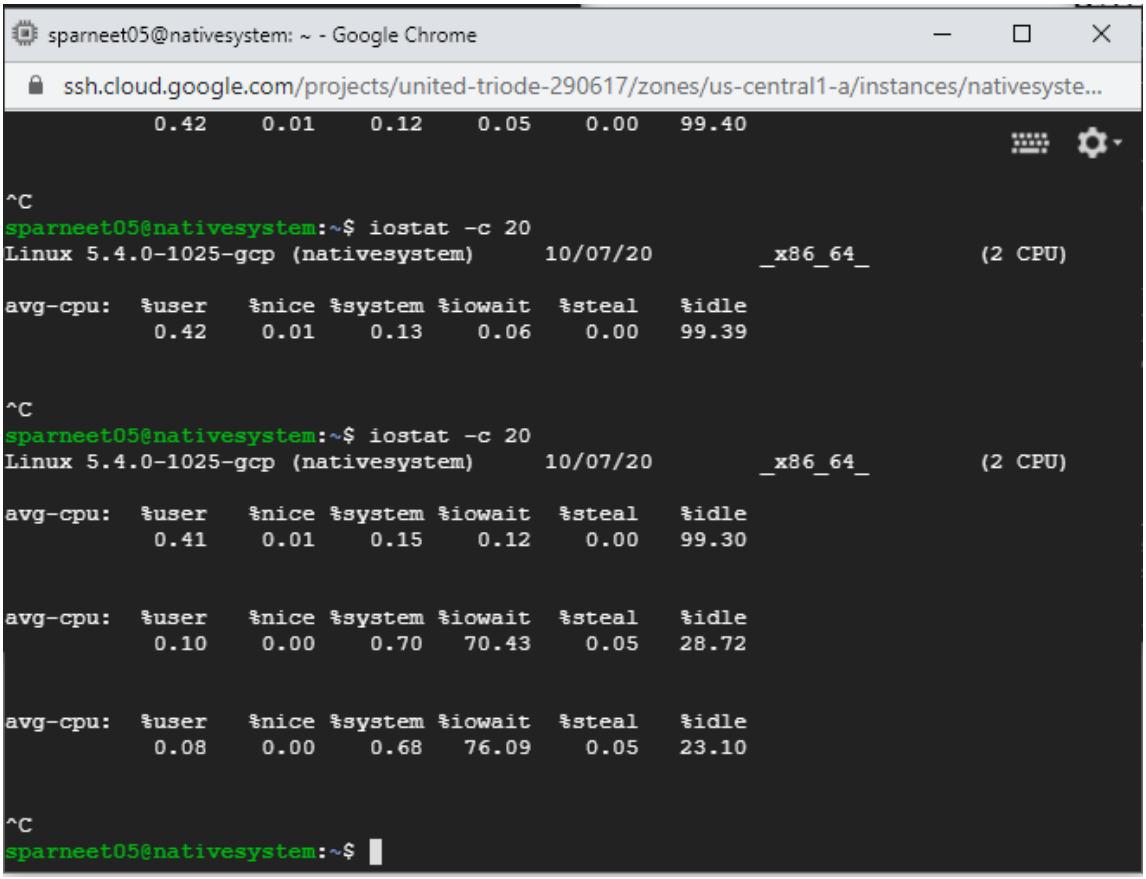
Command -

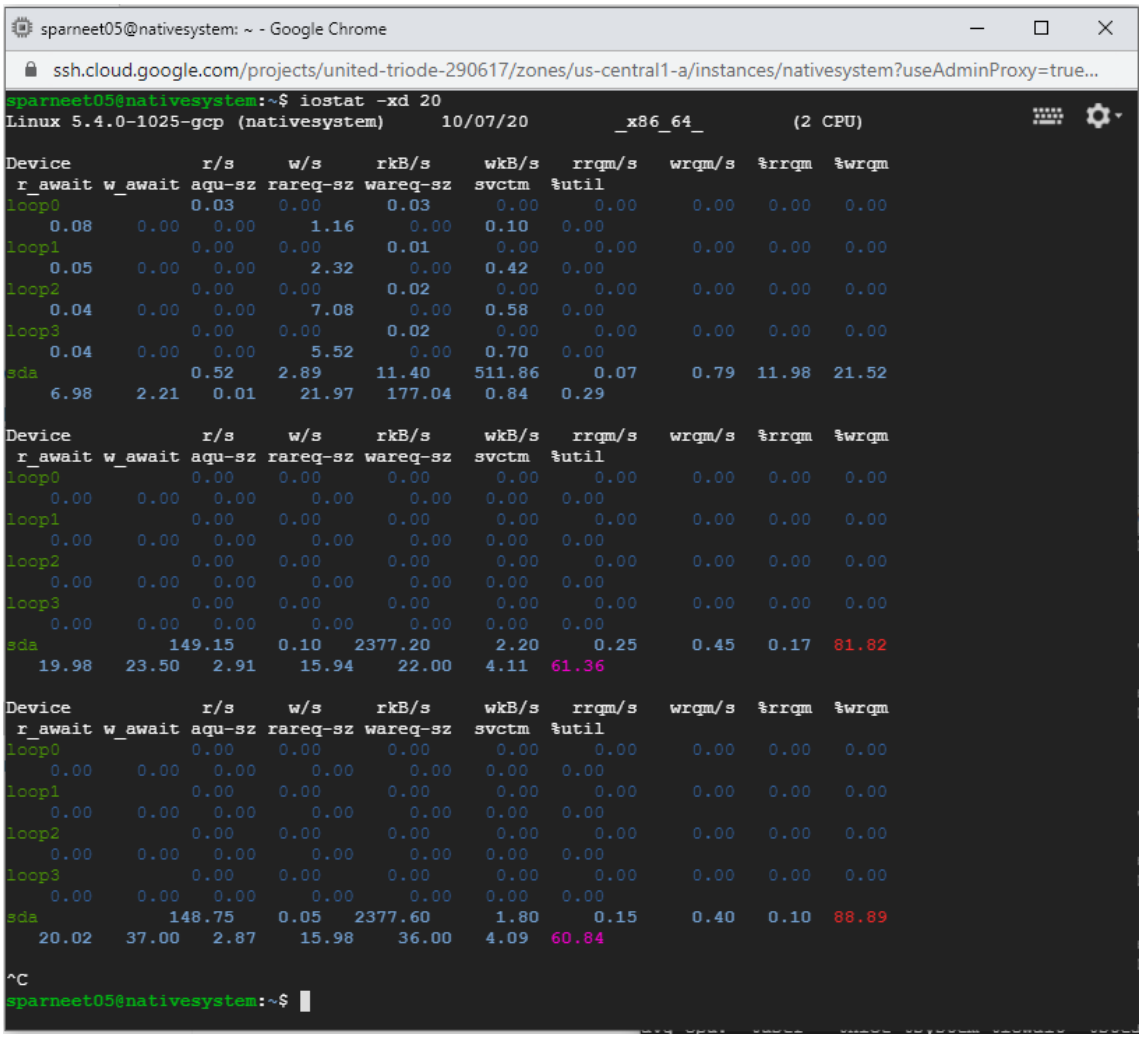
sysbench --num-threads=3 --test=fileio --file-total-size=10G --file-test-mode=rndrw prepare
sysbench --num-threads=3 --test=fileio --file-total-size=10G --file-test-mode=rndrw run
sysbench --num-threads=3 --test=fileio --file-total-size=10G --file-test-mode=rndrw cleanup

CPU measurement - iostat -c 20
Disk Measurement – iostat -xd 20
Total Time –44.5795 sec

ScreenShots-




sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesyste...
0.42 0.01 0.12 0.05 0.00 99.40
^C
sparneet05@nativesystem:~$ iostat -c 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.42 0.01 0.13 0.06 0.00 99.39
^C
sparneet05@nativesystem:~$ iostat -c 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.41 0.01 0.15 0.12 0.00 99.30
avg-cpu: %user %nice %system %iowait %steal %idle
0.10 0.00 0.70 70.43 0.05 28.72
avg-cpu: %user %nice %system %iowait %steal %idle
0.08 0.00 0.68 76.09 0.05 23.10
^C
sparneet05@nativesystem:~$


sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesystem?useAdminProxy=true...
sparneet05@nativesystem:~$ iostat -xd 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm
r_await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.03 0.00 0.03 0.00 0.00 0.00 0.00 0.00
0.08 0.00 0.00 1.16 0.00 0.10 0.00
loop1 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00
0.05 0.00 0.00 2.32 0.00 0.42 0.00
loop2 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 7.08 0.00 0.58 0.00
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 5.52 0.00 0.70 0.00
sda 0.52 2.89 11.40 511.86 0.07 0.79 11.98 21.52
6.98 2.21 0.01 21.97 177.04 0.84 0.29
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm
r_await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 149.15 0.10 2377.20 2.20 0.25 0.45 0.17 81.82
19.98 23.50 2.91 15.94 22.00 4.11 61.36
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm
r_await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 148.75 0.05 2377.60 1.80 0.15 0.40 0.10 88.89
20.02 37.00 2.87 15.98 36.00 4.09 60.84
^C
sparneet05@nativesystem:~$

