Cluster I/O Performance On Large Data Files

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Specifications

- Using CMS3 files trimmed to 2GB
- Reads compared:
  1) local disk
  2) HDFS through FUSE
  3) HDFS through C API
  4) ram cache

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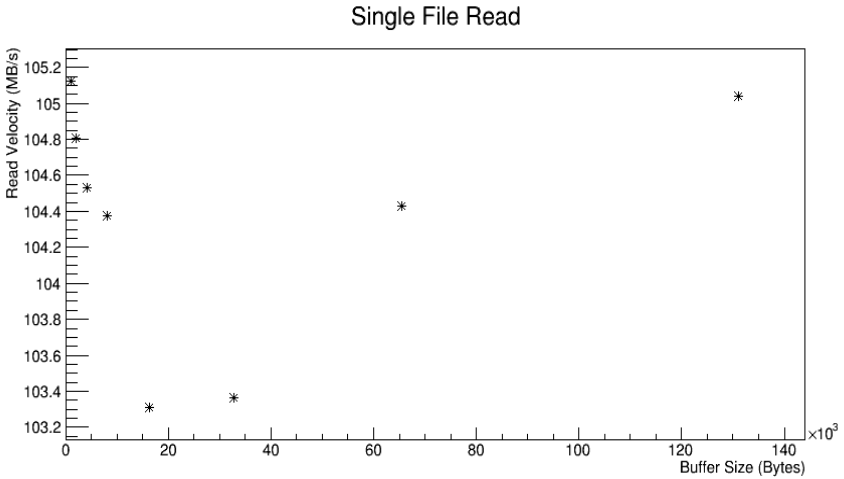
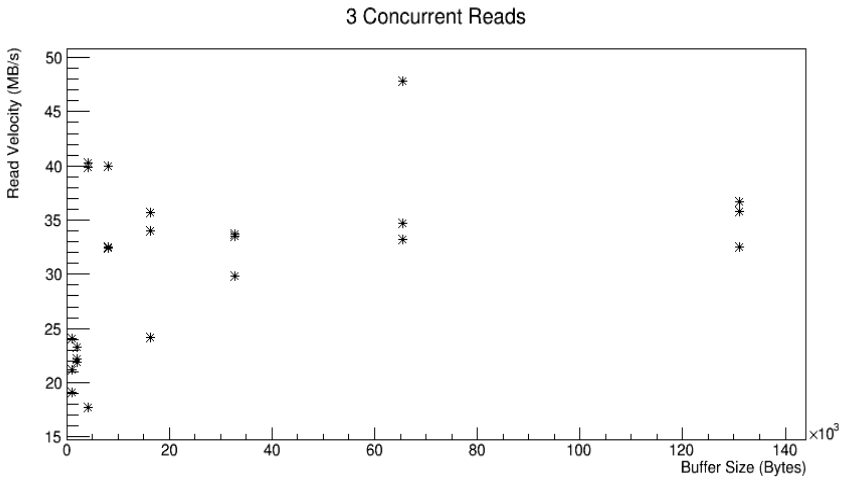
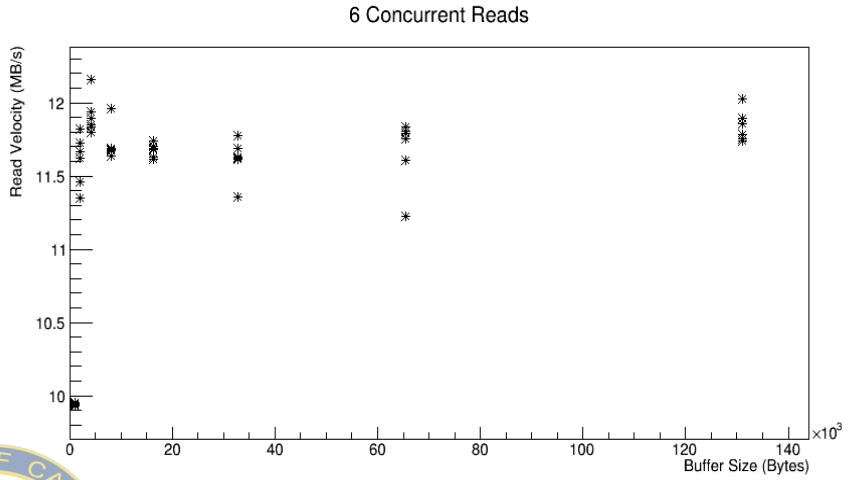
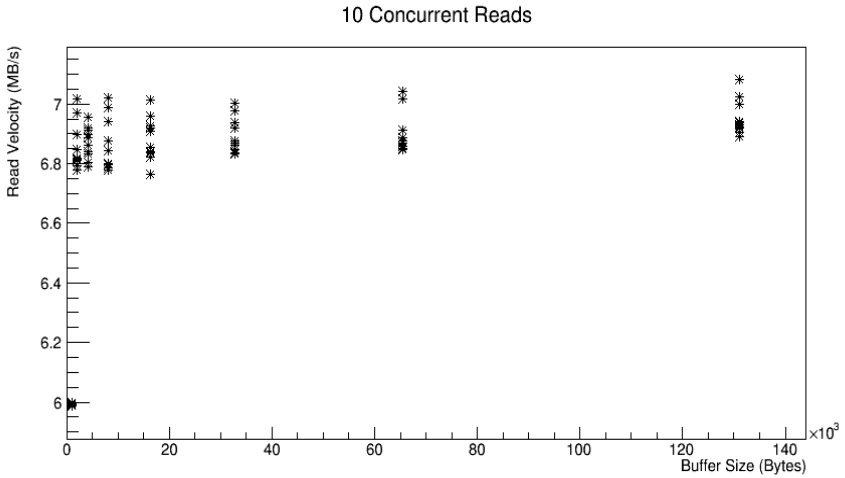
Local Disk Performance

