THOMAS KRENN®

server.hosting.customized.

TKperf Test Report

Contents

1   Setup Information

Tested Device:

- Model Number: Samsung SSD 840 PRO Series

- Serial Number: S1ANNEAD555659W

- Firmware Revision: DXM05B0Q

- device size with M = 1000*1000: 128035 MBytes (128 GB)

- write-caching = 1 (on)

Used command line:

- /usr/local/bin/tkperf ssd Samsung840PRO-128GB /dev/sda -nj 2 -iod 16 -rfb

Performance System:

- TKperf Version: 1.1

- Fio Version: fio-2.0.14

- Date of test run: 2013-10-15

- Number of jobs: 2

- Number of outstanding IOs (iodepth): 16

Operating System:

- Kernel Version: 3.2.0-38-generic

- Description: Ubuntu 12.04.2 LTS

2   General Information

- *workloads*: The percentage of read operations in the random mixed workload. In the plots the term "100/00" means 100% read and 0% write, "95/5" 95% read and 5% write, and so on.

- *block sizes*: The block size of Fio to be used for IO operations.

- *measurement window*: Those rounds, where the dependence variable became stable.

- *dependence variable*: A specific type of test variable to determine the steady state.

2.1   Steady State

The Steady State is to determine if a test has reached a steady performance level. Each test has a different dependence variable to check if the state has already been reached. To check for the steady state the performance values of a test measurement window are taken (the last 5 rounds). The steady state is reached if:

- The maximum data excursion is less than 20% of the average in the measurement window.

- The slope of the linear best fit line is less than 10% of the average in the measurement window

If these two conditions are met the steady state has been reach for the specific dependence variable. Therefore the test can be stopped and the performance values of the measurement window can be taken for the measurement plots. If the steady state has not been reached after a maximum number of rounds the test can be stopped as well. The numbers for these two variables are:

- Measurement Window: 4

- Max. number of rounds: 25

3 IOPS

The IOPS test consists of looping over the following parameters:

```
Make Secure Erase
Workload Ind. Preconditioning
While not Steady State
        For workloads  [100, 95, 65, 50, 35, 5, 0]
                For block sizes ['1024k', '128k', '64k', '32k', '16k', '8k', '4k', '512']
```

Each combination of workload and block size is carried out for 60 seconds using direct IO. The average number of read and write IOPS is measured and summed up, therefore 56 values are the result of the two loops. After these loops are finished one test round has been carried out. To detect the steady state the IOPS of 4k random write are taken.

- Dependent Variable: 4k block size, random write

3.1 Steady State Information

Steady State has been reached:

- True

Steady State has been reached in rounds :
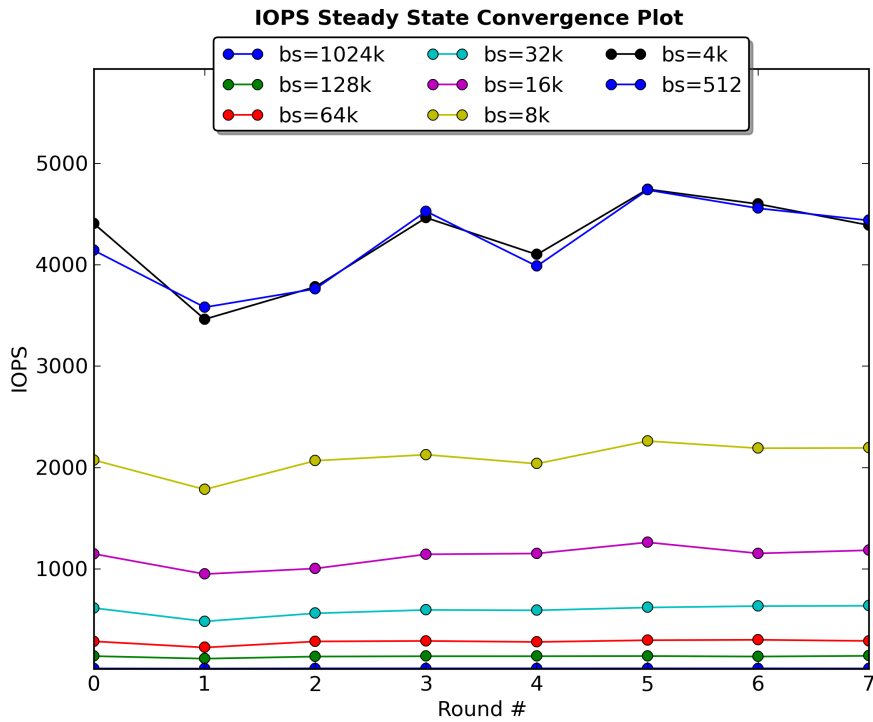
- deque([3, 4, 5, 6, 7])

