



Project report: Entry Points for DXRAM in Hadoop & HBase

To Get or To Become a Part of the Hadoop Tart

Jochen Peters

Department of Computer Science
Heinrich-Heine-University Düsseldorf, Germany

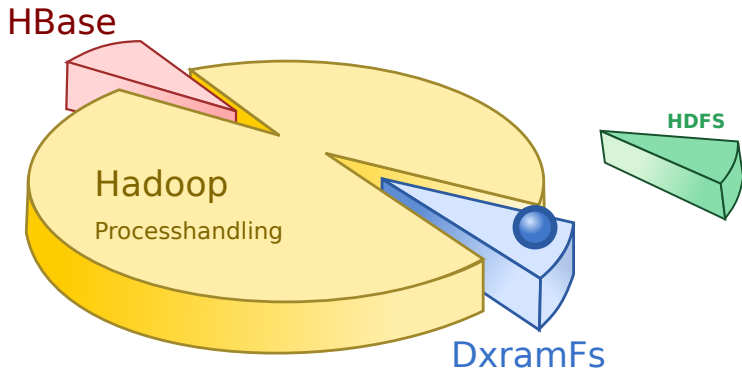
12. Dezember 2018

Contents

- Motivation
- Other Hadoop friendly RAM stores
- Approaches
- Implementation
- Conclusion



To Get or To Become a Part of the Hadoop Tart





DXRAM usage

- join to other popular Distrubuted Systems
- DXRAM as alternative storage system
- enlarge DXRAM popularity



Idea: become a part of a popular project

- Hadoop
- HBase

Big Vision: remove HDFS access in HBase by DXRAM





Hadoop





Excursion Hadoop

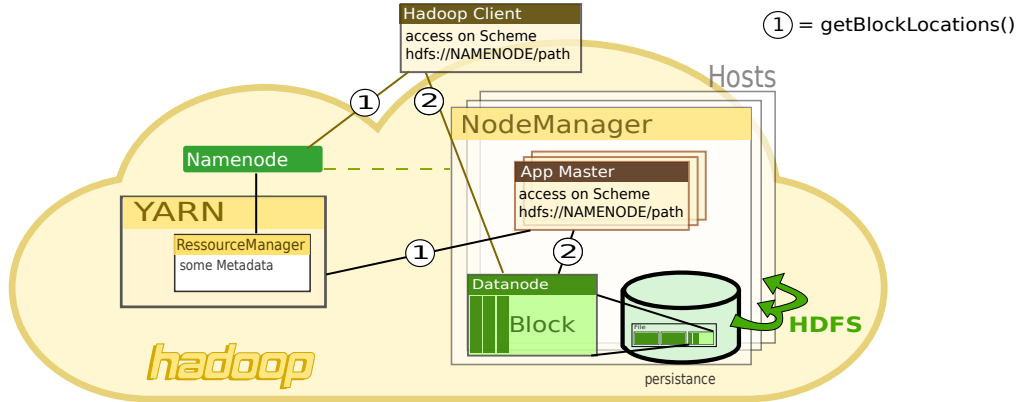
- starts with HDFS: split big files into big blocks
- a block maybe replicated
- Namenode: stores Blocklocations and infrastructure info
- MapReduce: split *Job* into *Tasks* on blocks
- becomes more and more a process handling “ecosystem” (YARN)

Run Task where data block is stored.





Excursion Hadoop - Sketch



Hbase





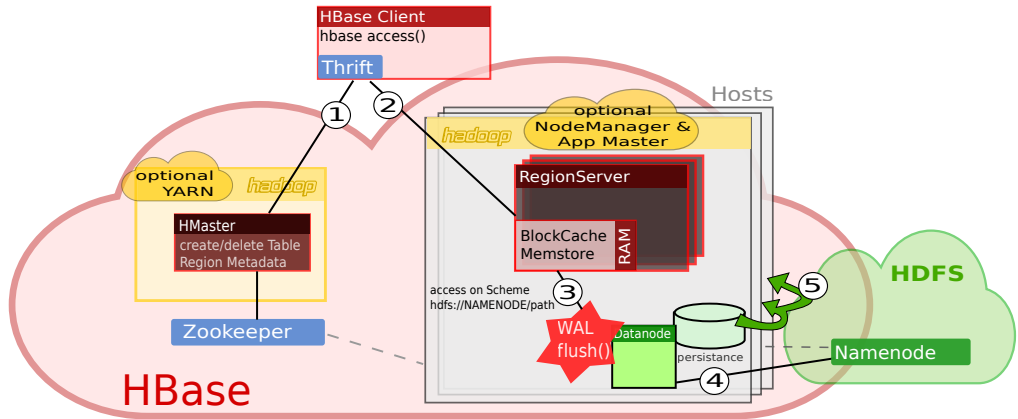
Excursion HBase

- noSQL with BASE and not ACID (SQL)
- store in RAM, but a WAL for persistence
- HDFS for WAL and flushes
- hard to balance (optimal for read OR write)
- each node has some RegionServer (handle key region for each column family)