Read From Local Disk, Cache Dropped









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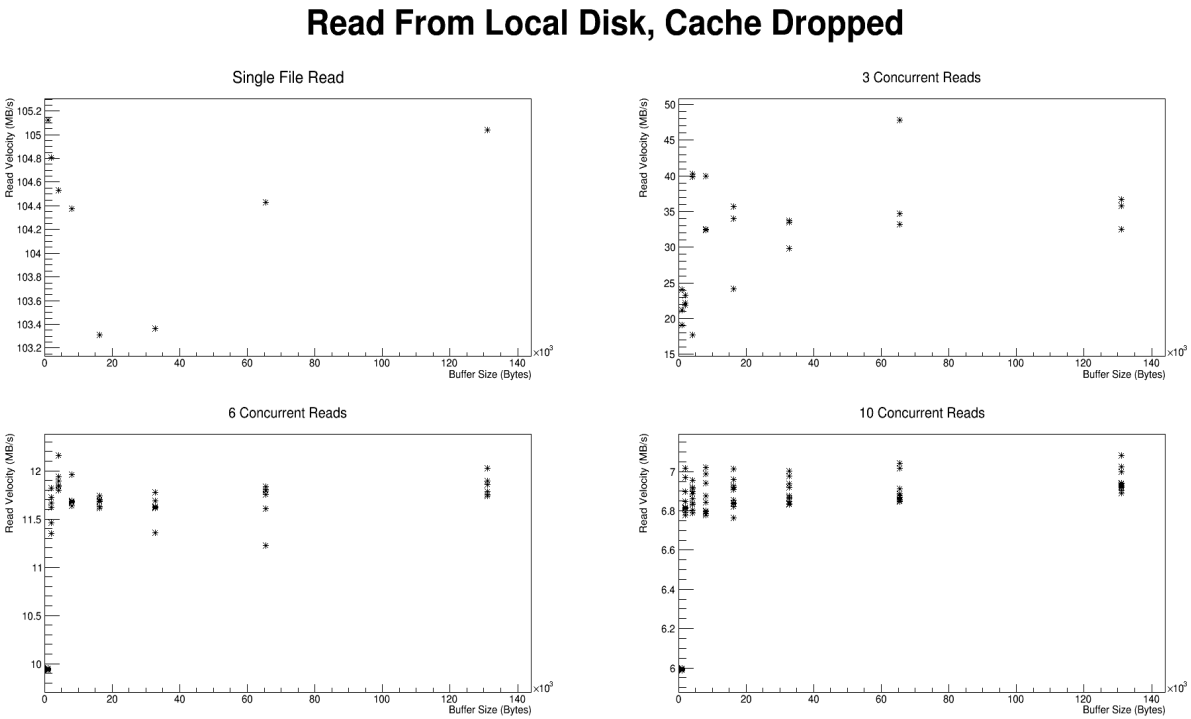
Local Disk Performance



1. No files being written to disk
2. Ram cache dropped after each read
3. Tested on UAF-4

Max Read Velocity ~ 100 MB/s from 1 or 3 files with large buffer size.
30% performance hit when reading from 10 files.

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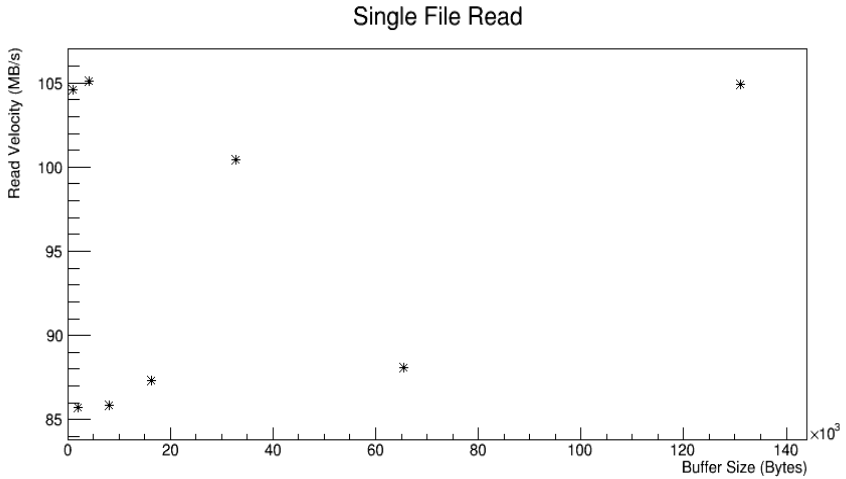
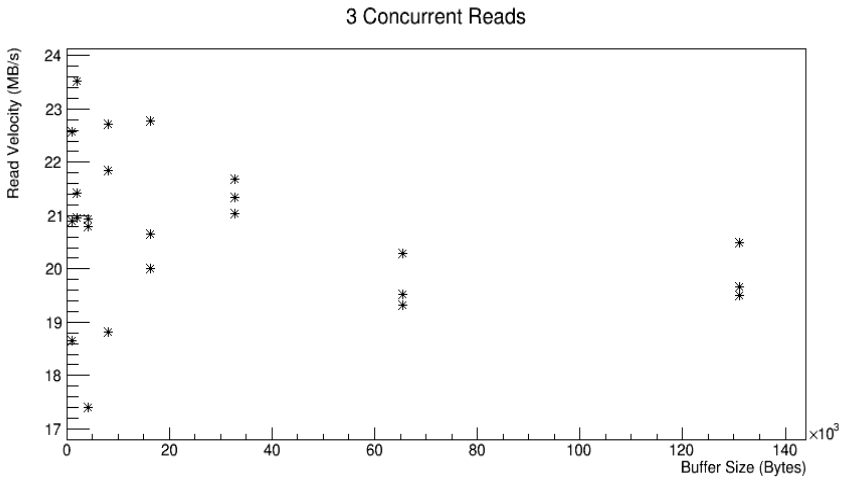
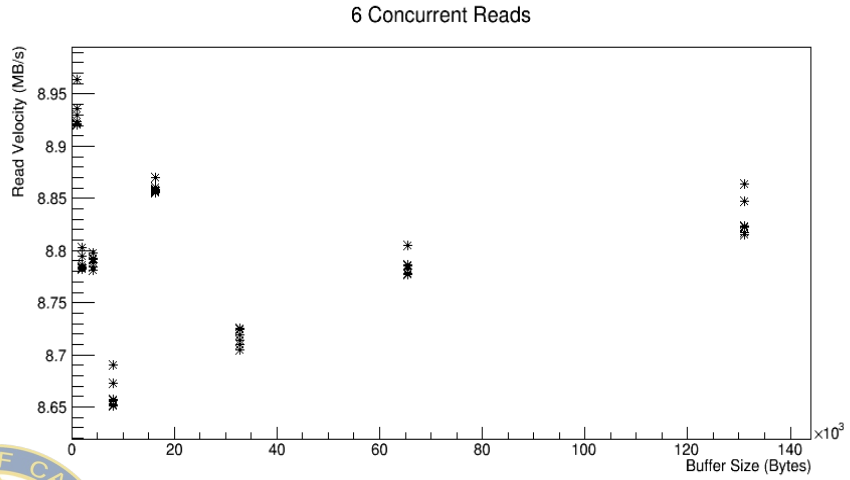
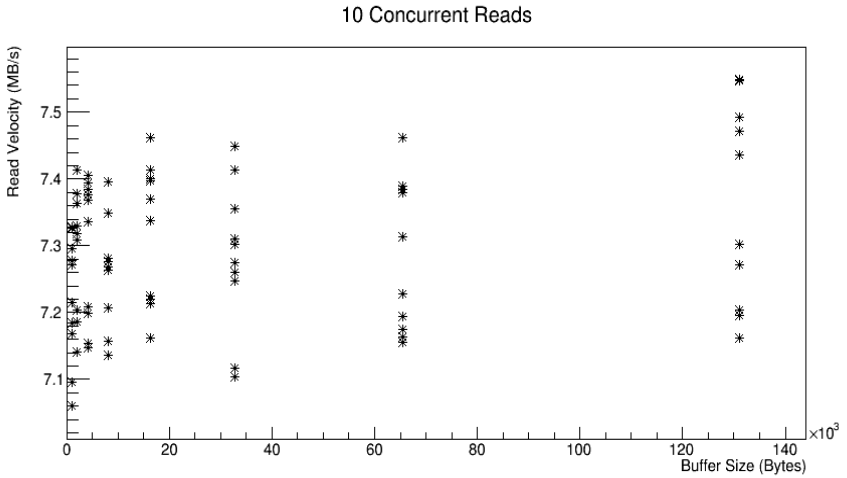
Local Disk Performance (with write)

