CSC443 - Part I: Disk access characteristics

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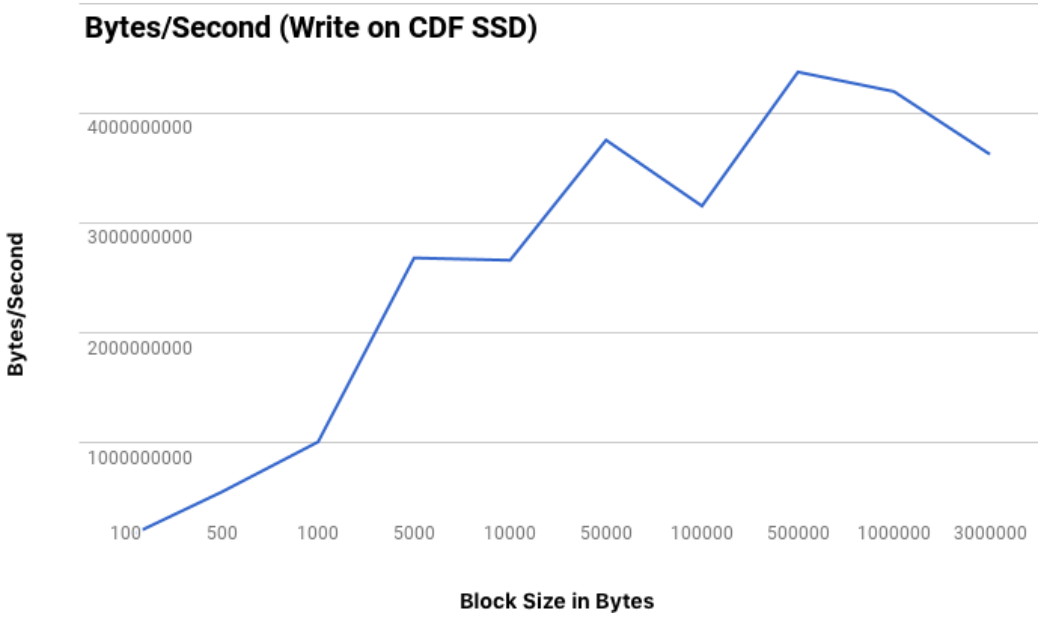
1.2. Experiments

Write Results on CDF SSD

Bytes/Second results and label are in Bytes.
All tests are conducted on 8MB files.
Each block size was repeated 100 times and averaged to get the Byte/Second result

Block Size in Bytes	Bytes/Second
100	140717099.4
500	556646842.4
1000	1010189583
5000	2682539683
10000	2661742792
50000	3754429083
100000	3154966454
500000	4373294060
1000000	4196145125
3000000	3624742268



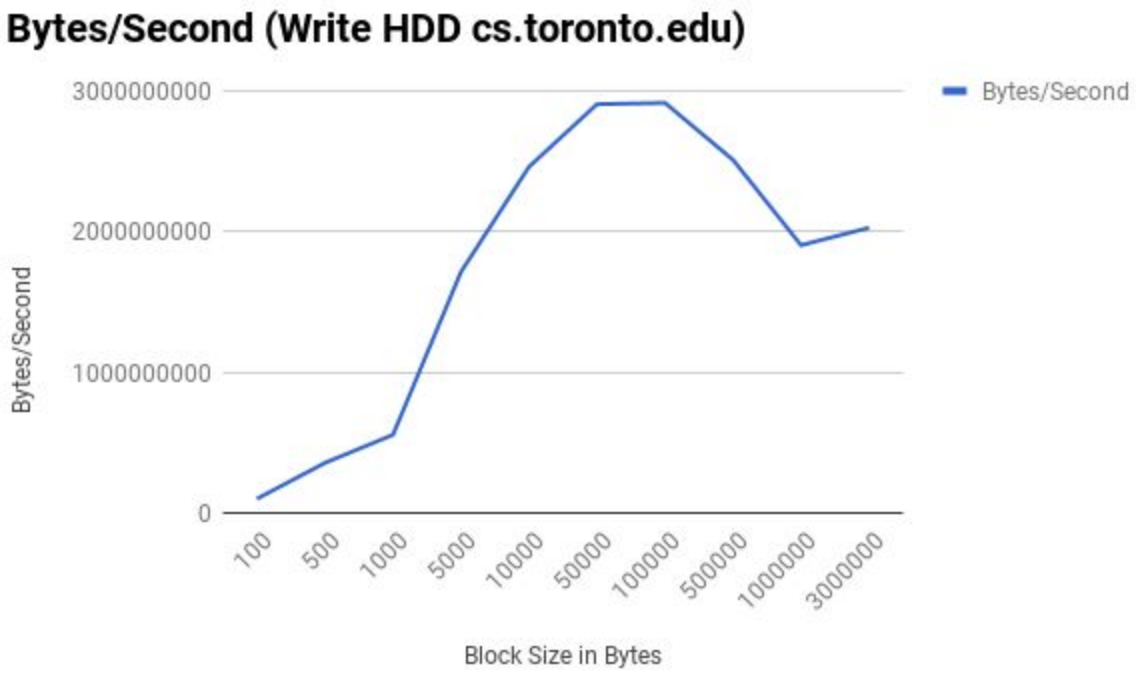
Write Results on HDD cs.toronto.edu

Bytes/Second results and label are in Bytes.

