Jonathan Ellis
@spyced
jbellis@riptano.com

The NoSQL Ecosystem

7-21-10

Executive summary

- NoSQL is about using the right tool for the job

My bias

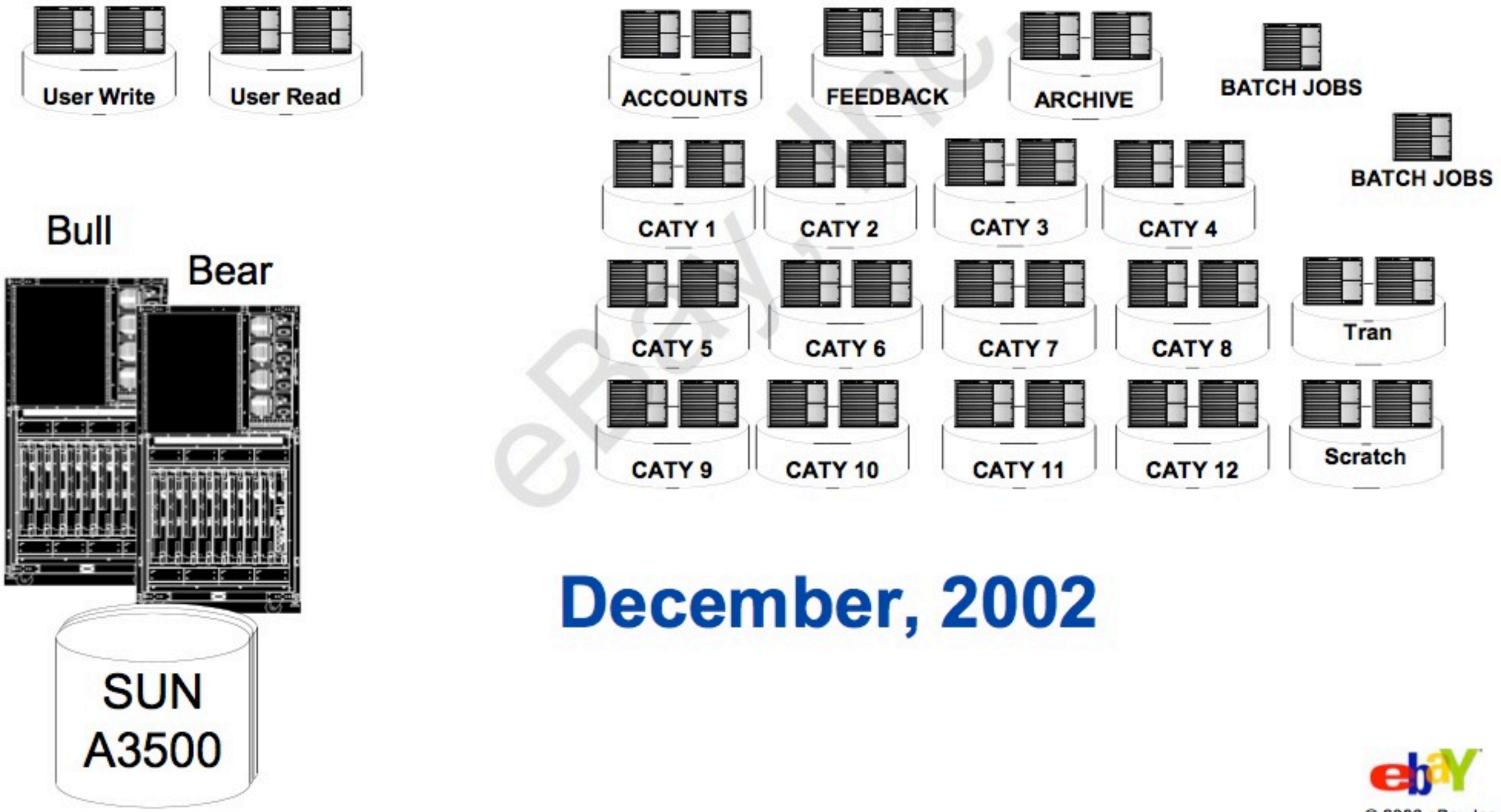
- Started working on Cassandra in 2009 after looking at the alternatives
- Co-founded Riptano in April 2010

NoSQL at OSCON

- Introduction to MongoDB
- Scaling Sourceforge with MongoDB
- Hadoop, Pig, and Twitter*
- (Plus the Neo4J and Cassandra tutorials Monday and Tuesday)