Read Local Disk With ~10MBps Write, Cache Dropped









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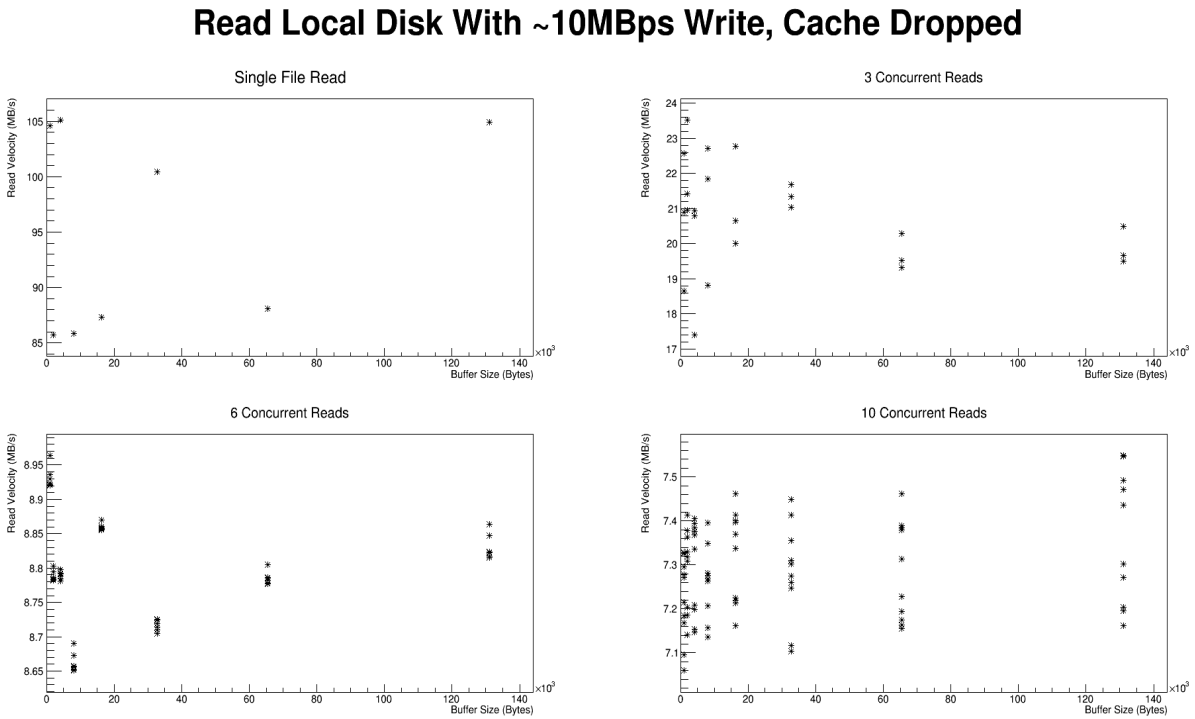
Local Disk Performance (with write)



1. No files being written to disk
2. Ram cache dropped after each read
3. Continuously writing ~10MB/s to disk
4. Tested on UAF-4

Max Read Velocity ~ 95 MB/s from 1 file, buffer size independent?
30% performance hit when reading from 10 files.