Values in stdy measurement window:
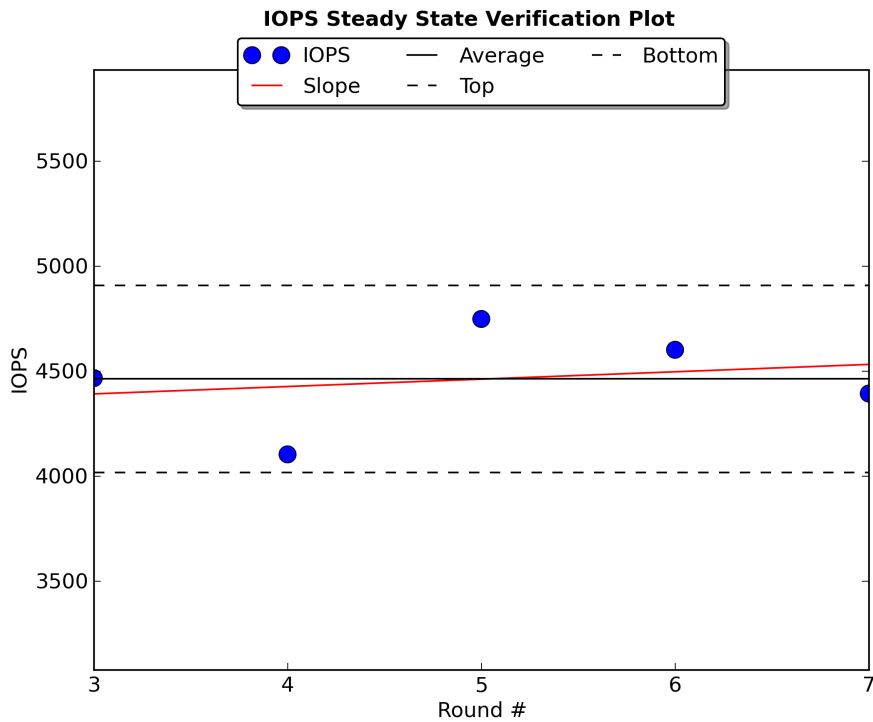
- deque([4466, 4102, 4747, 4601, 4392])

Average in stdy measurement window:

- 4461.6

3.2 Measurement Plots

IOPS Steady State Convergence Plot

The Steady State Convergence Plot shows the reached IOPS for all block sizes of random writes over all rounds.

IOPS Steady State Verification Plot

The Steady State Verification Plot shows the measured IOPS of 4k random writes, the 20% average window and the slope of the linear best fit line in the measurement window.