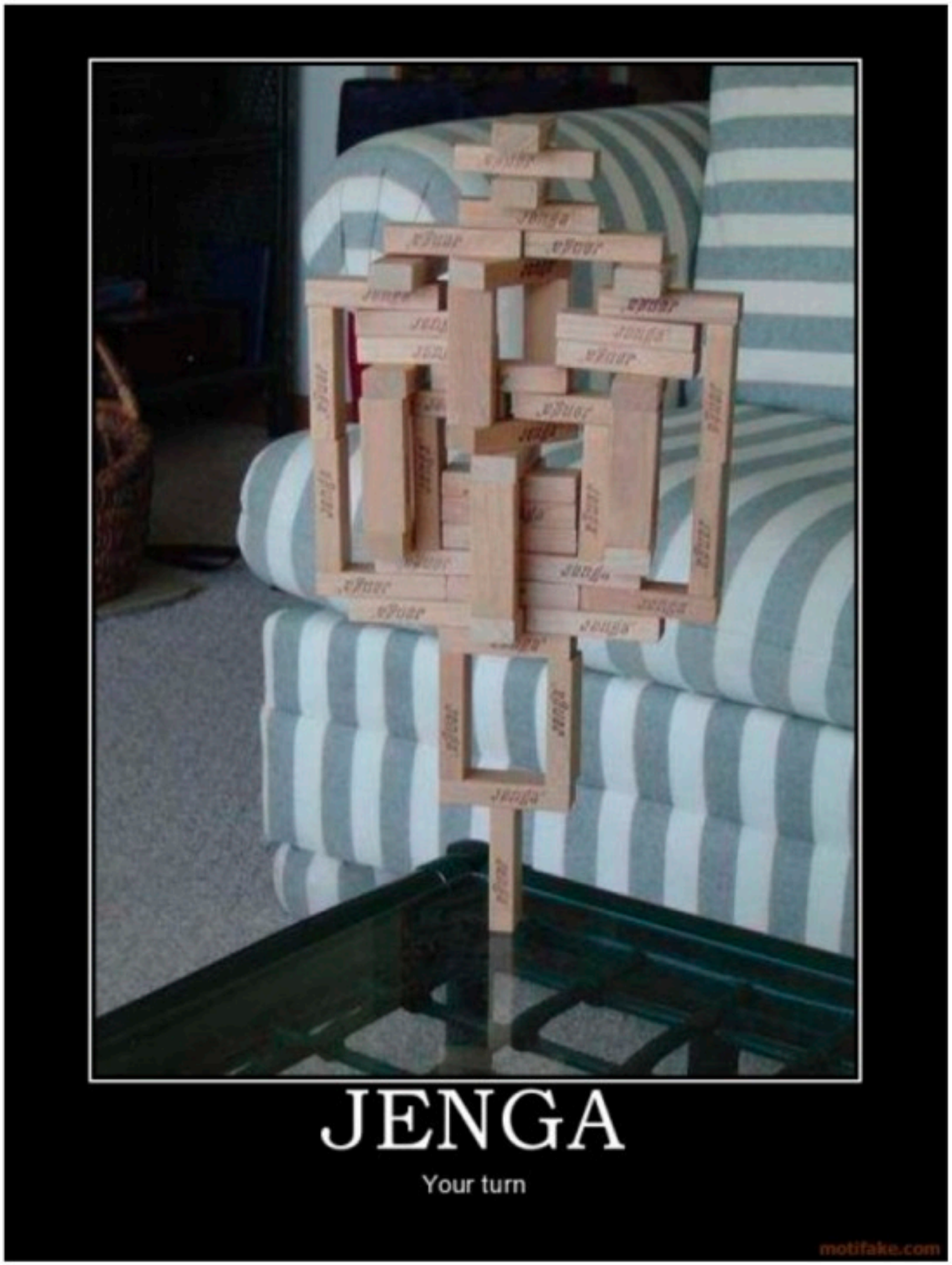
Why NoSQL? 1

- Relational databases don't scale



December, 2002

("The eBay Architecture," Randy Shoup and Dan Pritchett)


JENGA
Your turn
motifake.com

Why NoSQL? 2

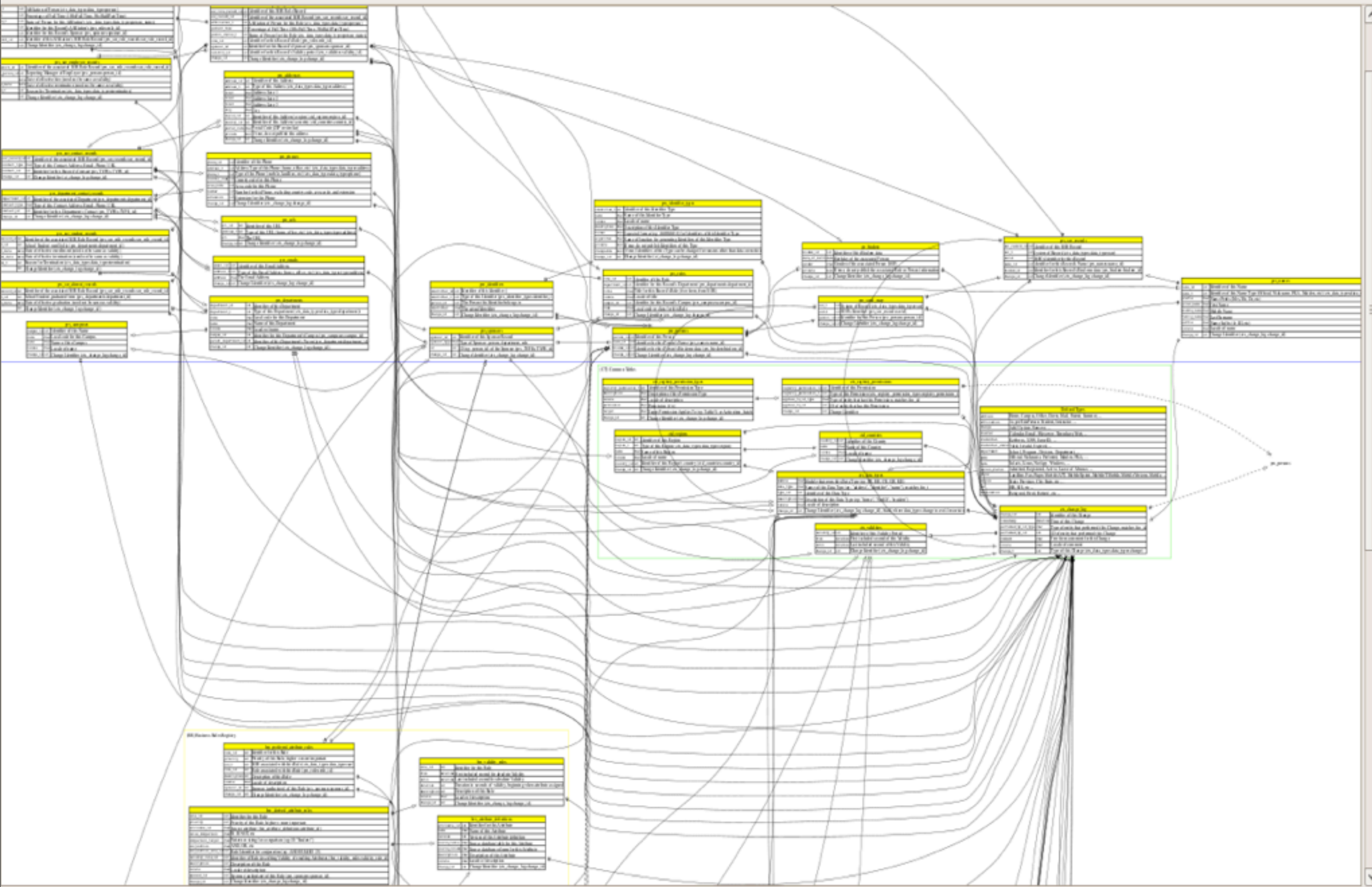
- The relational model maps poorly to some problems