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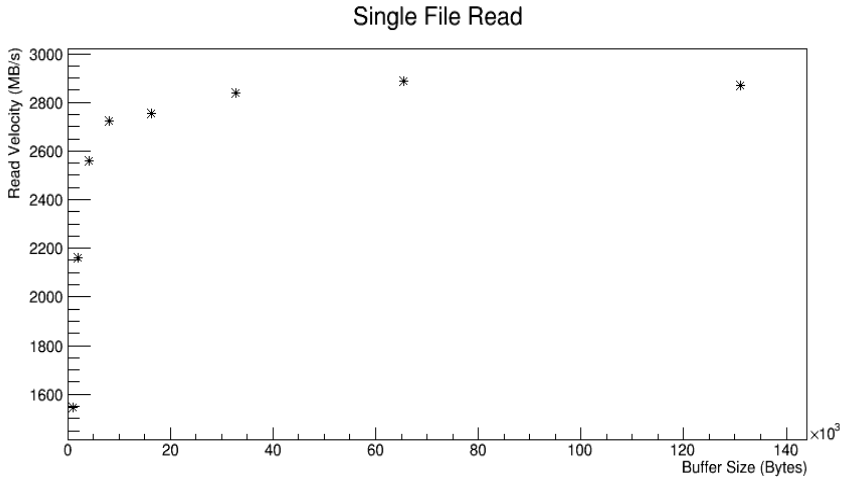
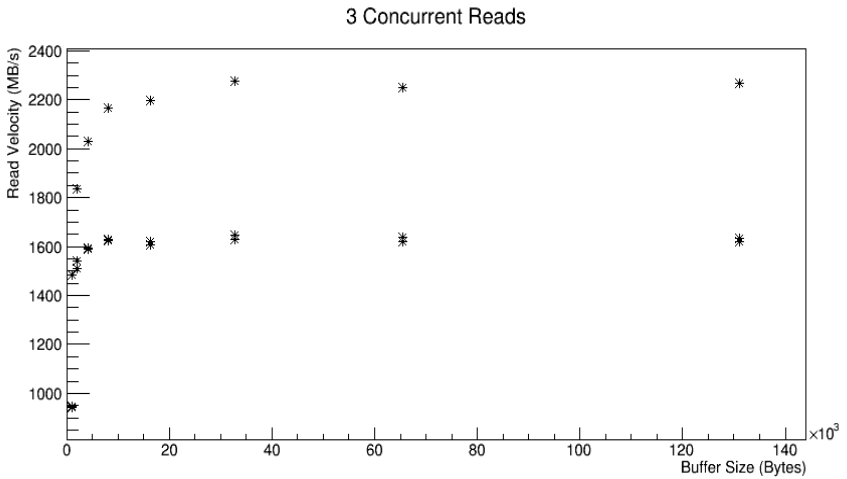
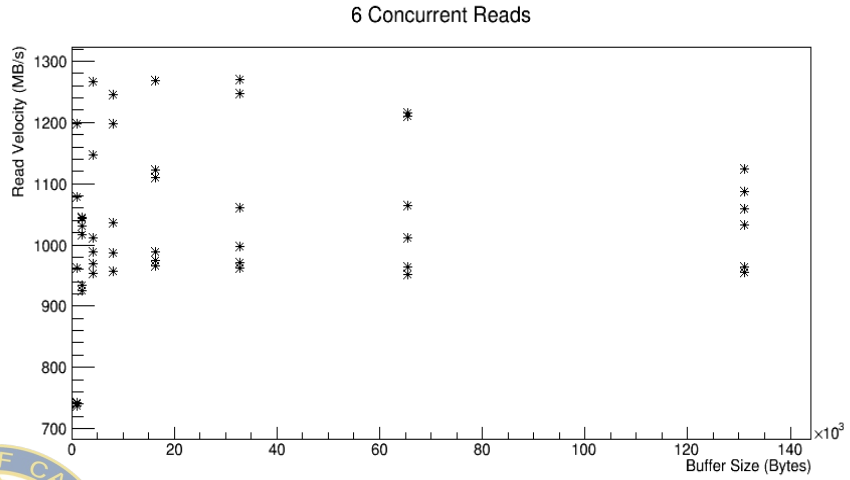
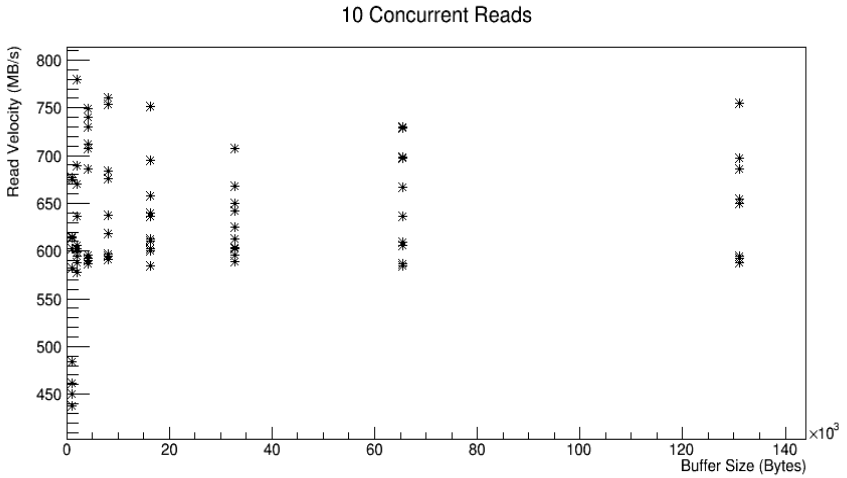
Ram Cache Performance

Read From Ram Cache









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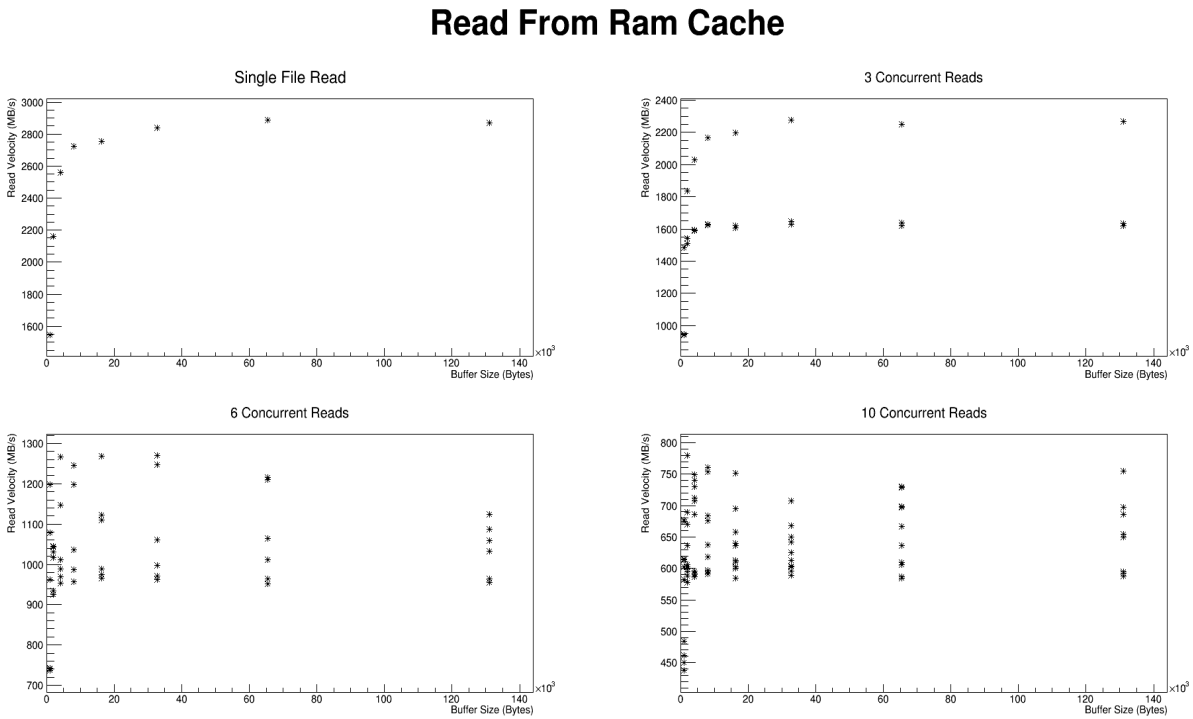
Ram Cache Performance



1. No files being written to disk
2. Tested on UAF-4

Max Read Velocity ~ 6 GB/s from 3, 6, or 10 files independent of buffer size. 50% performance hit when reading from 1 file.