Exkurs HBase - Sketch



HBase and DXRAM ?





HBase and DXRAM

- HBase uses MemStore & BlockCache (RAM)
- WAL: does an ACK after writing change to HDFS
- big focus on persistence and data compaction
- NoSQL: waiting for hard disk on writing? any benefit to normal SQL?

Why not using DXRAM as distributed RAM instead of harddisk, WAL and compaction processes?





Other Hadoop friendly RAM stores

Distributed Memory and Hadoop + HBase:
How does other projects handle this?





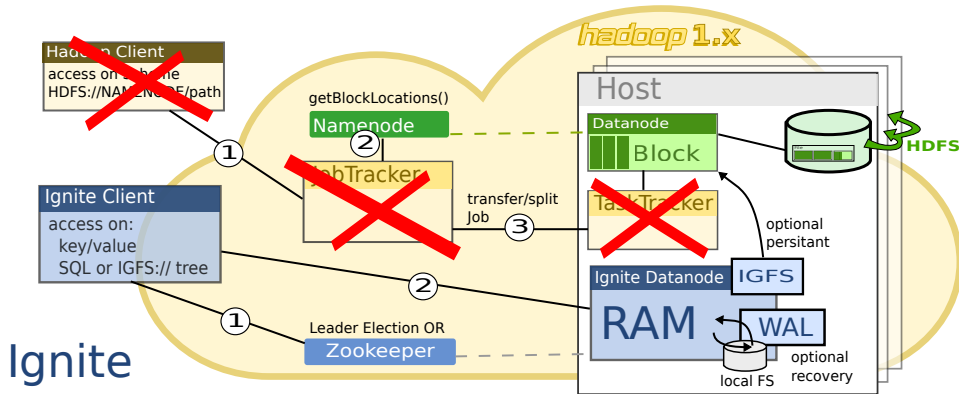
Other Hadoop friendly RAM stores

Ignite:

- distributed key-value storage
- has an optional SQL engine
- sees itself as a competition to HBase
- optional WAL for recovery: local FS
- has a Hadoop FS Connector `igfs://`
- optional `igfs` persistence: `hdfs://`



Ignite - Grafik





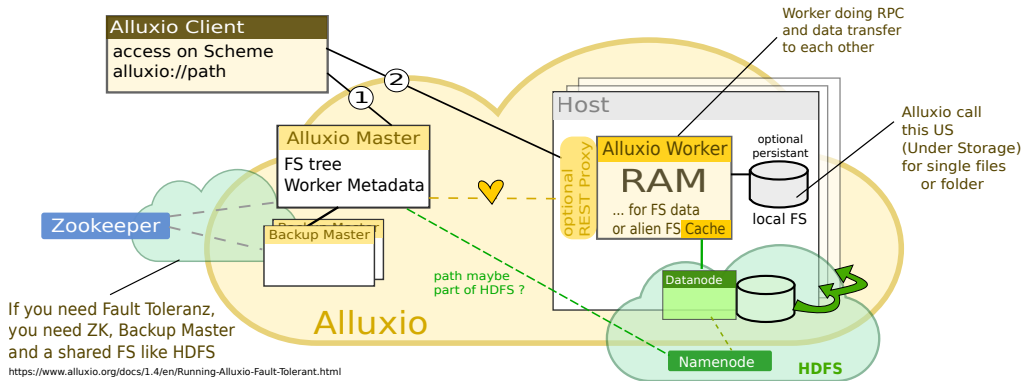
Other Hadoop friendly RAM stores

Alluxio:

- Code looks like a Hadoop „Branch“
- instead of Hadoop Scheme: mount into `alluxio://tree`
- can work as a distributed FS cache
- persistence is an optional FS feature
 - Under Storage: local FS
- has a Hadoop FS Connector
- FS Connector usable in HBase, too