- Sub-category: almost all NoSQL databases are schema-free or schema-optional to some degree

ORDATAMODEL

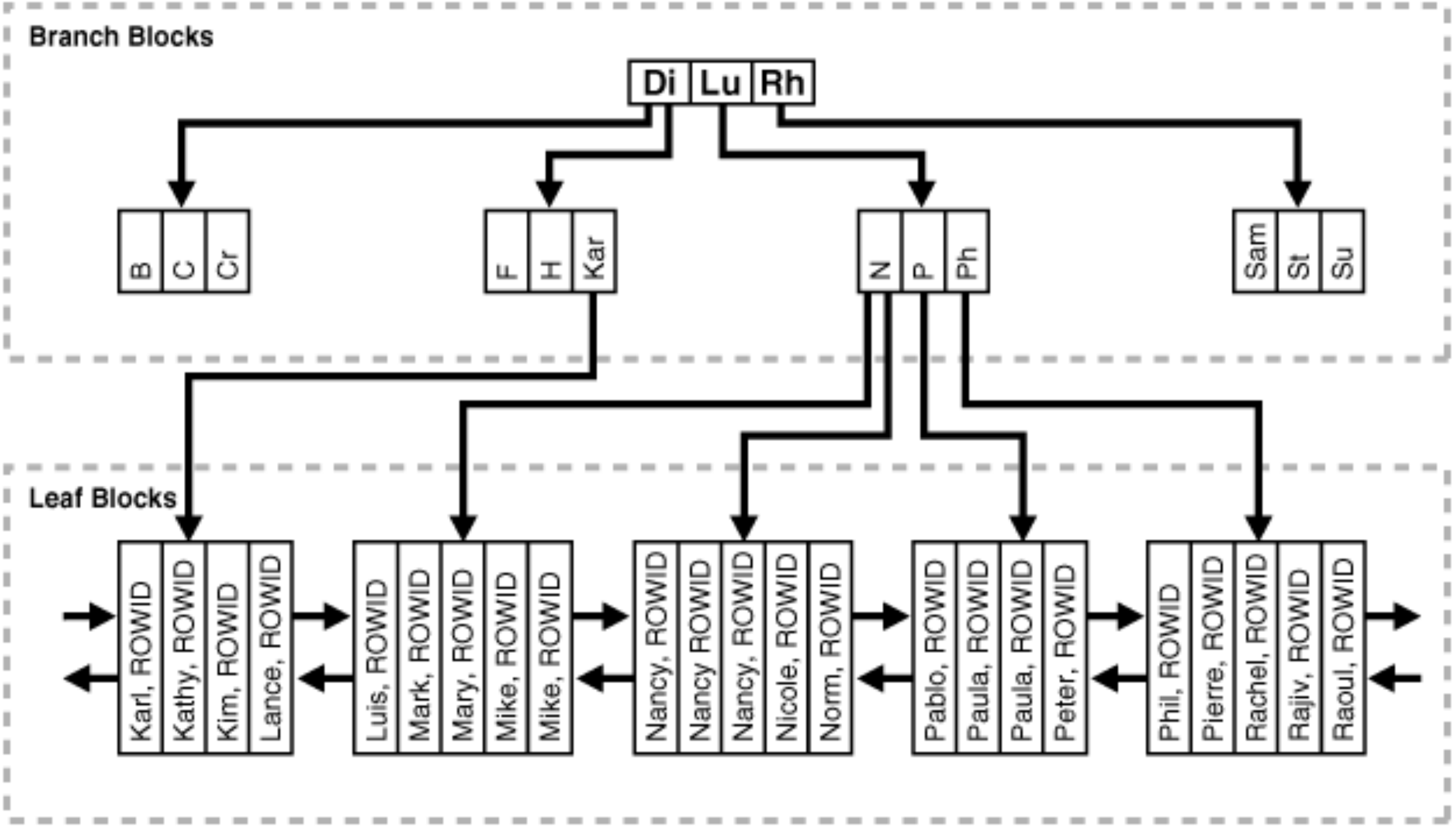
File Edit View Go Help

Previous Next 1 of 1 Continuous Best Fit Fit Width Zoom In Zoom Out 50%



Why NoSQL? 3

- Relational databases are slow


Branch Blocks
Di
Lu
Rh
B
C
Cr
F
H
Kar
N
P
Ph
Sam
St
Su
Leaf Blocks
Karl, ROWID
Kathy, ROWID
Kim, ROWID
Lance, ROWID
Luis, ROWID
Mark, ROWID
Mary, ROWID
Mike, ROWID
Mike, ROWID
Nancy, ROWID
Nancy ROWID
Nancy, ROWID
Nicole, ROWID
Norm, ROWID
Pablo, ROWID
Paula, ROWID
Paula, ROWID
Peter, ROWID
Phil, ROWID
Pierre, ROWID
Rachel, ROWID
Rajiv, ROWID
Raoul, ROWID

Myth 1

- "NoSQL is for people who don't understand {SQL, denormalization, query tuning, ...}"
  - Similarly: "Only users of [database X] are turning to NoSQL databases, because X sucks."

eBay: NoSQL pioneer

- "BASE is diametrically opposed to ACID. Where ACID is pessimistic and forces consistency at the end of every operation, BASE is optimistic and accepts that the database consistency will be in a state of flux. Although this sounds impossible to cope with, in reality it is quite manageable and leads to levels of scalability that cannot be obtained with ACID."

  - **"BASE: An Acid Alternative," Dan Pritchett, eBay**

Scale forces tradeoffs

Myth 2

- “NoSQL is nothing new because we had key/value databases like bdb years ago.”