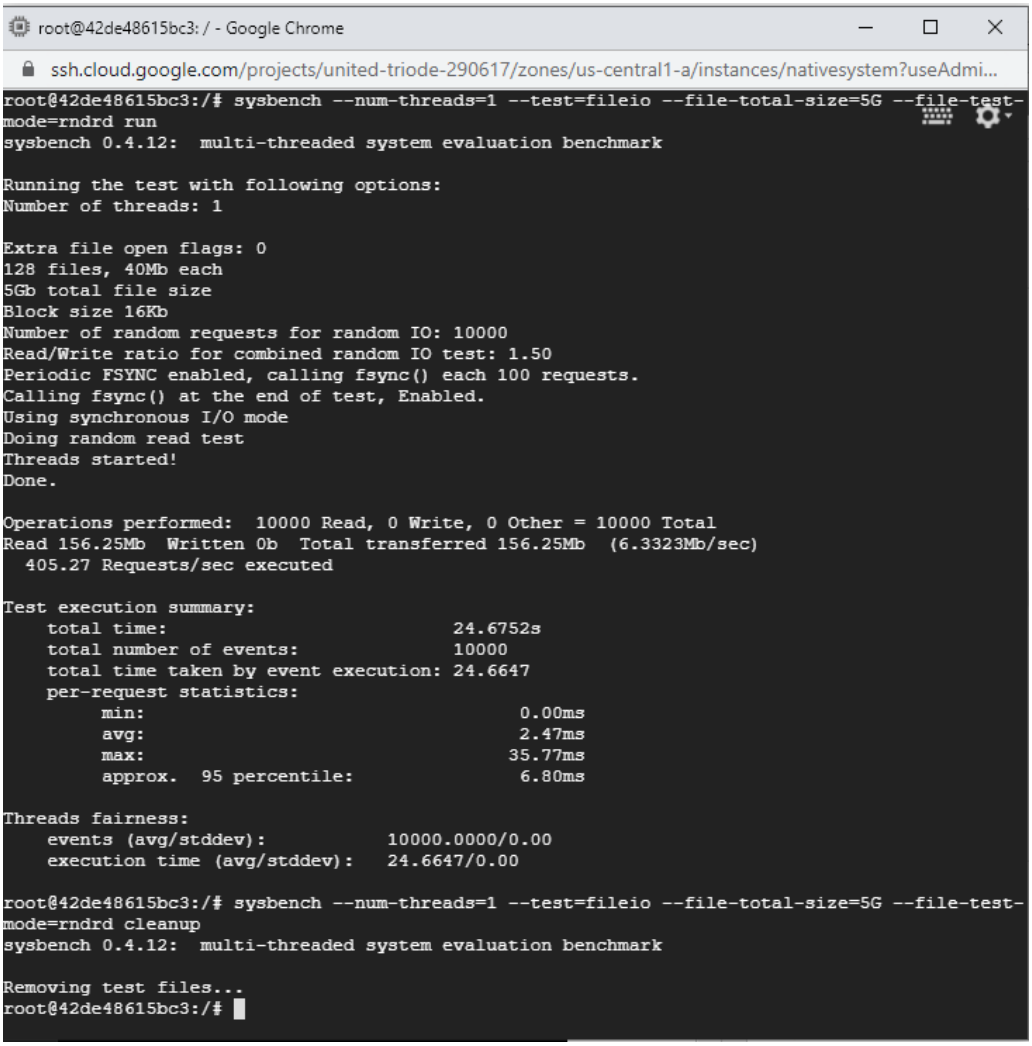
Test Case-2

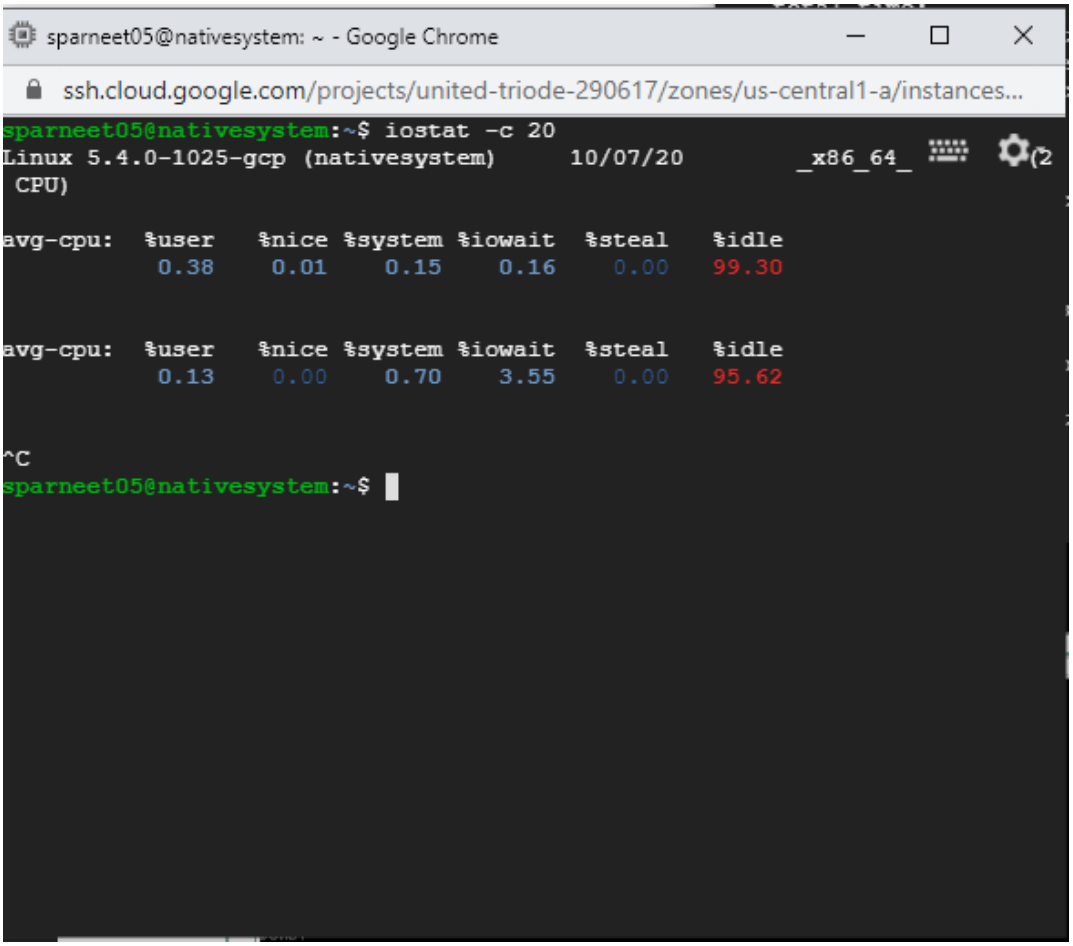
Command -

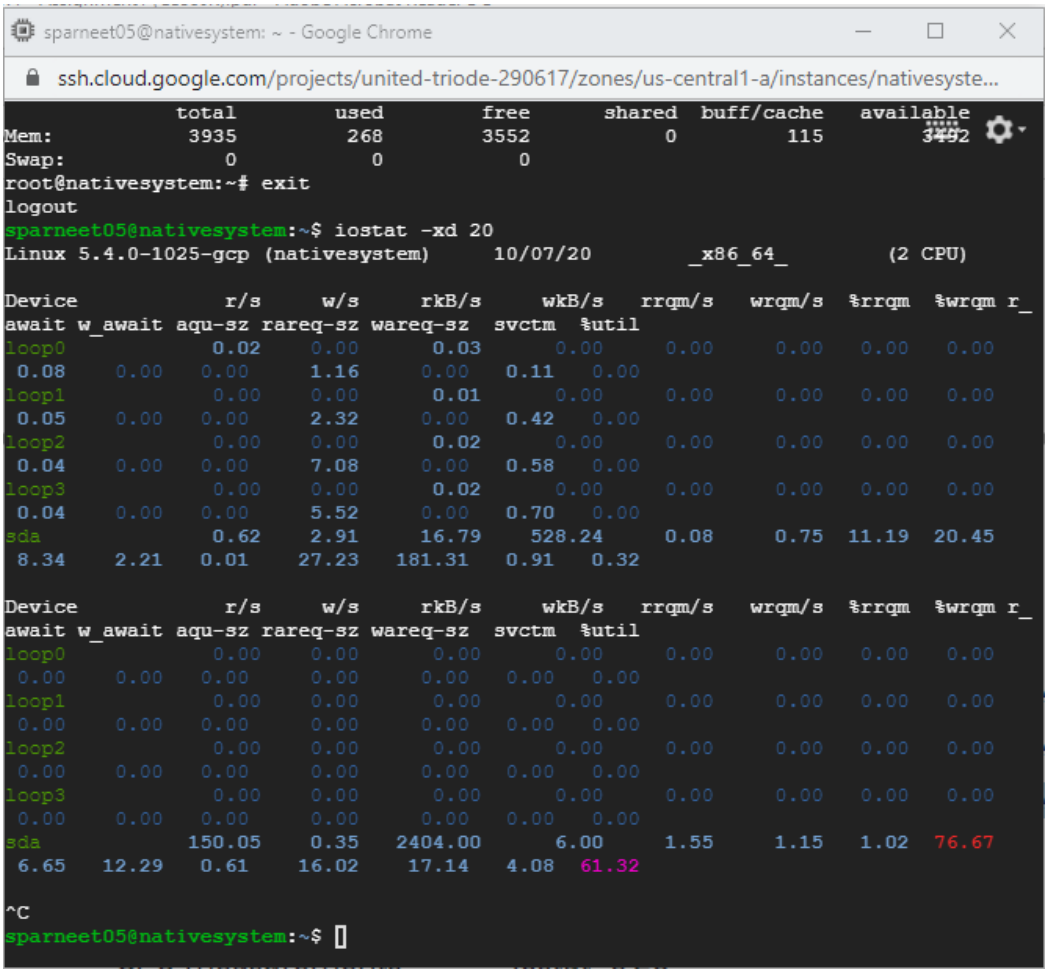
sysbench --num-threads=1 --test=fileio --file-total-size=5G --file-test-mode=rndrw prepare
sysbench --num-threads=1 --test=fileio --file-total-size=5G --file-test-mode=rndrw run
sysbench --num-threads=1 --test=fileio --file-total-size=5G --file-test-mode=rndrw cleanup