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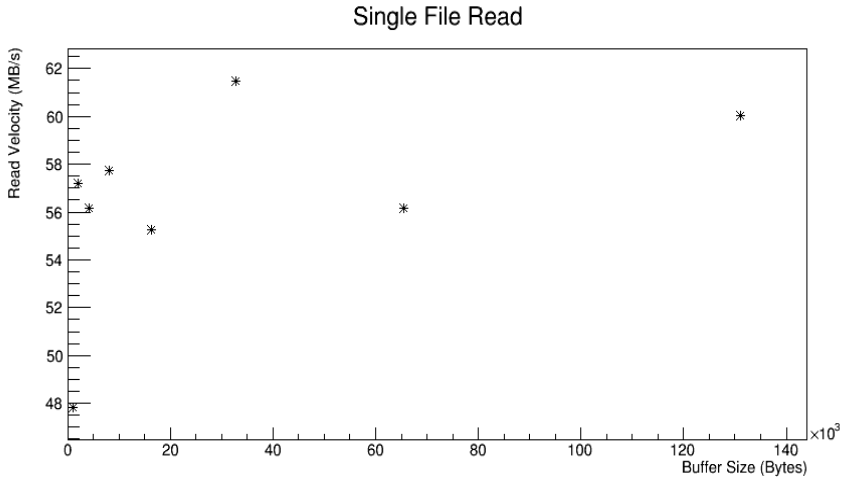
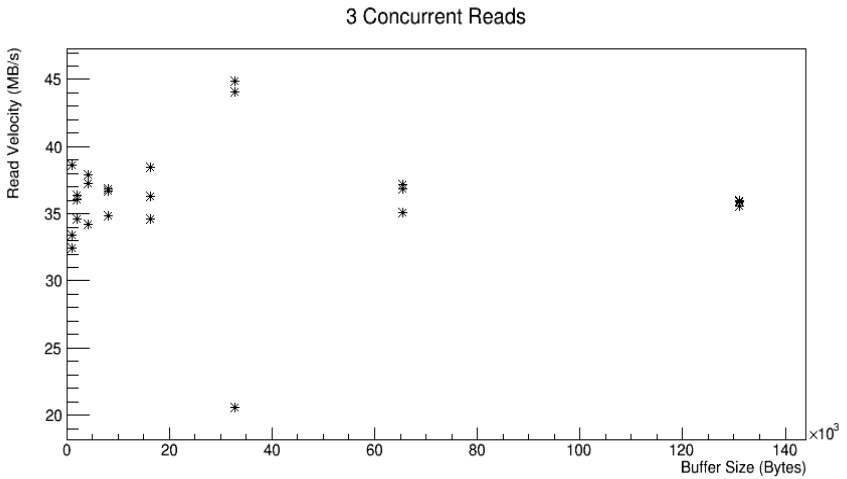
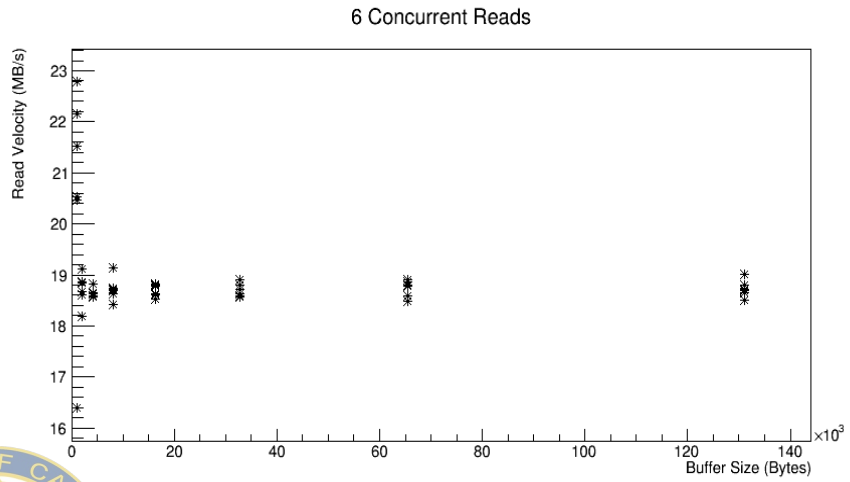
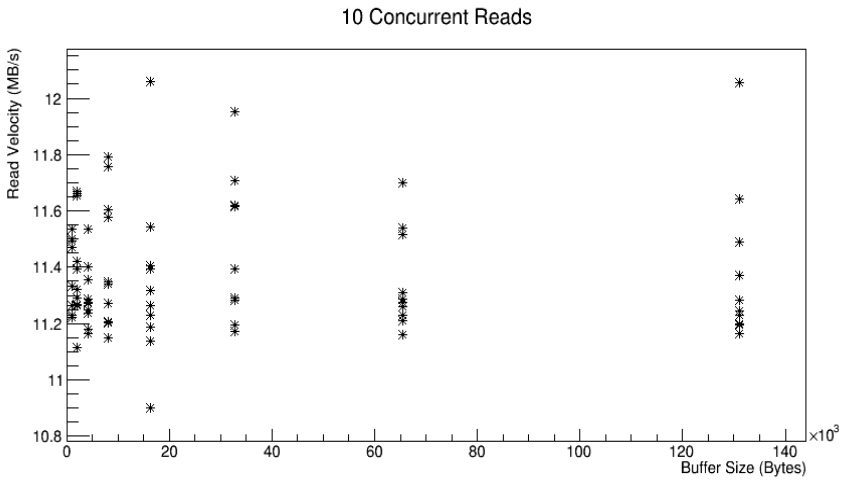
HDFS Performance (FUSE)