Myth 3

- “Only huge sites like Facebook and Twitter need to care about scalability.”

The downside to NoSQL-as-identifier

Evaluating NoSQL databases

- Data model / query language
- Scalability / availability
- Persistence

Data model

- Document
  - CouchDB, MongoDB, Riak
- ColumnFamily
  - Cassandra, HBase
- Graph
  - Neo4j, AllegroGraph, Objectivity InfiniteGraph
- Collections
  - Redis
- Key / value
  - bdb, bitcask, Memcached, Tokyo Cabinet

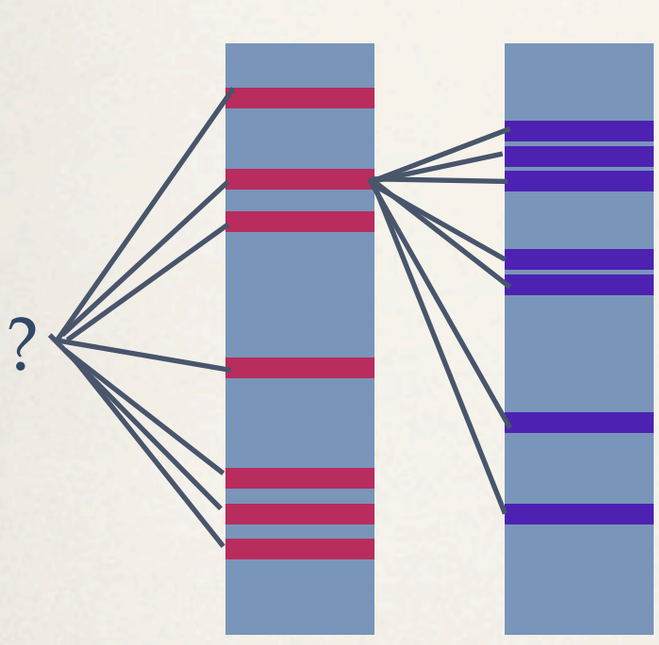
Document queries

- CouchDB
  - js map/reduce creates [materialized] views that may be queried
- MongoDB
  - b-tree indexes allow querying documents by field
- Riak
  - link-walking or [runtime] js map/reduce

ColumnFamily queries

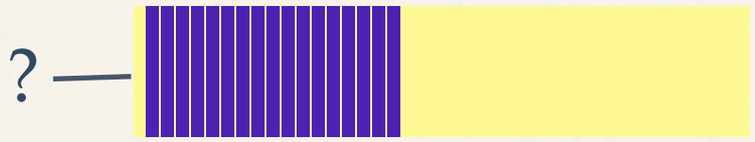
```
SELECT * FROM tweets
WHERE user_id IN (SELECT follower FROM followers WHERE user_id = ?)
```