CPU measurement - iostat -c 20
Disk Measurement – iostat -xd 20
Total Time –44.5795 sec

ScreenShots-




sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances...
sparneet05@nativesystem:~$ iostat -c 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2
CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.38 0.01 0.15 0.16 0.00 99.30
avg-cpu: %user %nice %system %iowait %steal %idle
0.13 0.00 0.70 3.55 0.00 95.62
^C
sparneet05@nativesystem:~$


sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesyste...
total used free shared buff/cache available
Mem: 3935 268 3552 0 115 3492
Swap: 0 0 0
root@nativesystem:~# exit
logout
sparneet05@nativesystem:~$ iostat -xd 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.02 0.00 0.03 0.00 0.00 0.00 0.00 0.00
0.08 0.00 0.00 1.16 0.00 0.11 0.00
loop1 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00
0.05 0.00 0.00 2.32 0.00 0.42 0.00
loop2 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 7.08 0.00 0.58 0.00
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 5.52 0.00 0.70 0.00
sda 0.62 2.91 16.79 528.24 0.08 0.75 11.19 20.45
8.34 2.21 0.01 27.23 181.31 0.91 0.32
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 150.05 0.35 2404.00 6.00 1.55 1.15 1.02 76.67
6.65 12.29 0.61 16.02 17.14 4.08 61.32
^C
sparneet05@nativesystem:~$

Test Case-3

Command -

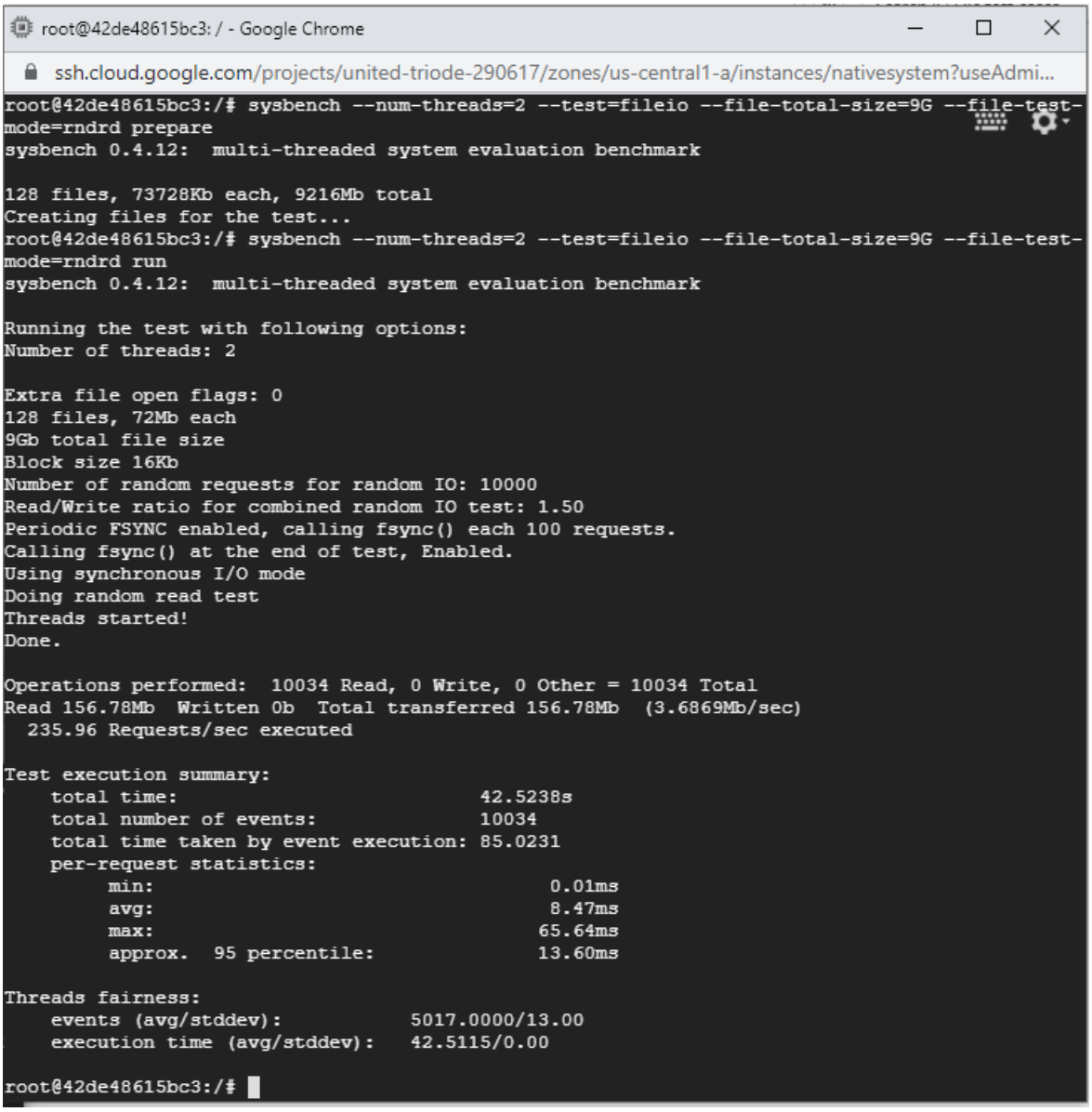
sysbench --num-threads=2 --test=fileio --file-total-size=9G --file-test-mode=rndrw prepare
sysbench --num-threads=2 --test=fileio --file-total-size=9G --file-test-mode=rndrw run
sysbench --num-threads=2 --test=fileio --file-total-size=9G --file-test-mode=rndrw cleanup