HDFS Through FUSE









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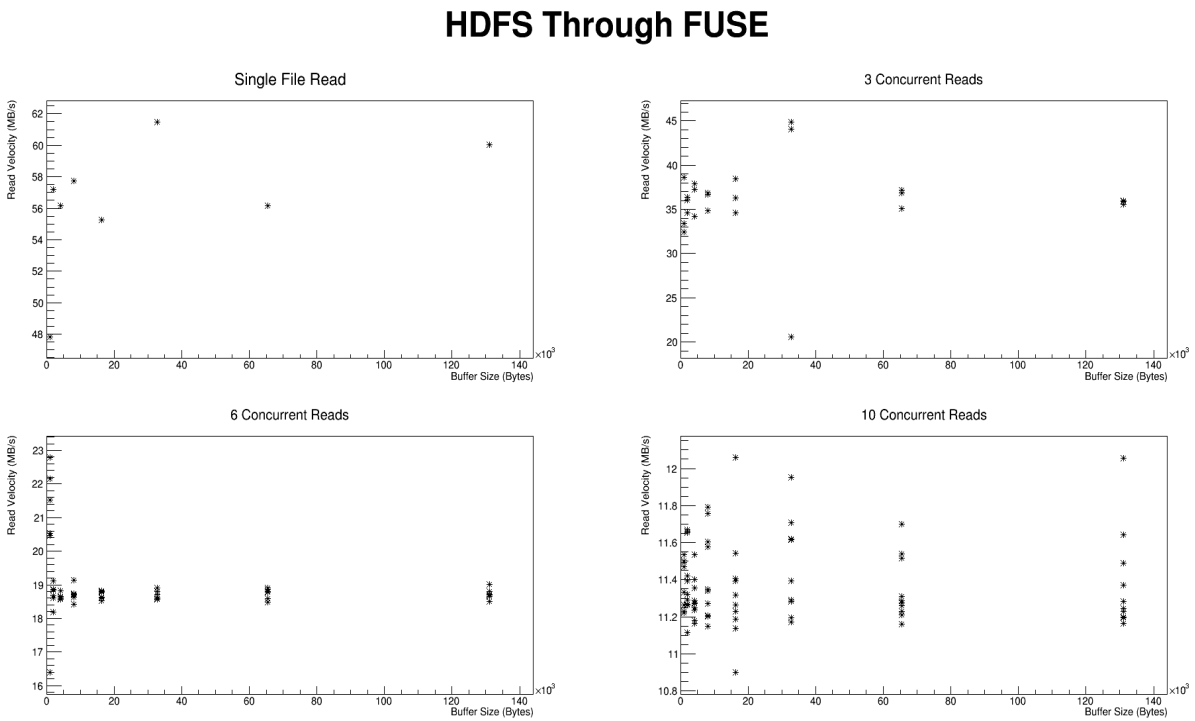
HDFS Performance (FUSE)



1. No files being written to disk
2. No attempt to drop ram cache
3. HDFS mounted through FUSE
4. Tested on UAF-4

Reproduces conditions for current babymaking procedure.

Max Read Velocity ~ 115 MB/s from 6 to 10 files with large buffer size.
50% performance hit when reading from 1 file.

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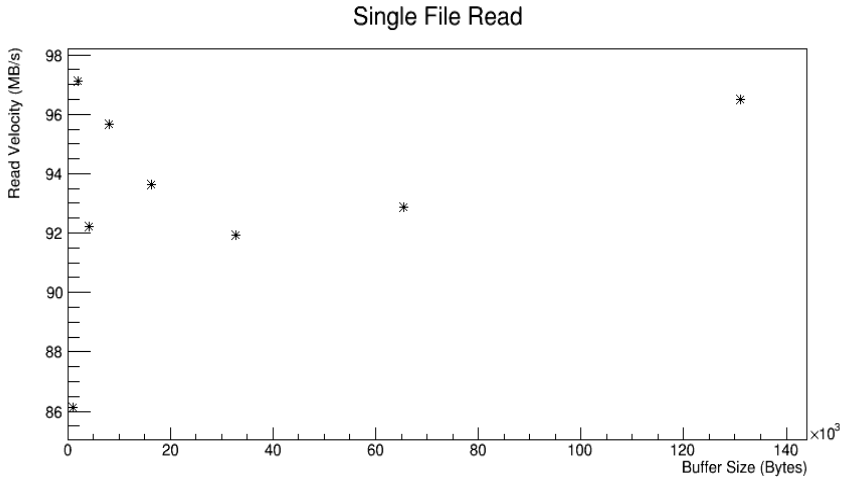
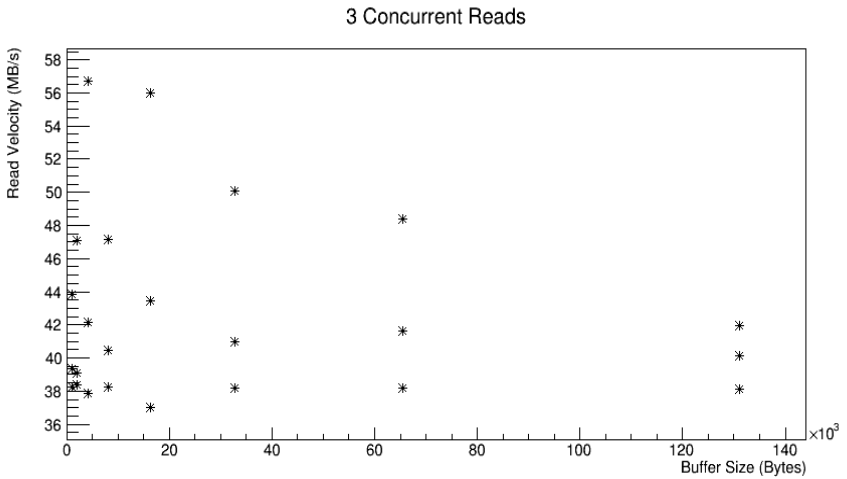
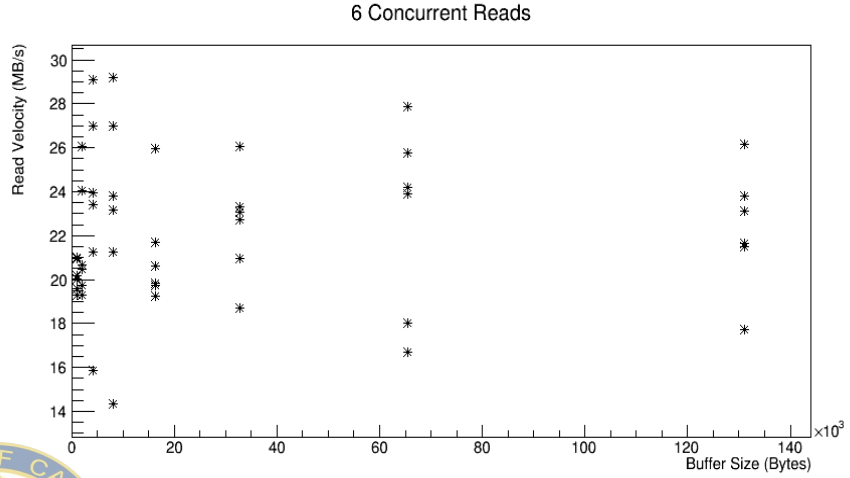
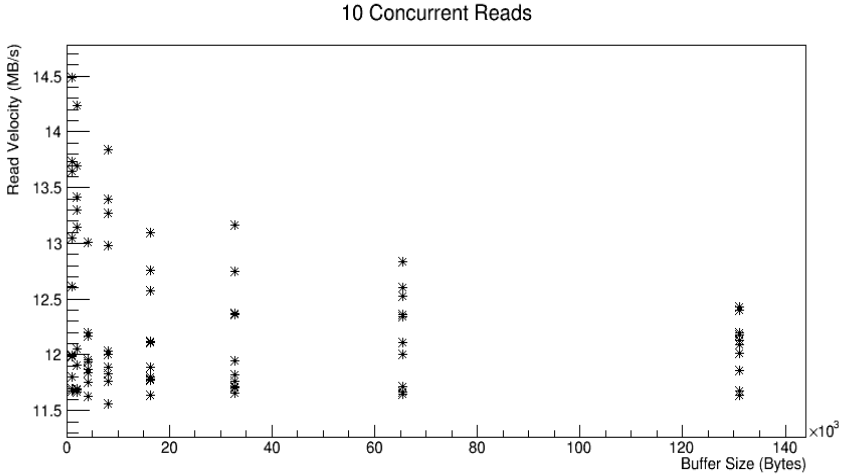
HDFS Performance (C API)