followers



tweets

timeline

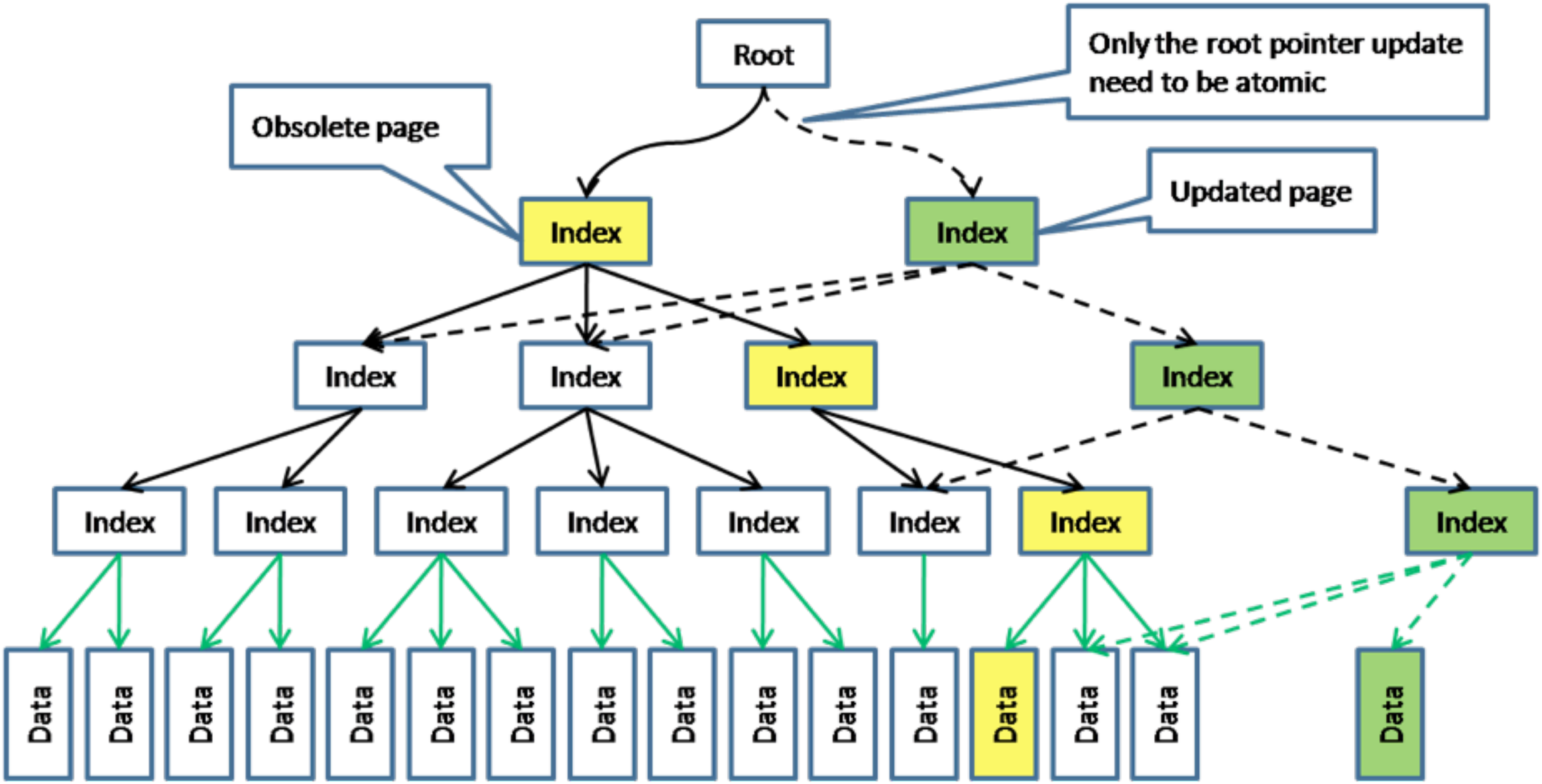


Persistence

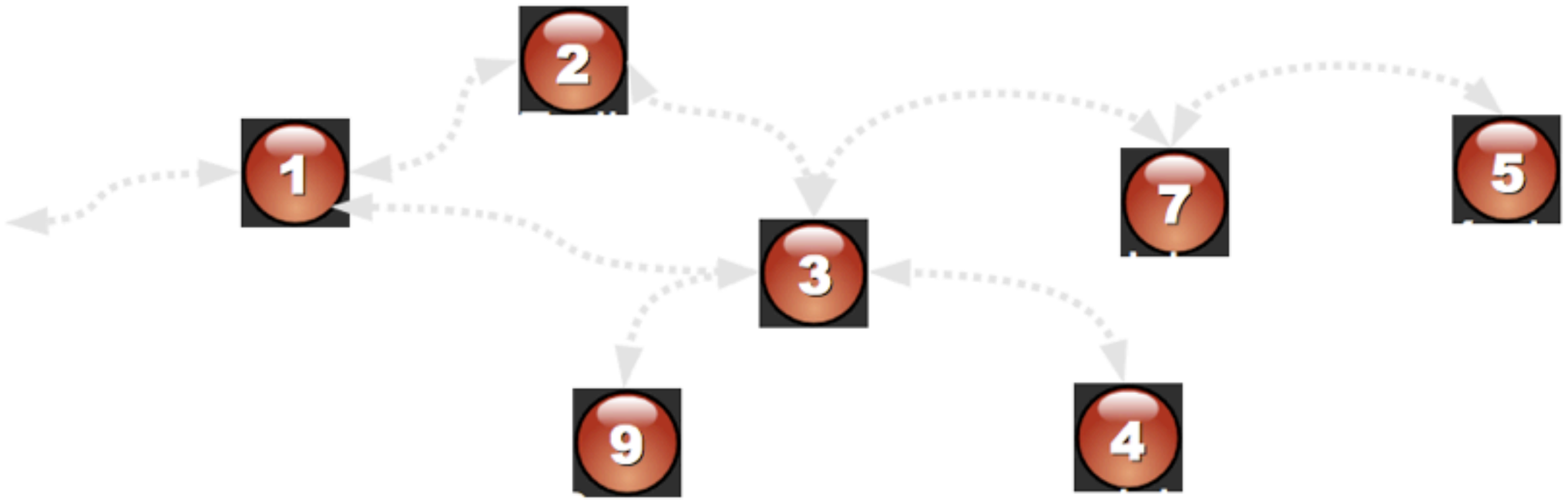
- Classic B-tree
  - bdb, TC, MongoDB
- Append-only B-tree
  - CouchDB
- On-disk linked lists
  - Neo4J
- Pluggable
  - Riak, Voldemort
- SSTable
  - Cassandra, HBase
- Memory-only
  - Memcached, VoltDB
- Memory w/checkpoint
  - Membase, Redis

Durable

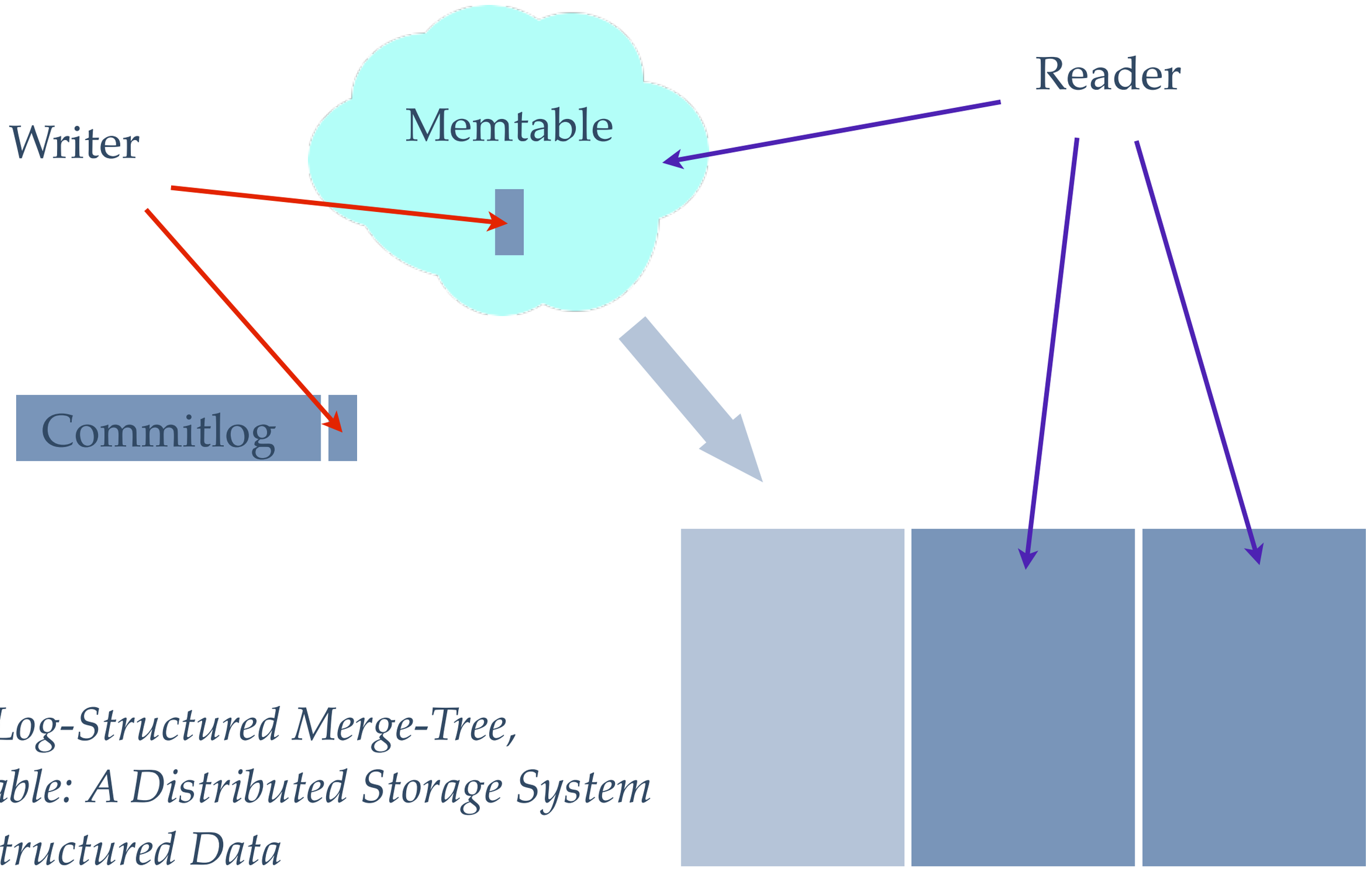
- bdb
- Cassandra
- CouchDB
- Neo4J
- Riak*, Voldemort*