IOPS Measurement Plot
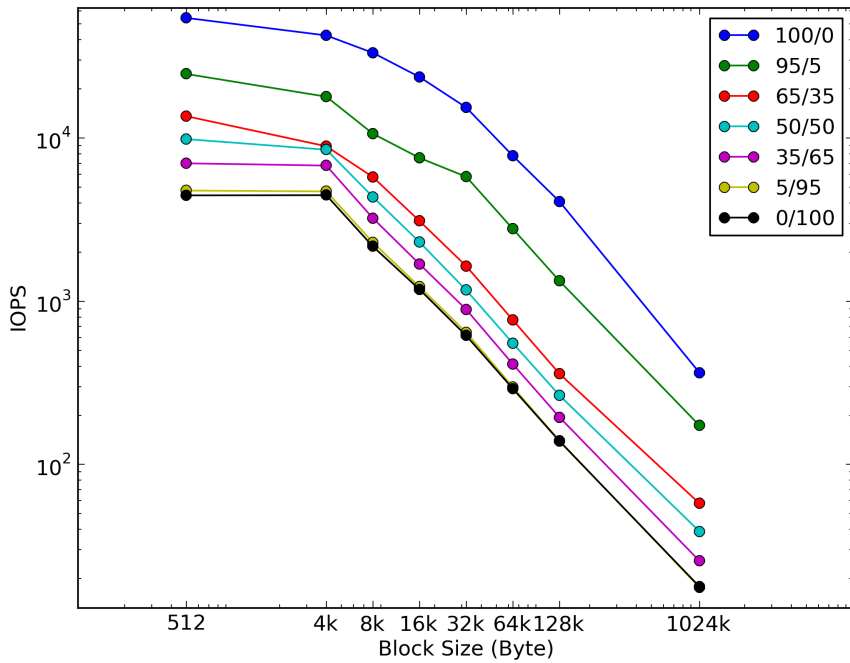
The Measurement Plot shows the average of IOPS in the measurement window. For every workload the IOPS of all block sizes are plotted.

IOPS 3D Measurement Plot
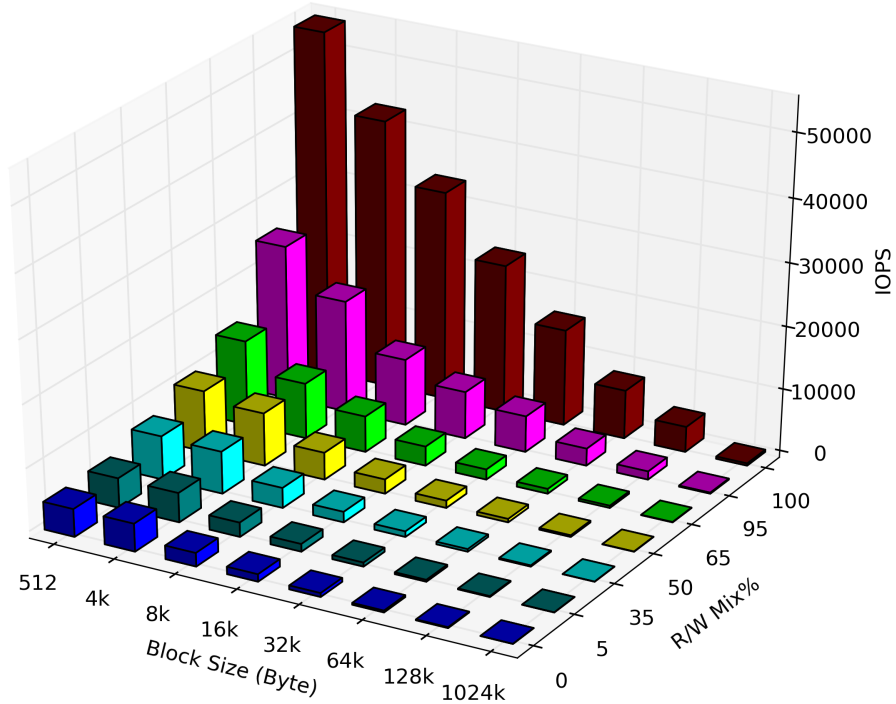
The Measurement 3D Plot shows the average of IOPS in the measurement window. For every workload the IOPS of all block sizes are plotted.

3.3 Measurement Window Summary Table

Average IOPS vs. Block Size and R/W Mix %

Block Size ↓	Wld. → 100/0	95/5	65/35	50/50	35/65	5/95	0/100
512	54396.2	24668.6	13599.2	9845.0	6994.4	4762.6	4451.0
4k	42481.6	17908.6	8897.6	8476.2	6775.0	4705.2	4461.6
8k	33221.0	10614.4	5756.6	4347.8	3220.2	2288.4	2162.4
16k	23621.0	7545.4	3096.0	2299.0	1686.6	1224.0	1179.0
32k	15350.0	5785.6	1639.6	1167.4	888.6	643.8	614.8
64k	7767.2	2768.4	765.6	551.8	411.0	297.2	290.6
128k	4071.2	1328.2	358.6	264.4	194.2	139.6	138.6
1024k	364.0	172.8	57.6	38.8	25.6	17.6	17.8