Alluxio - Grafik

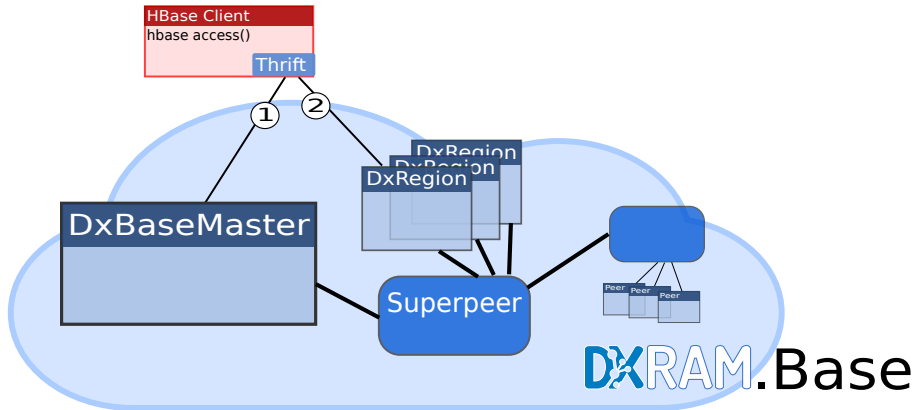


Solutions to use DXRAM in Hadoop and HBase



I: DXRAM.Base

HBase Replacement based on the Thrift IDL for HBase Clients



Pro

- maximal freedom to implement this
- maybe the most efficient way
- Hadoop independent



Contra

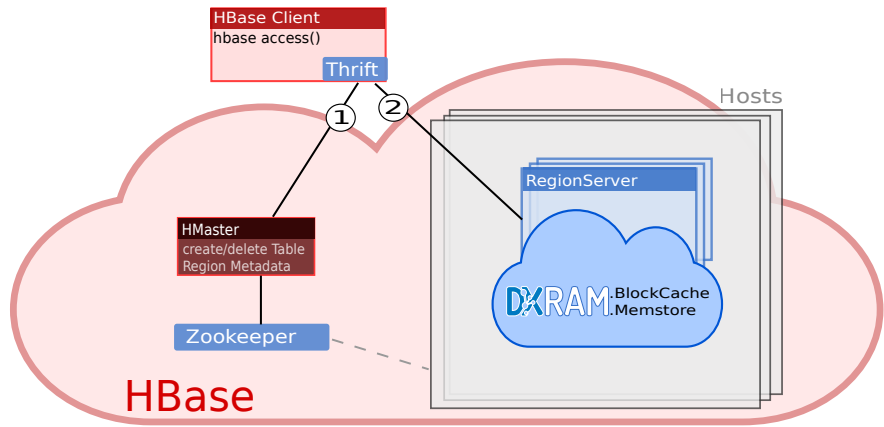
- unclear how HBase and the Hadoop community react to it
- the community may not want renounce Hadoop
- other Hadoop projects have low benefit from it





II: RegionServer Mod

RegionServer RAM access modified with DXRAM stuff.





II: RegionServer Mod

Pro

- optimized for HBase
- Hadoop independent
- maybe better compatibility than a complete HBase replacement





II: RegionServer Mod

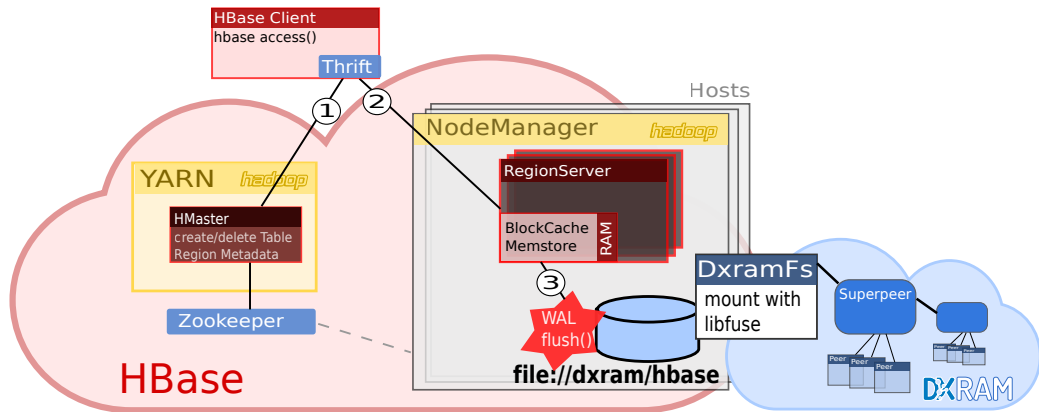
Contra

- deep know-how about code and HBase procedures necessary
- HBase Updates got in trouble
- other Hadoop projects have low benefit from it