HDFS C API









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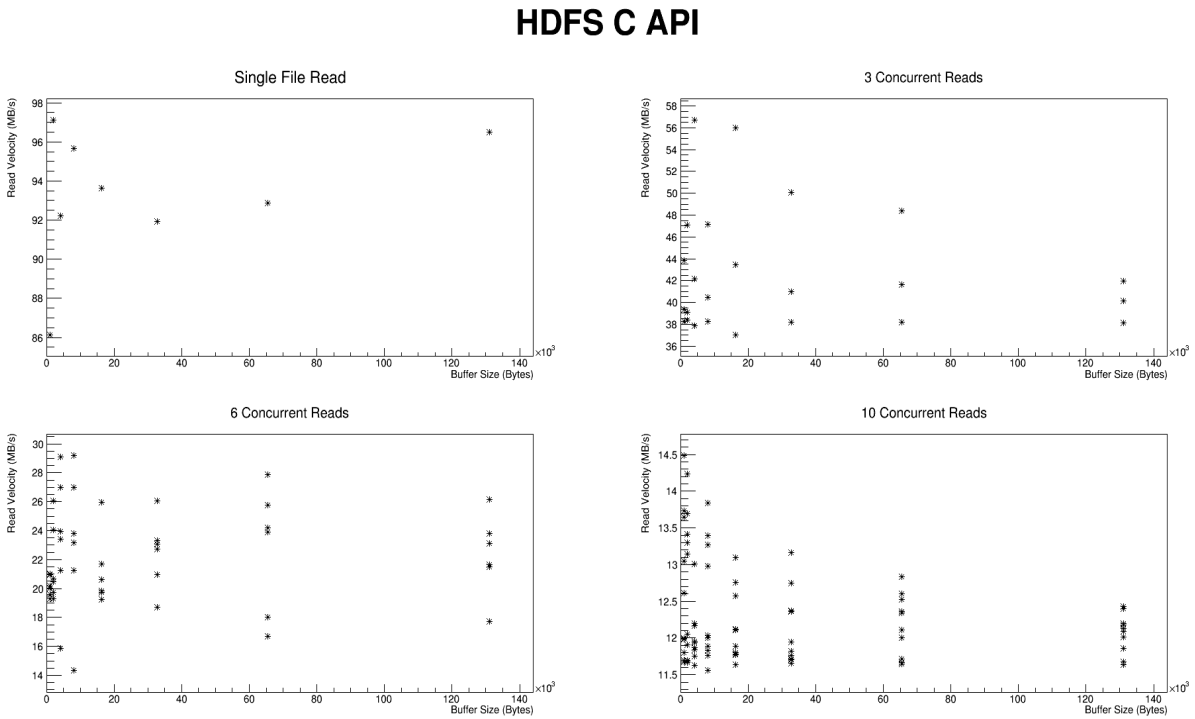
HDFS Performance (C API)



1. No files being written to disk
2. No attempt to drop ram cache
3. HDFS accessed through C API
4. Tested on UAF-4

Reproduces conditions for current babymaking procedure.

Max Read Velocity ~ 130 MB/s from 6 to 10 files with small buffer size.
25% performance hit when reading from 1 file.