4 Throughput

The throughput test consists of looping over the following parameters:

```
For block sizes  ['1024k', '64k', '8k', '4k', '512']
        Make Secure Erase
        While not Steady State
                Sequential read
                Sequential write
```

For each block size sequential read and write is carried out for 60 seconds using direct IO. The number of kilobytes for read and write is measured, therefore 2 values are the result of one round. To detect the steady state the throughput of 1024k sequential write is taken.

- Dependent Variable: 1024k block size, sequential write

4.1 Steady State Information

Steady State has been reached:

- True

Steady State has been reached in rounds :
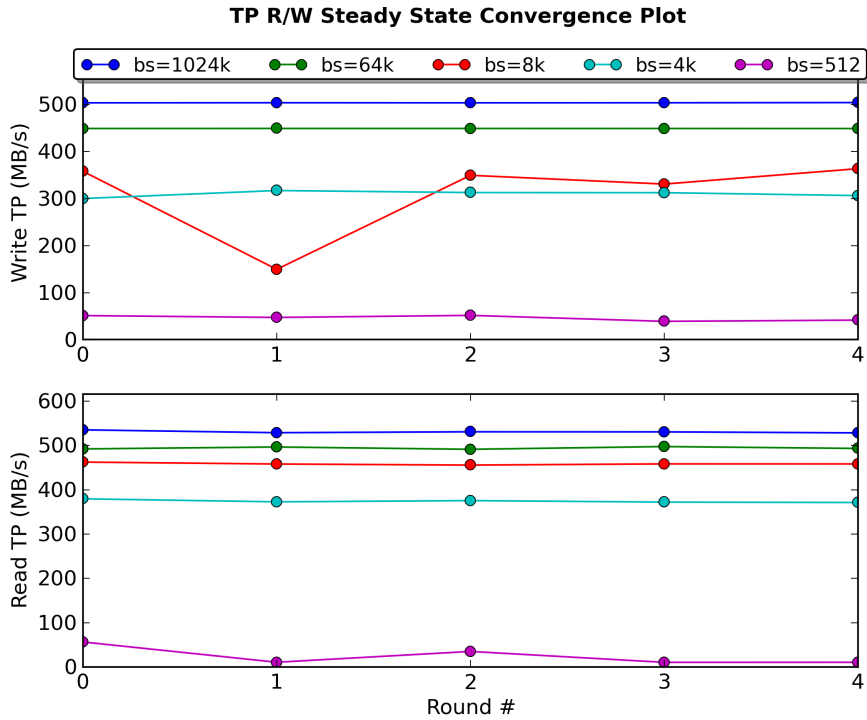
- deque([0, 1, 2, 3, 4])

Values in stdy measurement window:

- deque([515230, 515426, 515247, 515358, 515759])

Average in stdy measurement window:

- 515404.0

4.2 Measurement Plots

TP R/W Steady State Convergence Plot

The Read/Write Steady State Convergence Plot shows the bandwidth for all block sizes of seq. reads over all rounds. On the top the write throughput is plotted, below the throughput for read.