All tests are conducted on 8MB files.

Each block size was repeated 100 times and averaged to get the Byte/Second result

Block Size in Bytes	Bytes/Second
100	101716925.7
500	356879436.6
1000	556482555.1
5000	1714015199
10000	2460847705
50000	2905936508
100000	2914825397
500000	2509936508
1000000	1903904762
3000000	2027555556



Discussion

1.2.1 Observation:

It's clear that regardless the medium, increasing the block size yields faster bytes/second writes. With smaller block sizes, fwrite needs to switch between CPU and I/O time more frequently than with a larger block size; a larger block size results in less runs, hence more efficient use of CPU and I/O time. It is also clear that increasing the block size plateaue's at a certain point, which is most likely because it's reaching the limit of the write speed on the devices tested (trying to flush more data than we can write).

It should also be noted that for 1MB and 3MB block sizes, the ssd was able to hit 1ms write time, which is the fastest possible, and would suggest against plateauing. The HDD on the other hand appears to cap out at near 3ms.

1.2.2 Optimal:

The maximum block size defined by the CPU instruction set would likely yield the optimal block size. This would yield more optimal I/O in lower layers because it would know exactly all it needs to write beforehand.

1.2.3 Mediums:

Both hard drive and solid state drives back the initial claim of increasing the block size yields faster bytes/second writes. It is also evident that SSD's are significantly faster than HDD across all block sizes.

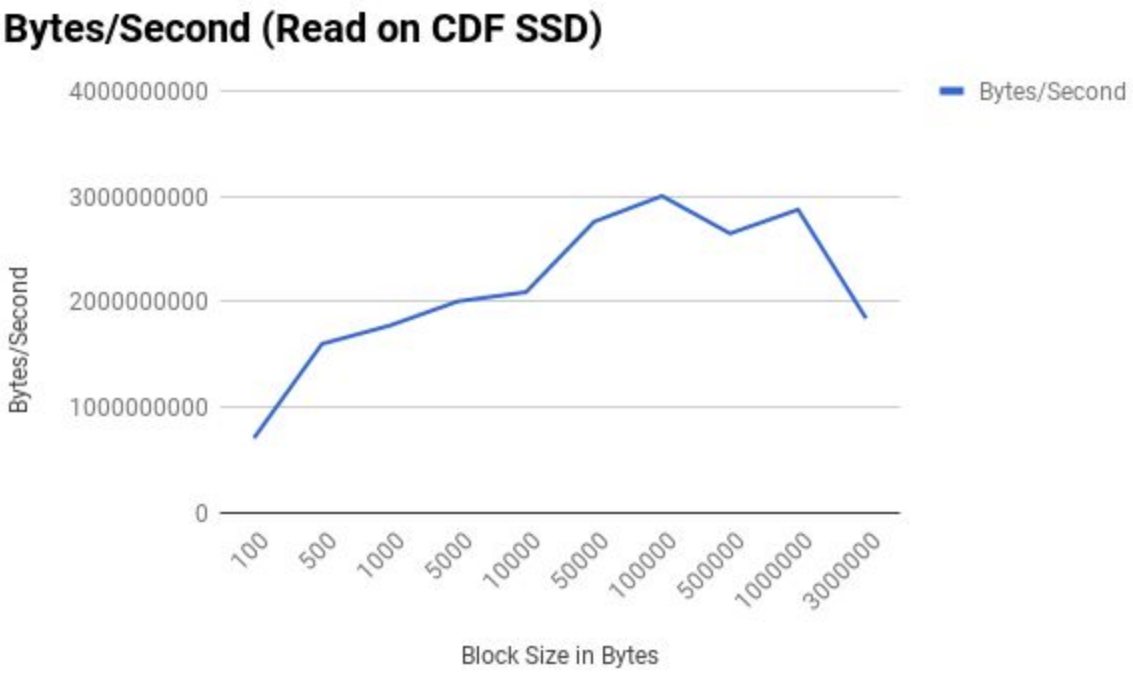
2.2. Experiments

Read Results on CDF SSD

Bytes/Second results and label are in Bytes.
All tests are conducted on 8MB files.
Each block size was repeated 100 times and averaged to get the Byte/Second result