III: Mounting DXRAM

Mount DXRAM as RAM-Drive with libfuse





III: Mounting DXRAM

Pro

- No HBase or Hadoop code have to been changed or added
- effect on all projects, using local FS for persistance and recovery





III: Mounting DXRAM

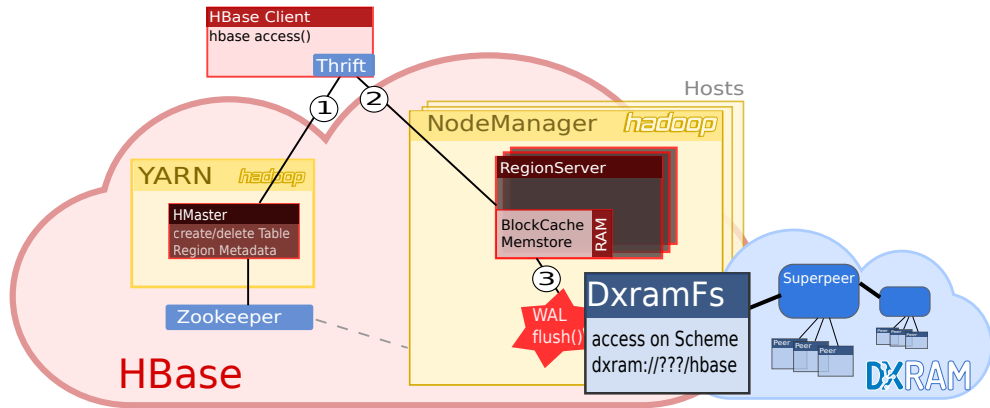
Contra

- Hadoop loses information about block locations. Host based Task splitting impossible
- Performance leaks with `libfuse`
- a bit complicated: build a NFS like filesystem with distributed block location



IV: DXRAM FS Connector

Like Ignite and Alluxio: build a DXRAM FS Connector.





IV: DXRAM FS Connector

Pro

- Modular addable to HBase and Hadoop
- benefit for all Hadoop projects without modifications
- Hadoops Host based Task splitting is possible





IV: DXRAM FS Connector

Contra

Big Milestones:

- build a FS based on DXRAM
- make FS similar to the block based HDFS
- transport data from DXRAM Application to an alien like Hadoop



The choice fell on the DXRAM FS Connector, because it offers the widest range of uses.

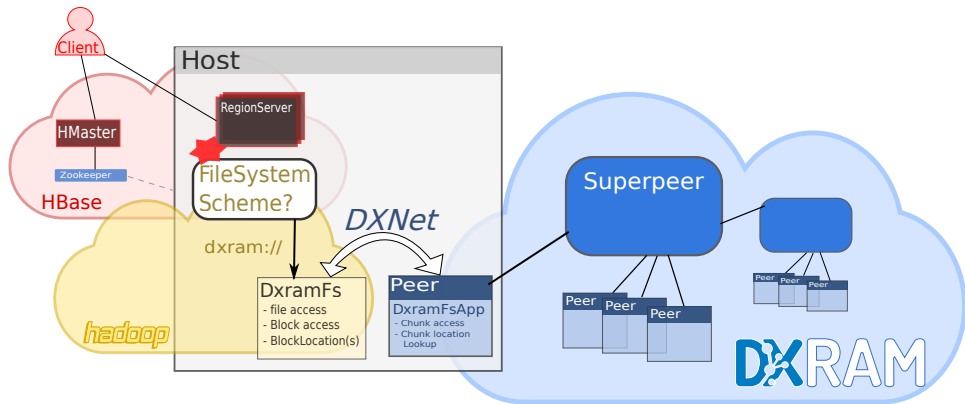


Implementation

- DxramFs App: Chunks are similar to blocks
- DXNET: RPC and data transport
- DxramFs Connector: Hadoop uses DXNET
- DXRAM not part of HBase or Hadoop