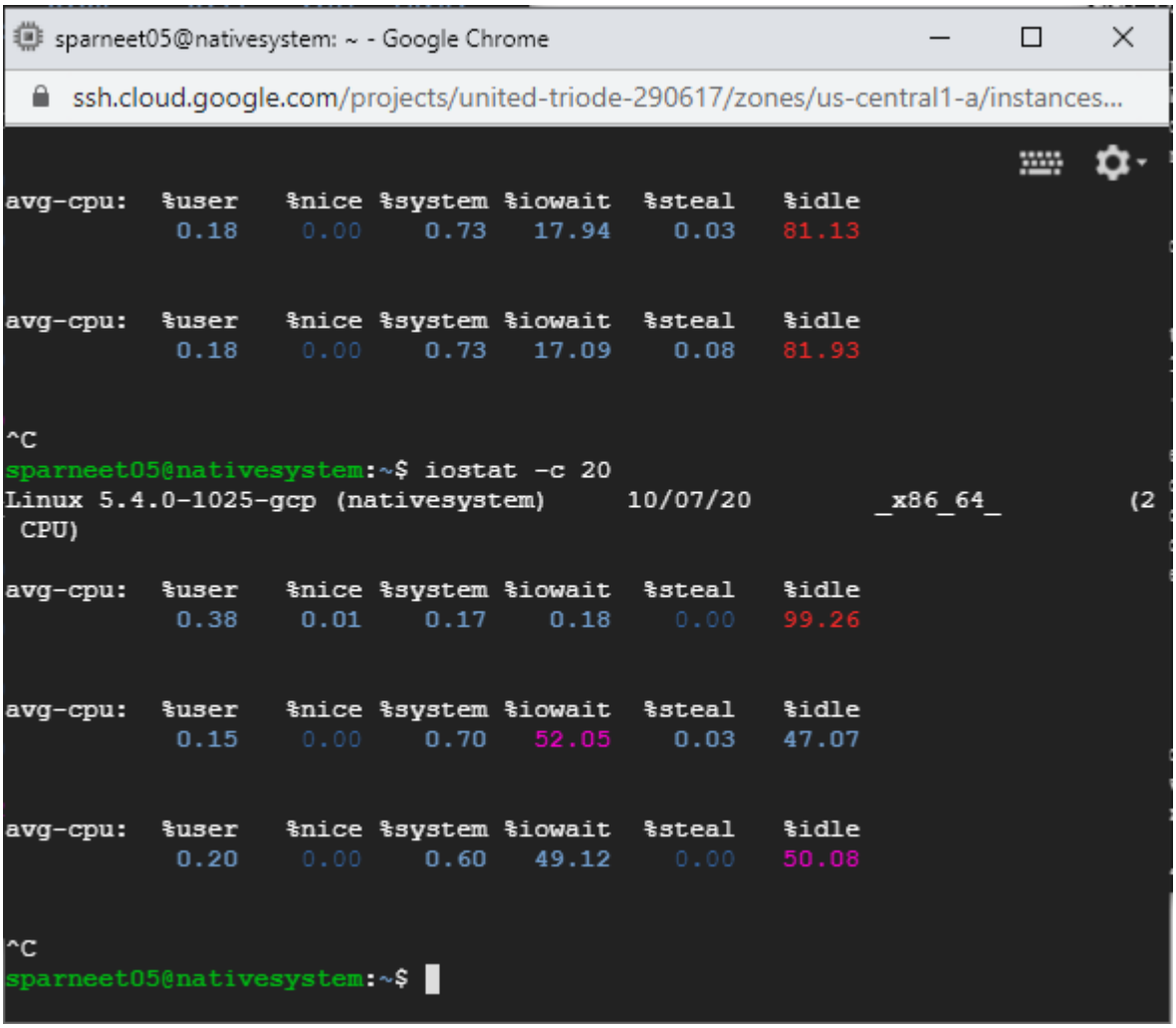
CPU measurement - iostat -c 20

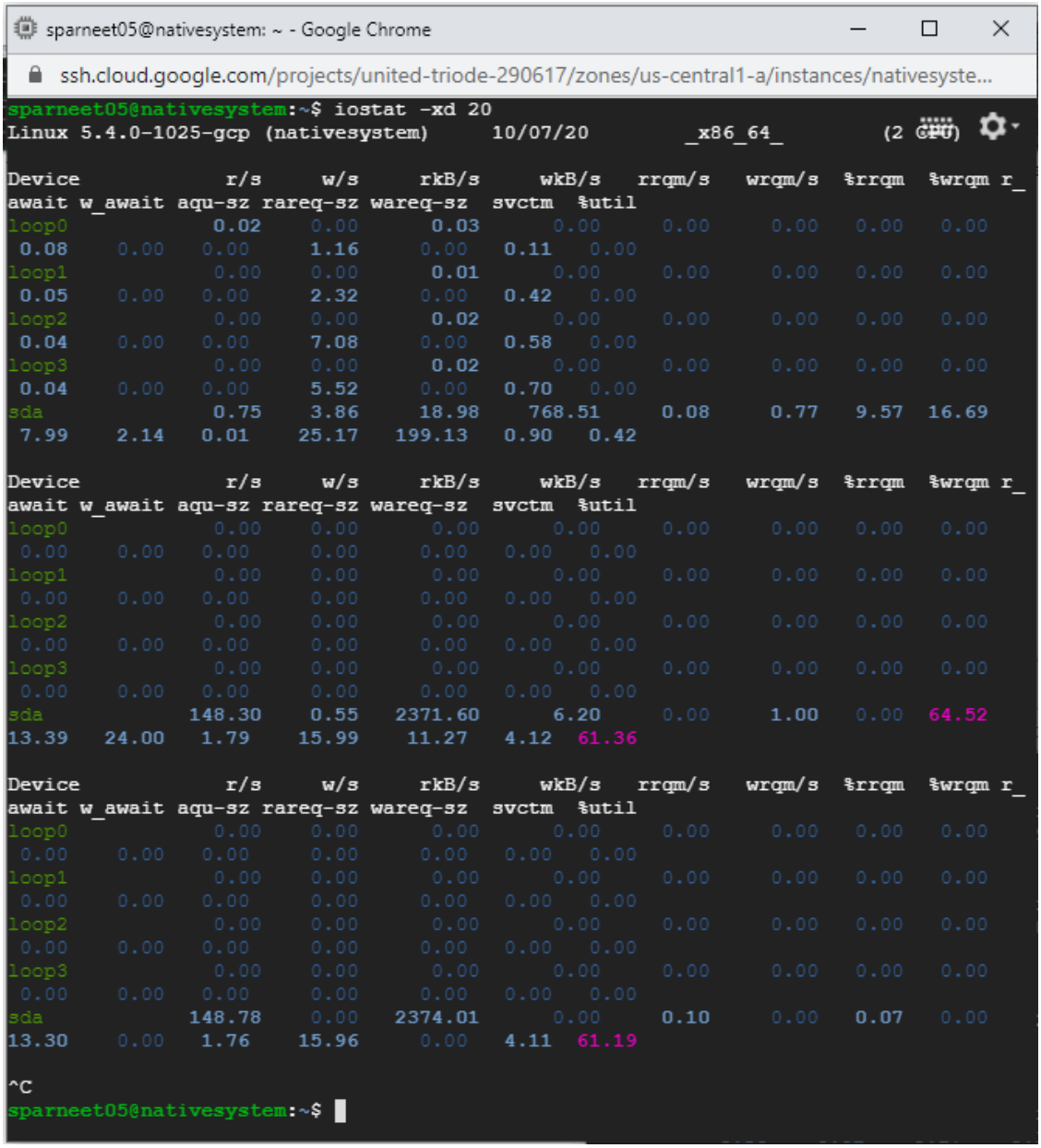
Disk Measurement – iostat -xd 20

Total Time –42.5238 sec

Screenshots-




sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances...
avg-cpu: %user %nice %system %iowait %steal %idle
0.18 0.00 0.73 17.94 0.03 81.13
avg-cpu: %user %nice %system %iowait %steal %idle
0.18 0.00 0.73 17.09 0.08 81.93
^C
sparneet05@nativesystem:~$ iostat -c 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2
CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.38 0.01 0.17 0.18 0.00 99.26
avg-cpu: %user %nice %system %iowait %steal %idle
0.15 0.00 0.70 52.05 0.03 47.07
avg-cpu: %user %nice %system %iowait %steal %idle
0.20 0.00 0.60 49.12 0.00 50.08
^C
sparneet05@nativesystem:~$