Root
Only the root pointer update need to be atomic
Obsolete page
Updated page
Index
Index
Index
Index
Index
Index
Index
Index
Index
Index
Index
Index
Index
Index
Index
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data
Data

pathExists(a, b, 4)



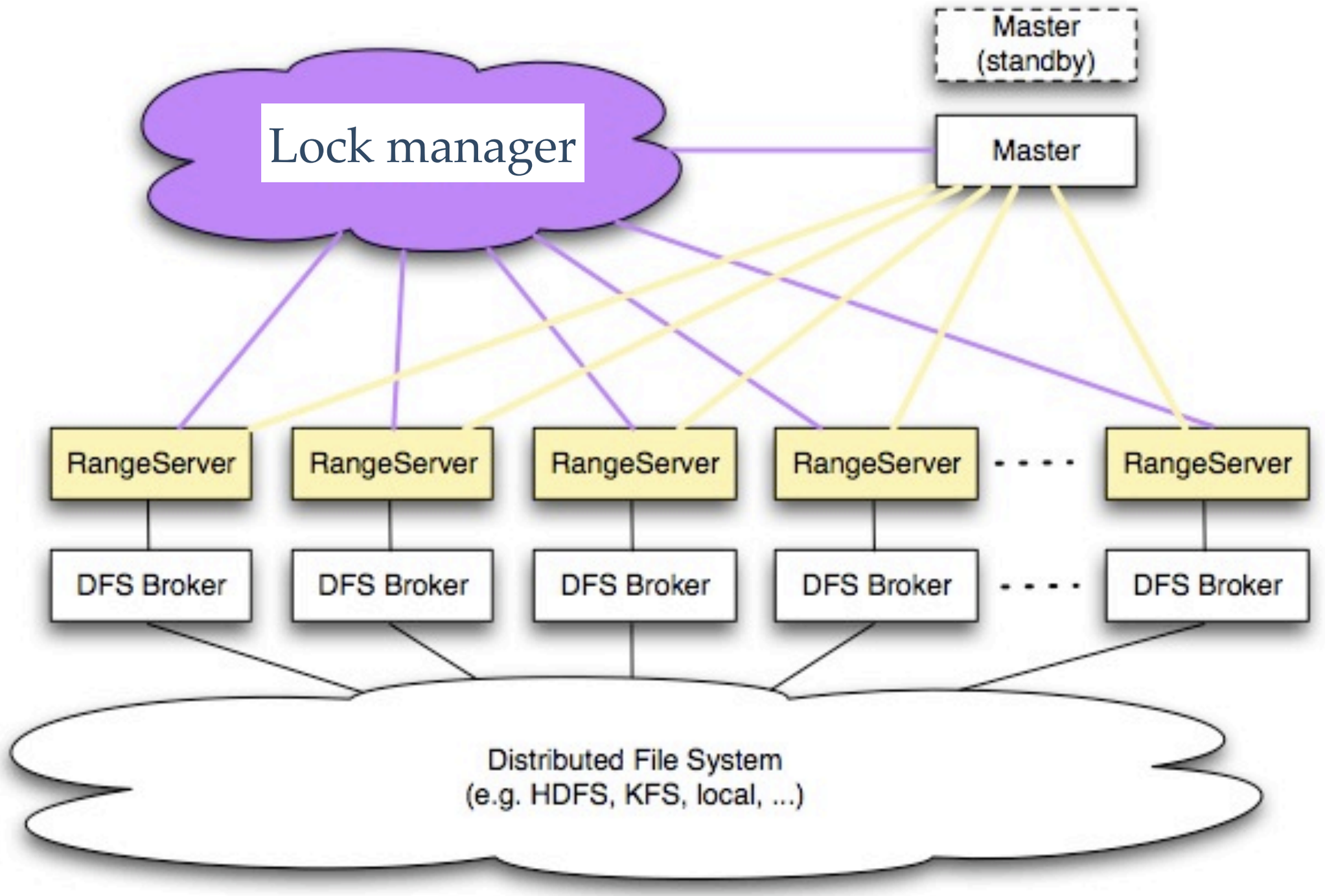
	# persons	query time
MySQL	1 000	2 000 ms
Neo4j	1 000	2 ms
Neo4j	1 000 000	2 ms