Implementation - Sketch



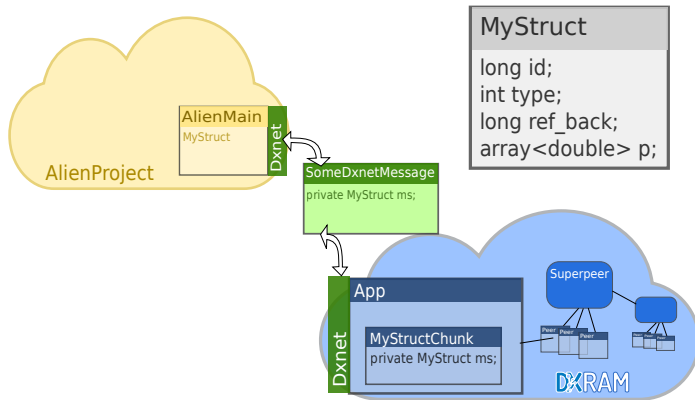
Implementation :-(

Project failed primarily because of debugging effort in serializing pure attribute classes.





Implementation: Fail 1



MyStruct

```
long id;  
int type;  
long ref_back;  
array<double> p;
```

Open questions:

- initial & maximal size
- initial values
- fill with new array length
- when to do NEW ?
(read/write payload)
- Java Heap slowdown
with to many copies?

=> get/set each single
attribute is ugly

=> Bytearray and JSON?

Abbildung: without wrapper or preprocessing



Implementation: Fail 1

- initial values, different size with new data
- a IDL like Apache Thrift would be nice





DXRAM feature request

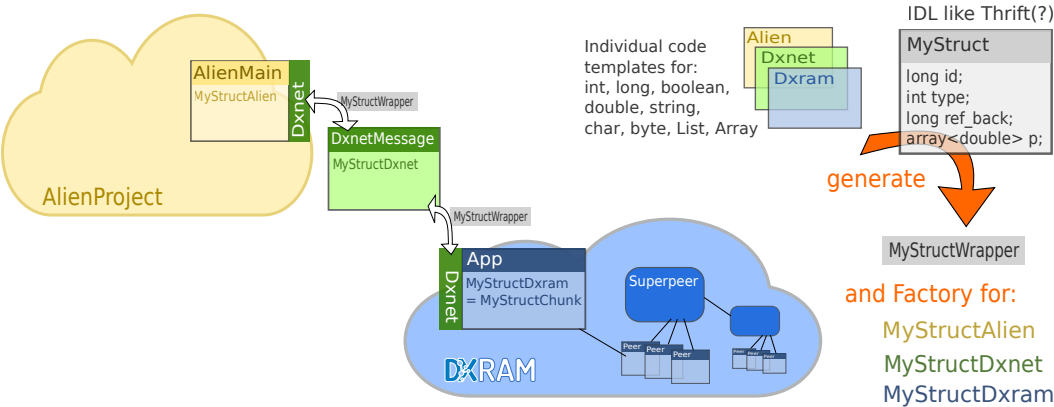


Abbildung: with preprocessing



Implementation: Fail 2

The next mistake: slicing up the multipeer use-case





Implementation: Fail 2

Single peer on localhost is a bad testing scene:

- Questions about an Alien Node to DXRAM Node mapping answered to late
- Hadoop Task splitting still not tested
- errors caused by wrong stored Chunks occurs next to project end

Instead of building a local FS connector as a first test, I should have better converted the Hadoop FTP connector to Multipeer szenario.





Implementation: DXNET Transport

Is it optimal? Hadoop transfer jobs to local data, thus DXNET doing network traffic just on localhost.



Implementation: Now

Finished: FS structure, operations on directories





Implementation: Now

still open

- bugs on storing and sharing chunks between peers
- starting with: `create`, `open`, `flush`, `In-` and `OutStream`
- small bugs in copy and rename (see website)
- big FS contents, really big file handling
- handling multiple DXNET RPCalls



far away

- ATOMar FS access, Hadoop unit tests
- test with MapReduce and HBase code examples
- performance tests





Conclusion

- Ignite & Alluxio: Doing a YARN replacement
- Hadoop ecosystem is too close to HDFS block handling
- Is it easier to build a distributed noSQL Database than a distributed FS with an key-value store?!





Conclusion

BUT: **nobody** advertises to **replace** HBase or Hadoop, but to be able to **cooperate** with them.



Questions

Questions?



Questions



Thank you for your attention.



References

You got everything on no-go.github.io/HadoopDxramFS.