Block Size in Bytes	Bytes/Second
100	711004653.8
500	1603064935
1000	1777454745
5000	2006958474
10000	2093698894
50000	2760557961
100000	3004542592

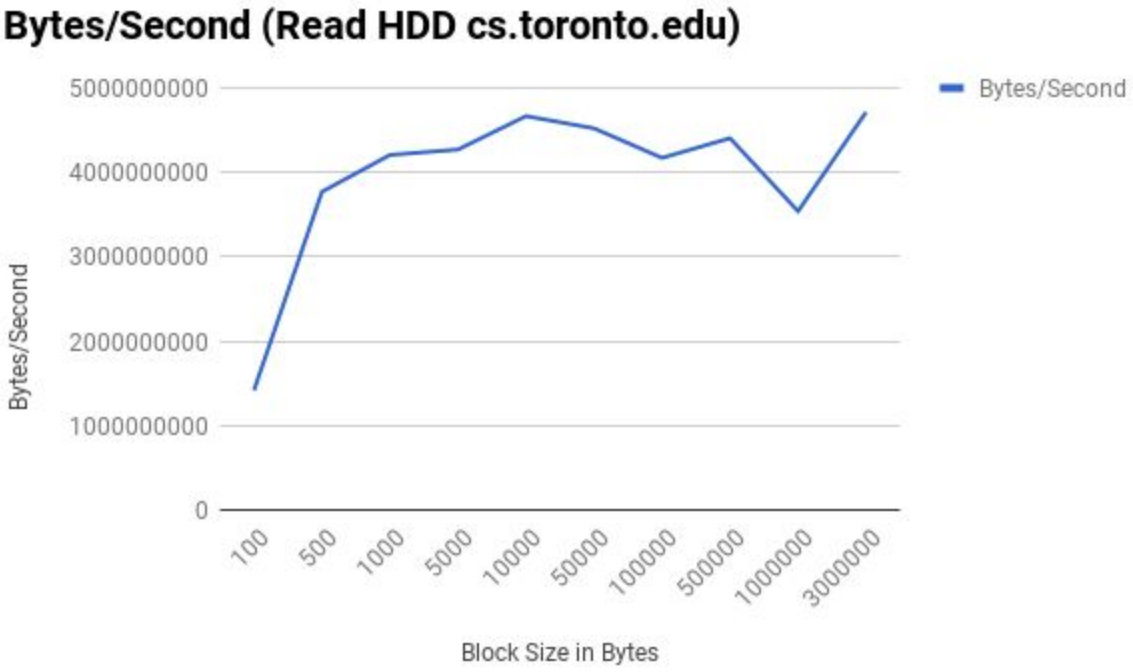
500000	2649451808
1000000	2875793651
3000000	1844761905



Read Results on HDD cs.toronto.edu
Bytes/Second results and label are in Bytes.
All tests are conducted on 8MB files.
Each block size was repeated 100 times and averaged to get the Byte/Second result

Block Size in Bytes	Bytes/Second
100	1418623800
500	3770550490
1000	4206535948
5000	4270393375
10000	4666666667
50000	4521518987
100000	4171535581
500000	4404909180
1000000	3539518900

3000000	4713804714



Discussion

2.2.1 Observation:

Similar to writes, as the block size increases, the bytes/second read speed also increases. It should be noted however that the HDD is a lot faster during the smaller block size stages (100 - 1000) when compared to the SSD. This can be due to the HDD being able to do a sequential read because the needle head of the disk would be at the start of the block. The SSD on the other hand has to deal with parallel allocation.

2.2.2 1) Optimal:

Similar to the explanation behind write, the maximum block size defined by the CPU instruction set would likely yield the optimal block size.

2.2.2 2) Write comparison:

It is clear that reads on the HDD are faster than writes on the HDD. This can be a manufacturer decision to have the reads be faster than the write. It is also the case normally that reads are faster than writes, because you theoretically have to wait for the write to finish writing to disk and the fflush function confirming completion of the write.

However, in the case of the SSD, the writes are faster than the reads. From reading up on fflush, when this function returns, we interpret it as completion of writing to disc. This is however not true, as depending on the system, this function returns earlier than expected and does not truly represent confirmation of being written to disc. This behaviour might be the

reason for why writes are faster than reads, since reads will only complete once our buffer is filled.

2.2.3 Mediums:

The difference in mediums can be seen from HDD having a faster read time during the smaller block stage, speculated by having the needle head being at the start of the block, and sequentially reading the data. All while the SSD has parallel reading.