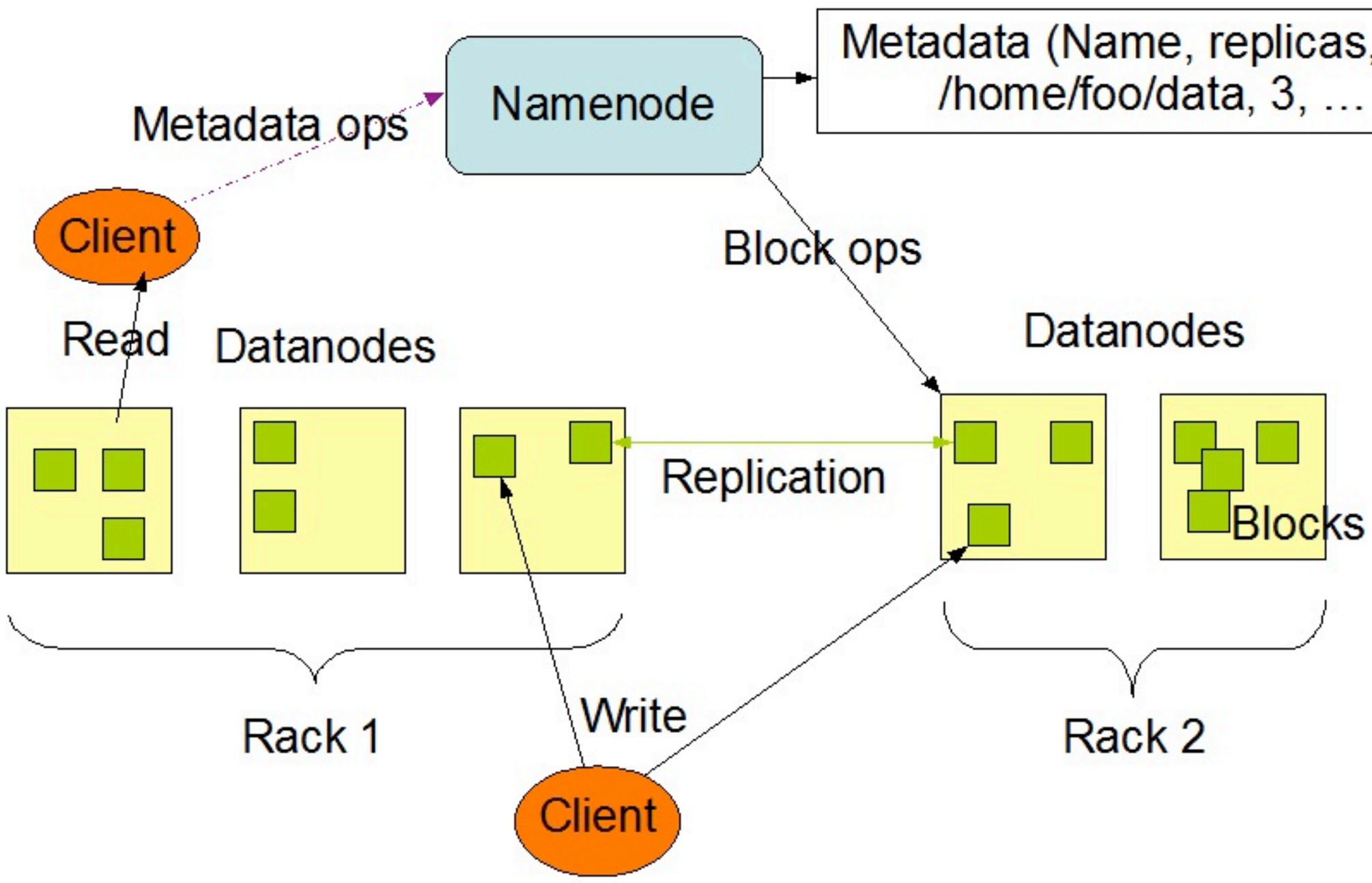
The Log-Structured Merge-Tree, Bigtable: A Distributed Storage System for Structured Data