sparneet05@nativesystem: ~ - Google Chrome
ssh.cloud.google.com/projects/united-triode-290617/zones/us-central1-a/instances/nativesyste...
sparneet05@nativesystem:~$ iostat -xd 20
Linux 5.4.0-1025-gcp (nativesystem) 10/07/20 _x86_64_ (2 CPU)
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.02 0.00 0.03 0.00 0.00 0.00 0.00 0.00
0.08 0.00 0.00 1.16 0.00 0.11 0.00
loop1 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00
0.05 0.00 0.00 2.32 0.00 0.42 0.00
loop2 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 7.08 0.00 0.58 0.00
loop3 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00
0.04 0.00 0.00 5.52 0.00 0.70 0.00
sda 0.75 3.86 18.98 768.51 0.08 0.77 9.57 16.69
7.99 2.14 0.01 25.17 199.13 0.90 0.42
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 148.30 0.55 2371.60 6.20 0.00 1.00 0.00 64.52
13.39 24.00 1.79 15.99 11.27 4.12 61.36
Device r/s w/s rkB/s wkB/s rrqm/s wrqm/s %rrqm %wrqm r_
await w_await aqu-sz rareq-sz wareq-sz svctm %util
loop0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
loop3 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00
sda 148.78 0.00 2374.01 0.00 0.10 0.00 0.07 0.00
13.30 0.00 1.76 15.96 0.00 4.11 61.19
^C
sparneet05@nativesystem:~$

*The above number of threads, file sizes(for IO test mode) and CPU max prime(for CPU test mode) are chosen in accordance such that the process may last longer i.e. around 30-60 seconds. The less number of threads and larger file size or max prime number will result in increase of total time. This is done so that with the use of iostat, a proper CPU and disk measurements can be taken.(The first line of measurement is usually not considered useful as it does not display the true use of resources.)

CPU Performance Analysis

CPU Utilization

	User-level(%user)	Kernel-level(%system)
Test Case 1	99.90	0.07
Test Case 2	50.06	0.10
Test Case 3	96.02	3.95

IO Utilization

	Throughput(%tps)	Latency(%await)	Disk Utilization(%util)
Test Case 1	0.10	0.00	0.02
Test Case 2	0.00	0.00	0.12
Test Case 3	0.00	0.00	0.06

IO Performance Analysis

CPU Utilization

	User-level(%user)	Kernel-level(%system)
Test Case 1	0.10	0.70
Test Case 2	0.13	0.70
Test Case 3	0.15	0.70

IO Utilization

	Throughput(%tps)	Latency(%await)	Disk Utilization(%util)
Test Case 1	149.25	2.91	61.36
Test Case 2	150.40	0.61	61.32
Test Case 3	148.85	1.79	61.36

Data Analysis

- User-level CPU usage is much higher in the CPU test mode performance analysis than the IO test mode performance analysis.
- Throughput, Latency and Disk Utilization is much higher in the IO test mode performance analysis since the files are being transferred in the process.
- There is much higher latency in the IO test mode performance analysis than its counter one.
- Disk utilization is very low in the CPU test mode performance analysis since CPU processing does not require disk space.

QEMU

Installation steps

- Installed QEMU on Google Instance
- Downloaded ubuntu 18.04 LTS server and created bootable image
- Setup the Firewall
- Accessed the instance from VNC Viewer
- Installed Ubuntu VM instance on QEMU

Commands in the process:

- sudo apt-get install qemu
- wget http://mirror.pnl.gov/releases/18.04/ubuntu-18.04.5-live-server-amd64.iso
- sudo qemu-img create ubuntu.img 10G
- $sudo qemu-system-x86_64 -hda ubuntu.img -boot d -cdrom ./ubuntu-16.04.6-server-amd64.iso -m 1536
- $sudo qemu-system-x86_64 -hda ubuntu.img -m 1536 [To start QEMU]

Time taken to boot: It took around 3 mins to the time it asks for username and password. Total time was approx. 17 mins.

Why it is so slow to run such a VM under QEMU?

Running a VM under QEMU is slow because it will have to share its resources for the VM itself as well as the emulated operating system (Ubuntu in our case). The OS running in a virtual machine will run slower than if it would run directly on that same machine without a virtualization layer. We will have a performance penalty of VM processing + Ubuntu processing - before actually running any application under Ubuntu. As we add layers of software between the physical hardware and the application you choose to run, there will be a performance hit at each layer.

In general, CPU and DRAM virtualization overheads are comparatively low due to the hardware-assisted virtualization techniques. However, the disk virtualization or emulation has considerable overheads, because the virtual disk emulation is implemented in userspace.