TP Steady State Verification Plot
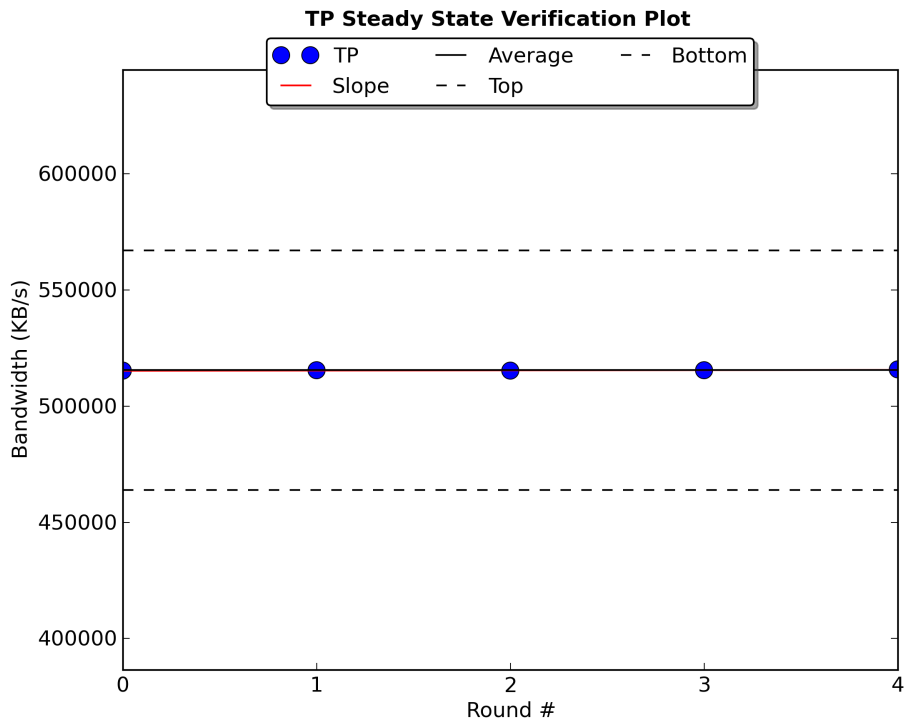
The Steady State Verification Plot shows the bandwidth of 1024k seq. writes, the 20% average window and the slope of the linear best fit line in the measurement window.

TP Measurement Plot
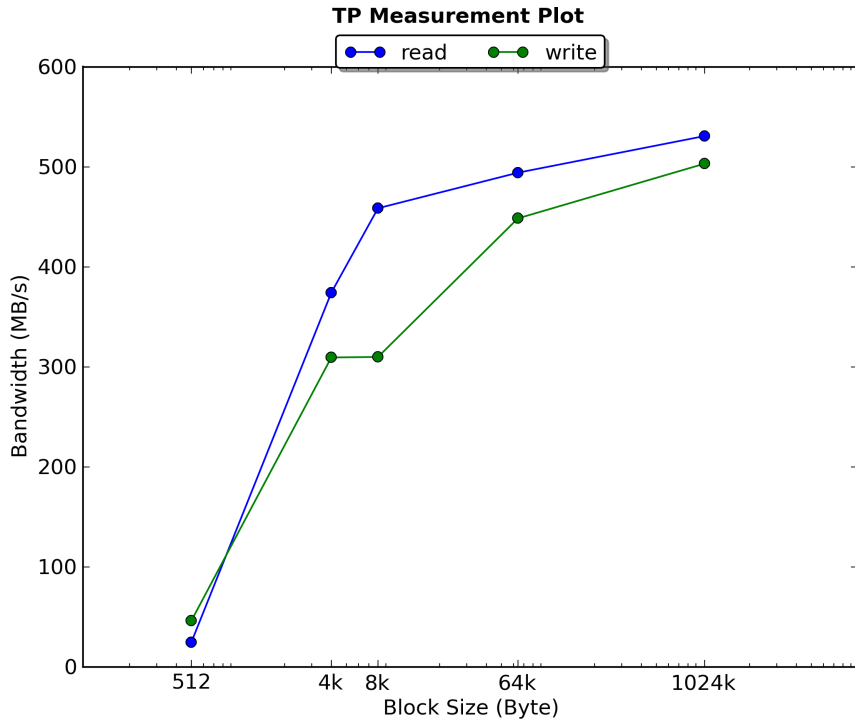
The Measurement Plot shows the average bandwidth of reads and writes in the measurement window. For all block sizes the seq. read and write bandwidth is plotted.