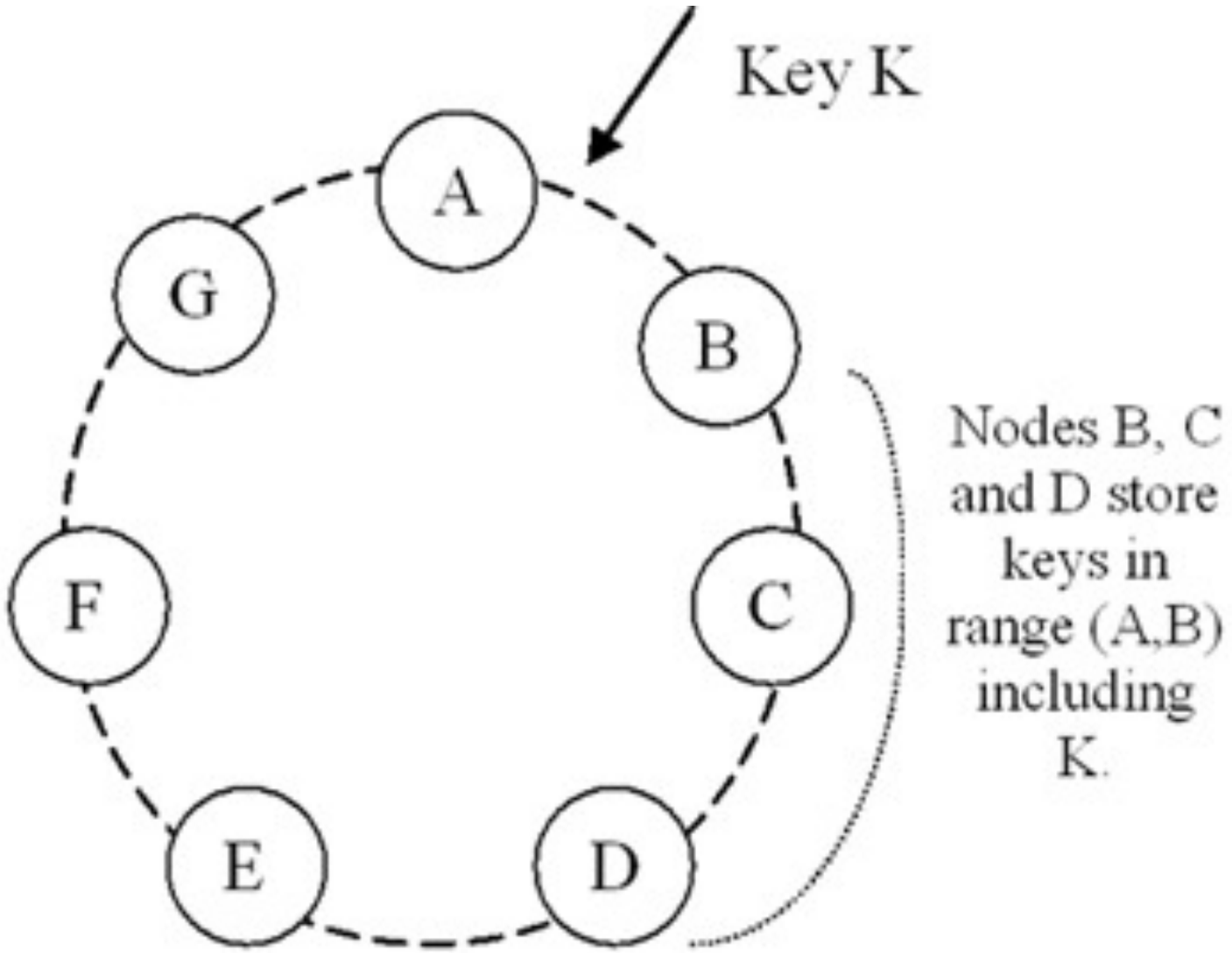
Scalability

- Master-driven vs distributed replicas


Lock manager
Master
(standby)
Master
RangeServer
RangeServer
RangeServer
RangeServer
RangeServer
DFS Broker
DFS Broker
DFS Broker
DFS Broker
DFS Broker
Distributed File System
(e.g. HDFS, KFS, local, ...)

HDFS Architecture

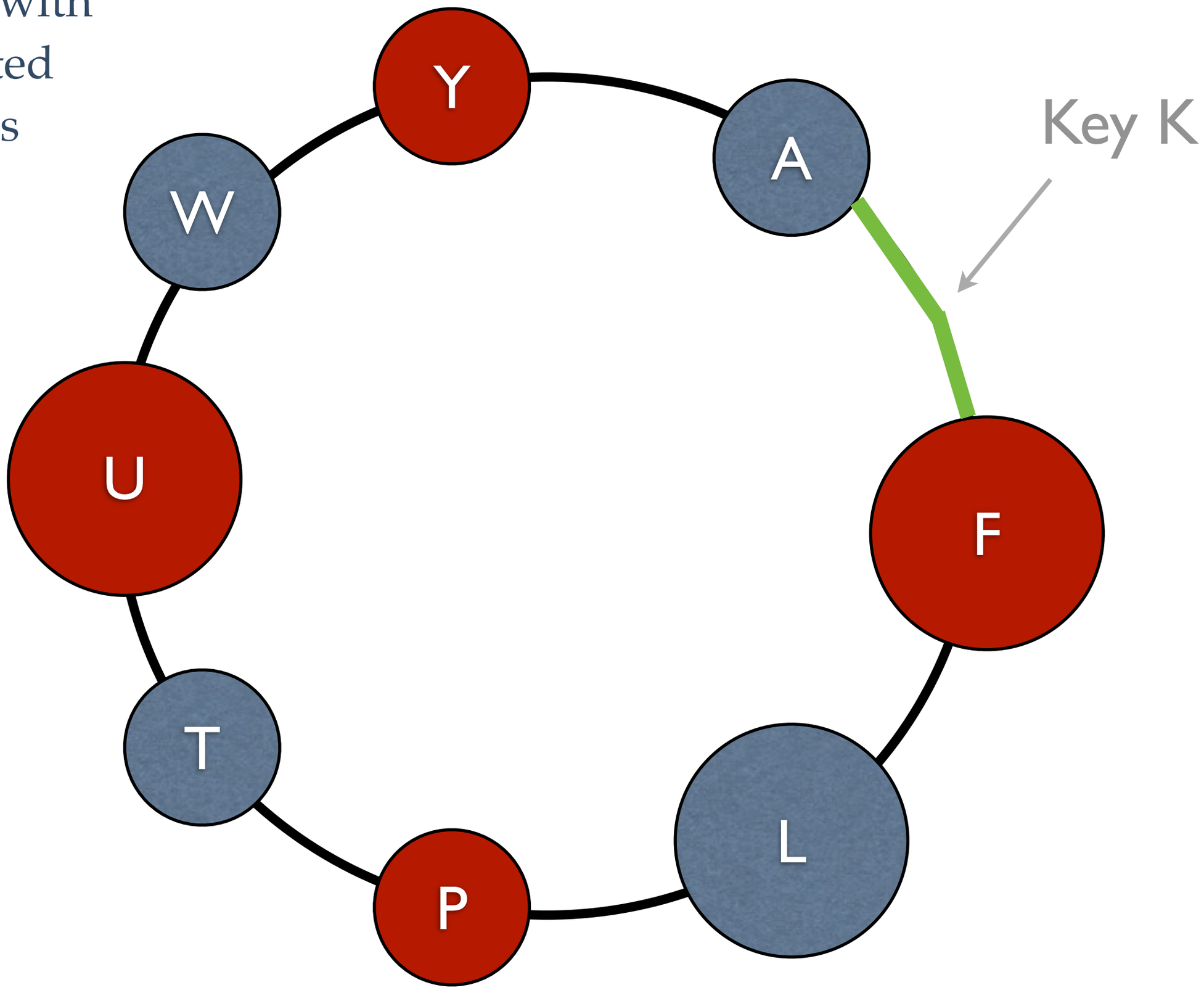



Key K
A
B
C
D
E
F
G
Nodes B, C and D store keys in range (A,B) including K.

CAP

- Consistency
- Availability
- Partition tolerance

Multi-DC with distributed replicas



CA

- Scalaris
- VoltDB

Conclusion

- “If you’re deploying memcache on top of your database, you’re inventing your own ad-hoc, difficult to maintain NoSQL data store”