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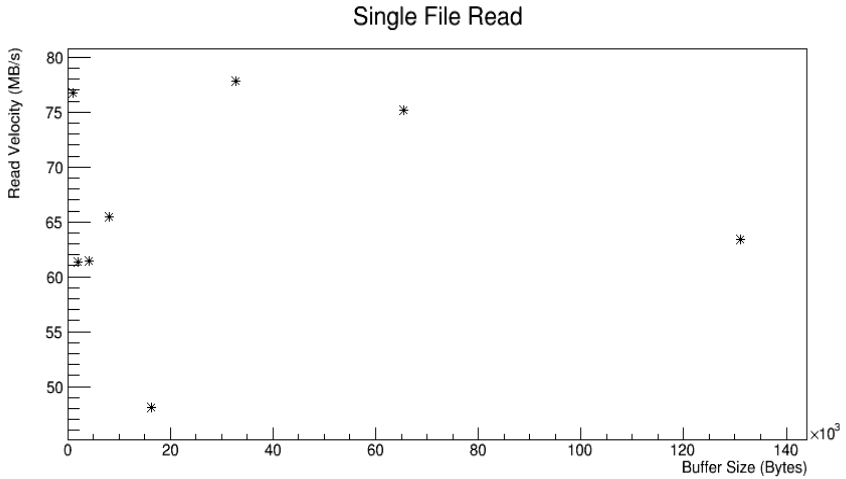
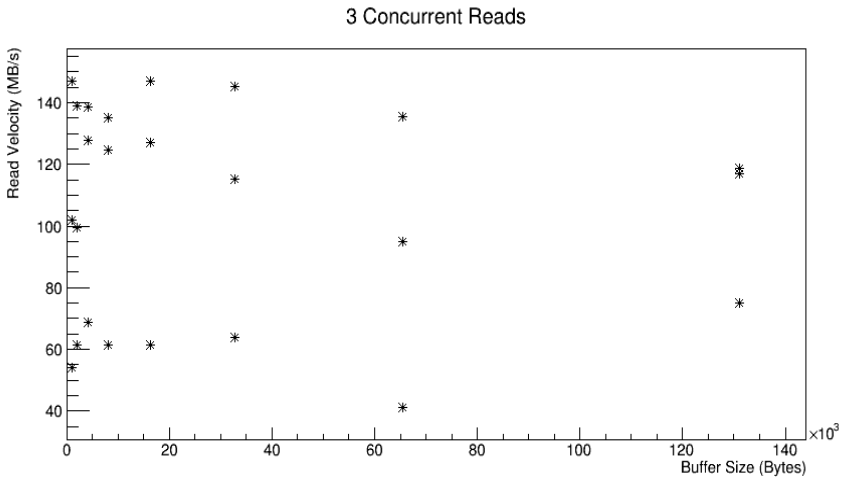
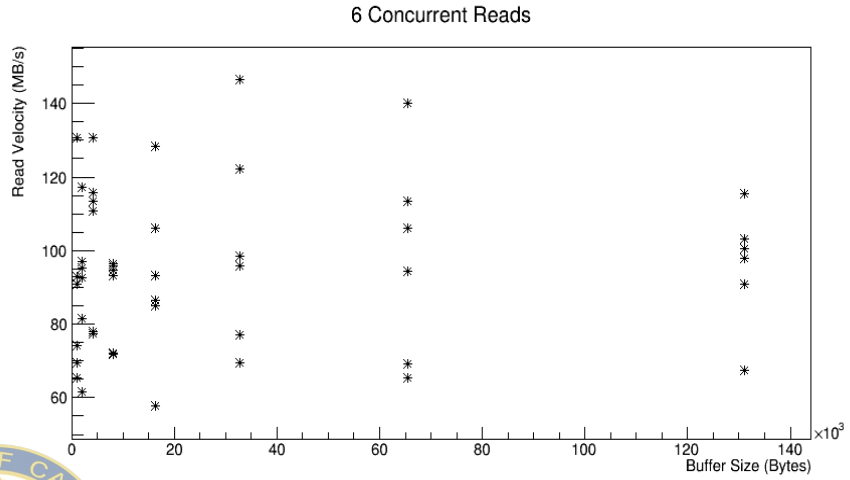
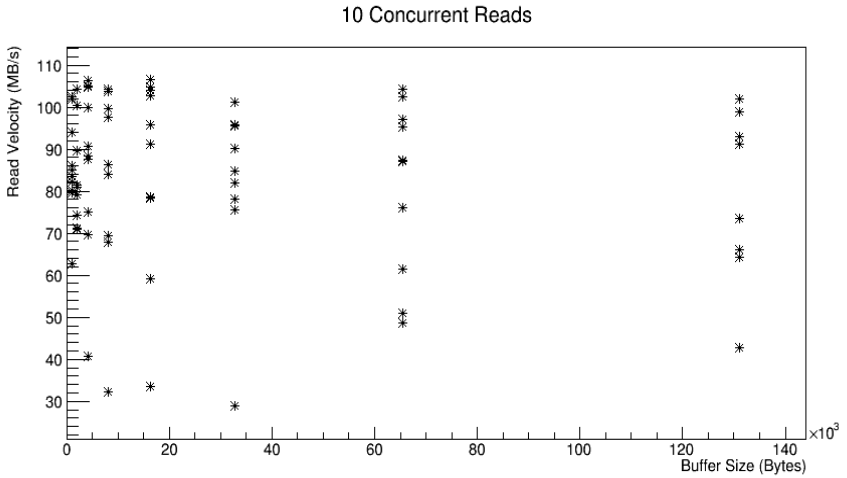
Local Disk Per File

Disk Per File, Cache Dropped, cabinet-8-8-0









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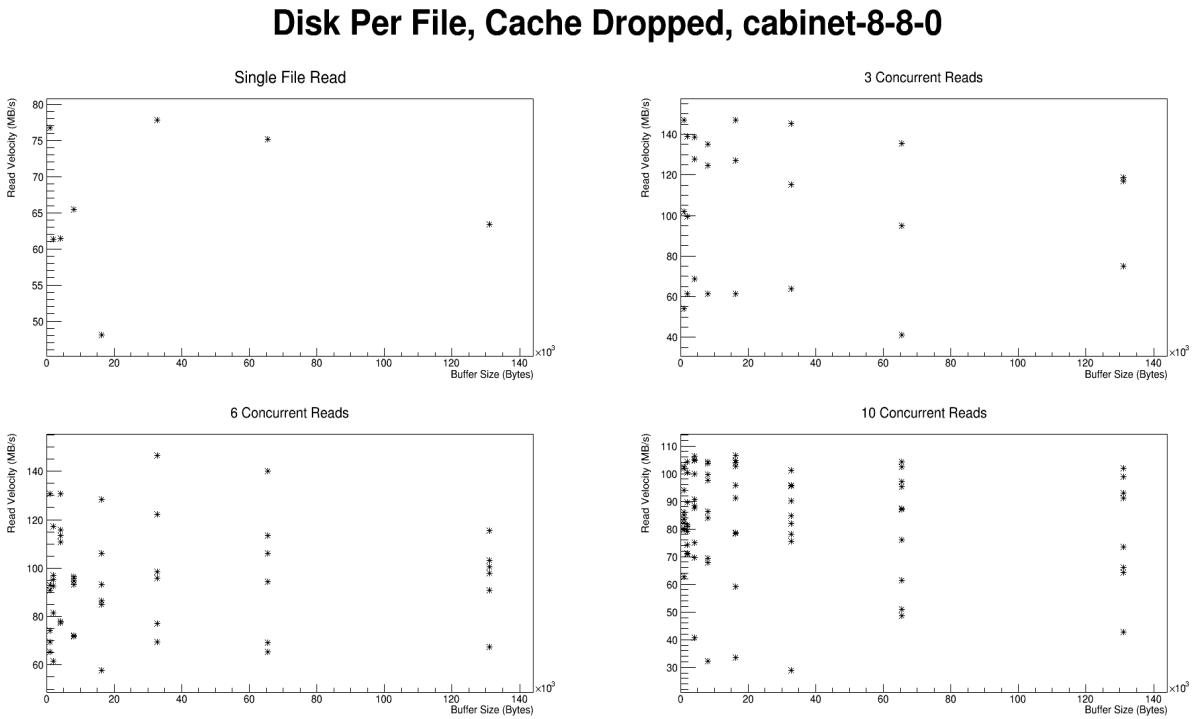
Local Disk Per File



1. No files being written to disk
2. Cache cleared
3. Tested on cabinet-8-8-0 under full load (~24 jobs)

Reproduces conditions for proposed babymaking procedure.

Max Read Velocity ~ 800 MB/s from 10 files, buffer size dependence unclear.

~5x niave improvement over HDFS C API best case(no cache clearing) vs LDPF worst case on 10 file reads.

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Next Steps

1)Take HDFS reads when the cache has been dropped?
2)Convert babymaking code to read from local disk

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Conclusions

1) HDFS read is network limited near 120 MB/s which is approximately equal to the performance of a single drive.
2) By storing files in a careful ordered maner across disks, file I/O could be niavely sped up by at least half an order of magnitude.

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