4.3 Measurement Window Summary Table

Average MB/s vs. Block Size and R/W

Block Size ↓	Read	Write
1024k	530.949	503.324
64k	494.315	448.626
8k	458.748	310.043
4k	374.358	309.546
512	24.698	46.209

5 Latency

The latency test consists of looping over the following parameters:

```
Make Secure Erase
Workload Ind. Preconditioning
While not Steady State
        For workloads  [100, 65, 0]
                For block sizes ['8k', '4k', '512']
```

For all block sizes random read, a 65/35 read/write mixed workload and random write is carried out for 60 seconds using direct IO. For every combination the Min, Max and Mean Latency is measured. After these loops are finished one test round has been carried out. To detect the steady state the mean latency of 4k

random write is taken.

- Dependent Variable: 4k block size, random write mean latency

5.1 Steady State Information

Steady State has been reached:

- True

Steady State has been reached in rounds :
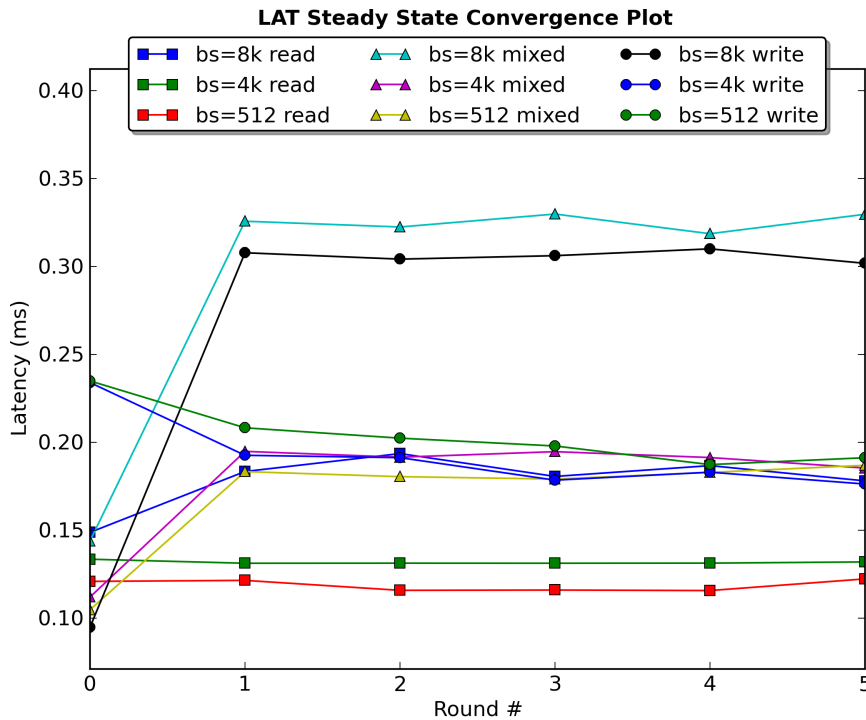
- deque([1, 2, 3, 4, 5])

Values in stdy measurement window:

- deque([192.727155, 191.38746, 178.598987, 183.122101, 176.388503])
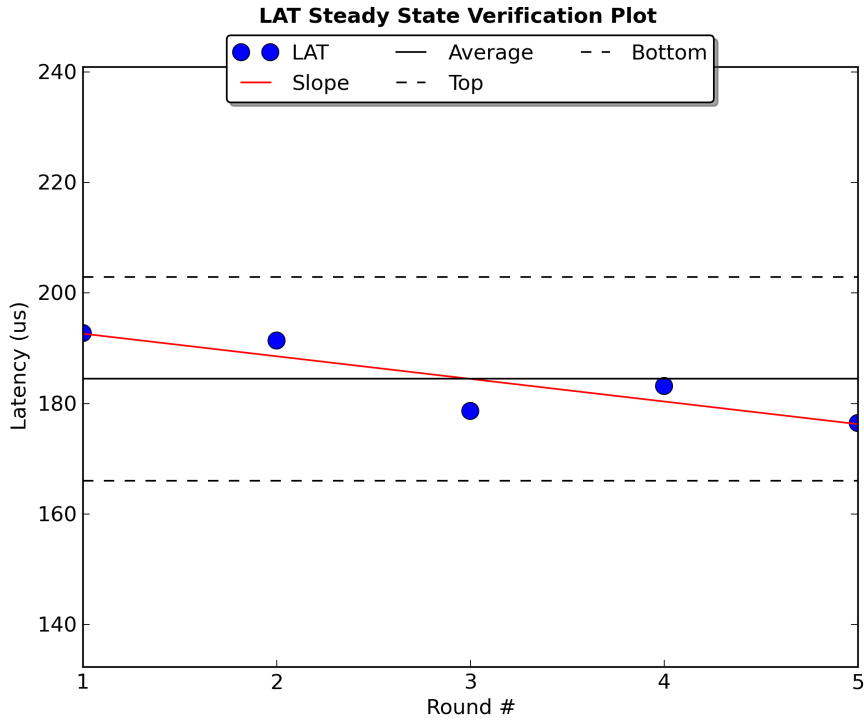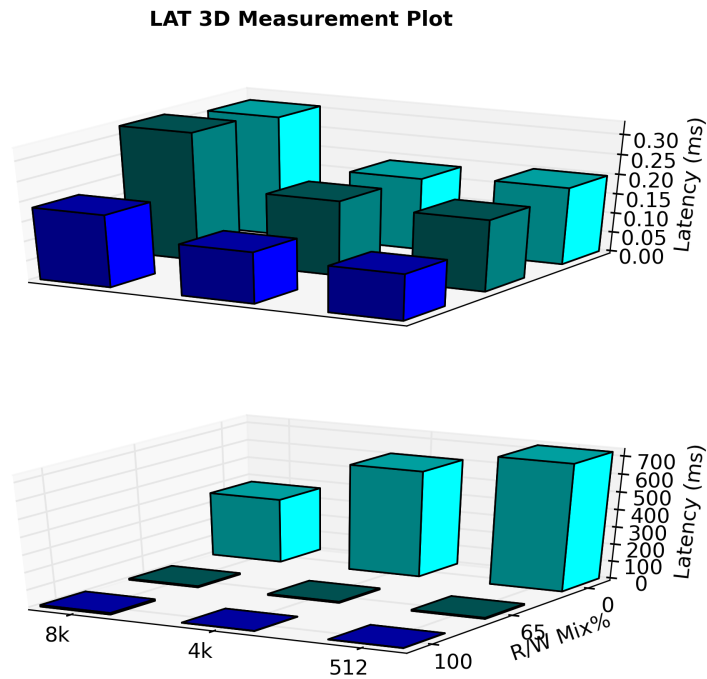
Average in stdy measurement window:

- 184.4448412

5.2 Measurement Plots

The Steady State Convergence Plot shows the mean latency for all block sizes of random read, mixed workload and write.

LAT Steady State Verification Plot

The Steady State Verification Plot shows the mean latency of 4k random writes, the 20% average window and the slope of the linear best fit line in the measurement window.

LAT 3D Measurement Plot

The Latency Measurement 3D Plot shows the average latency on top and the max latency below it. For the measurement window every workload including all block sizes is plotted.

5.3   Measurement Window Summary Table

Average Latency (ms) vs. Block Size and R/W Mix %

Block Size ↓	Wld. → 0/100	65/35	100/0
8k	0.306	0.325	0.185
4k	0.184	0.192	0.132
512	0.198	0.183	0.118

Max Latency (ms) vs. Block Size and R/W Mix %

| Block Size ↓	Wld. → 0/100	65/35	100/0
8k	367.408	6.924	9.263
4k	606.177	6.687	1.125
512	724.925	6.642	1.121

6   Write Saturation

The write saturation test consists of looping over the following parameters:

```
Make Secure Erase
While not written 4x User Capacity or 24h
        Carry out random write, 4k block size for 1 minute.
```

For 4k block size random write is carried out for 60 seconds using direct IO. For each round (60 second window) the write IOPS and latencies are measured. Also the total written IO is measured to check if 4x capacity has been written.

As no steady state detection is necessary there is no dependence variable.

