Fast MapReduce over Apache HBase

or How to Stop Worrying and Run MapReduce Directly Against Your HFiles

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Agenda

1. Introduction/Motivation
2. Design
3. Operation

What is HBase

- Hadoop's stock key value store.

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- Because of low-latency writes, files are not typed by column.
- HBase is "garbage collected" and online-transformative.

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- HBase allows you to control your own destiny.
- Interface is always bytes.
- Lots of control. No mandatory schemas or serialization of data types.

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- Three interfering use cases: read, write, and batch.
- Running MapReduce over an HBase table will destroy your read performance. The scanners that the MapReduce job employs flood the block cache with data that does not reflect your random read access patterns. Also, be prepared to deal with thrashing as your HBase table is probably quite large and none of it will be read twice, so none of this cache management is beneficial.

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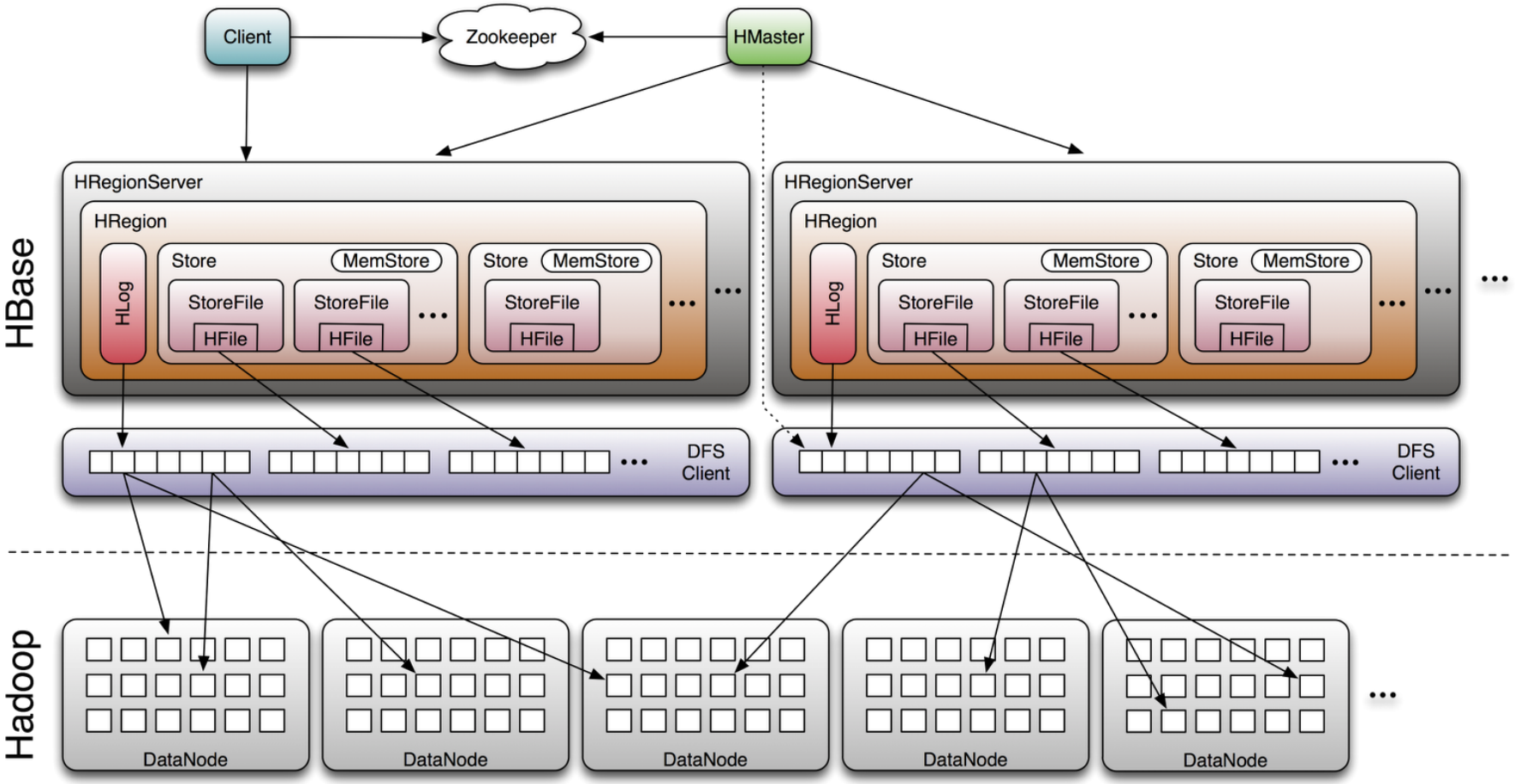
- What is happening with a typical Scan?

Architecture of an HBase Scan [4]



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- Each map task uses the client API to scan over the Results in the HBase table. The primary advantage over typical use is merely concurrent scans allowing parallelism. The overhead of the client server architecture is offset by a large amount of buffering to reduce the impact of Remote Procedure calls, but it is far from the mark of a direct file-system access even if the data is local to the MapReduce task.

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- An InputFormat that allows direct, read-only subscription to the StoreFiles for an HBase Table.
- Through some conversation with the HBase committers, especially St. Ack, we were told
  1. We were crazy for thinking of this.
  2. More direct data access is something that's been requested before.
  3. We might have a viable approach by spinning up our own Region objects and using those to gain access to the underlying HFiles.
- There are a few contraindications to the approach that we will discuss later.

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- Back to online-transformation again. Tombstone markers handle with reverse-timestamp sorting.

Anatomy of an HFile [1, 2]

A Typical HFile	
1	Data Block 0
2	Data Block 1
3	Meta Block
4	File Info
5	Data Block Index
6	Meta Block Index
7	Trailer

A Typical DataBlock	
1	Data Block Magic
2	Key Length
3	Value Length
4	Key
5	Value
6	Key Length
7	Value Length
8	Key
9	Value
10	...

Implementation

- Here at Explorys, we implemented this proposed InputFormat to be used as a plug and play replacement for TableInputFormat.
- Almost...
- The code is hosted on github at https://github.com/ExplorysMedical/Apothecary
- Problems? Compaction and Region Splitting. Memstore access. Why?

Dealing with HBase Data Administration

1. Turn off data source or funnel into temporary storage.
2. Trigger flush and compaction.
3. Wait for flush and compaction to finish. All the data is on disk.
4. Create a log of the existing storefiles.
5. Run the MapReduce Job
6. Check the log to see that the state of the table didn't change (region splits or compaction).
7. Possible do-over.

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- Hard links?

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	TableInputFormat	HFiles
Copying a Table	5:06	0:26
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- Indexing Job run with 800 input splits, about 300 concurrent mappers.
- Copy Job run with 800 input splits, 95 concurrent Mappers.
- Significantly less cluster resources allocated to HBase on Copy Job.

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- Better over large tables where cache doesn't have an impact.
- Worth the operation overhead in some circumstances.
- Major motivation for hard links and/or table snapshotting.

Problems

- Serious memory usage. HFile block indexes can be quite large, although needn't be loaded in full since HBase 0.92 [3]
- Operational constraints unwieldy. HBase Administration is asynchronous, doesn't return monitoring object.
- Tenuous relationship with non-exposed API. No guarantees that upgrades won't break it.
- Not tested with filesystems other than HDFS.
- Aside from compaction rearranging files, Memstore is not included. We could possibly read WAL and construct our own memstore if compaction problem is solved.

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