6.1   Measurement Plots

Write Saturation Test
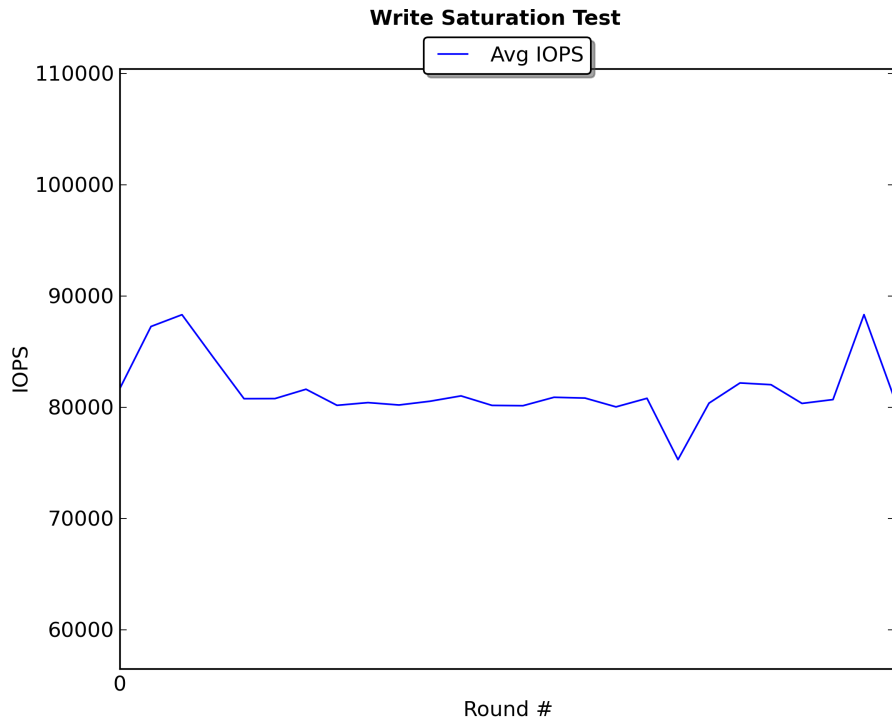
The Write Saturation IOPS Plot shows the average IOPS of 4k random writes over all rounds.

Write Saturation Test
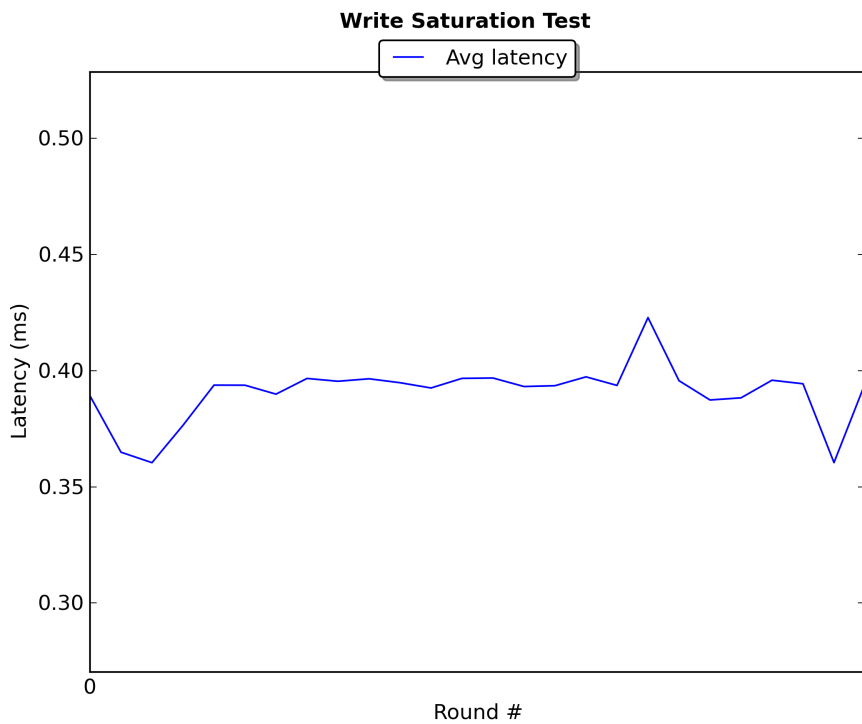
The Write Saturation Latency Plot shows the mean latency of 4k random writes over all rounds.