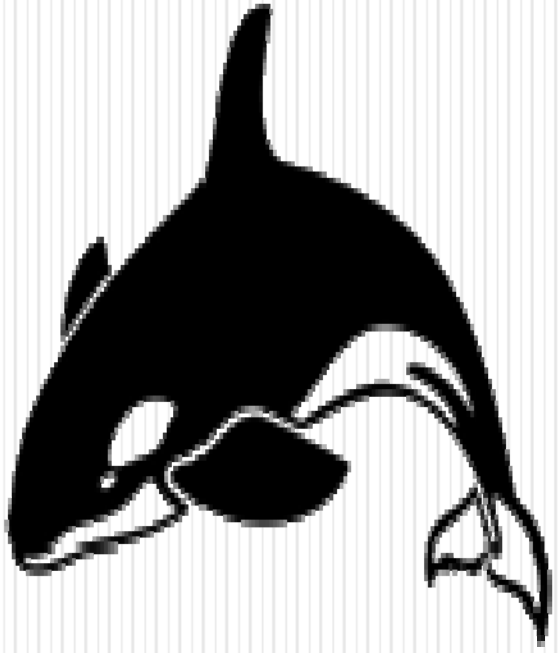
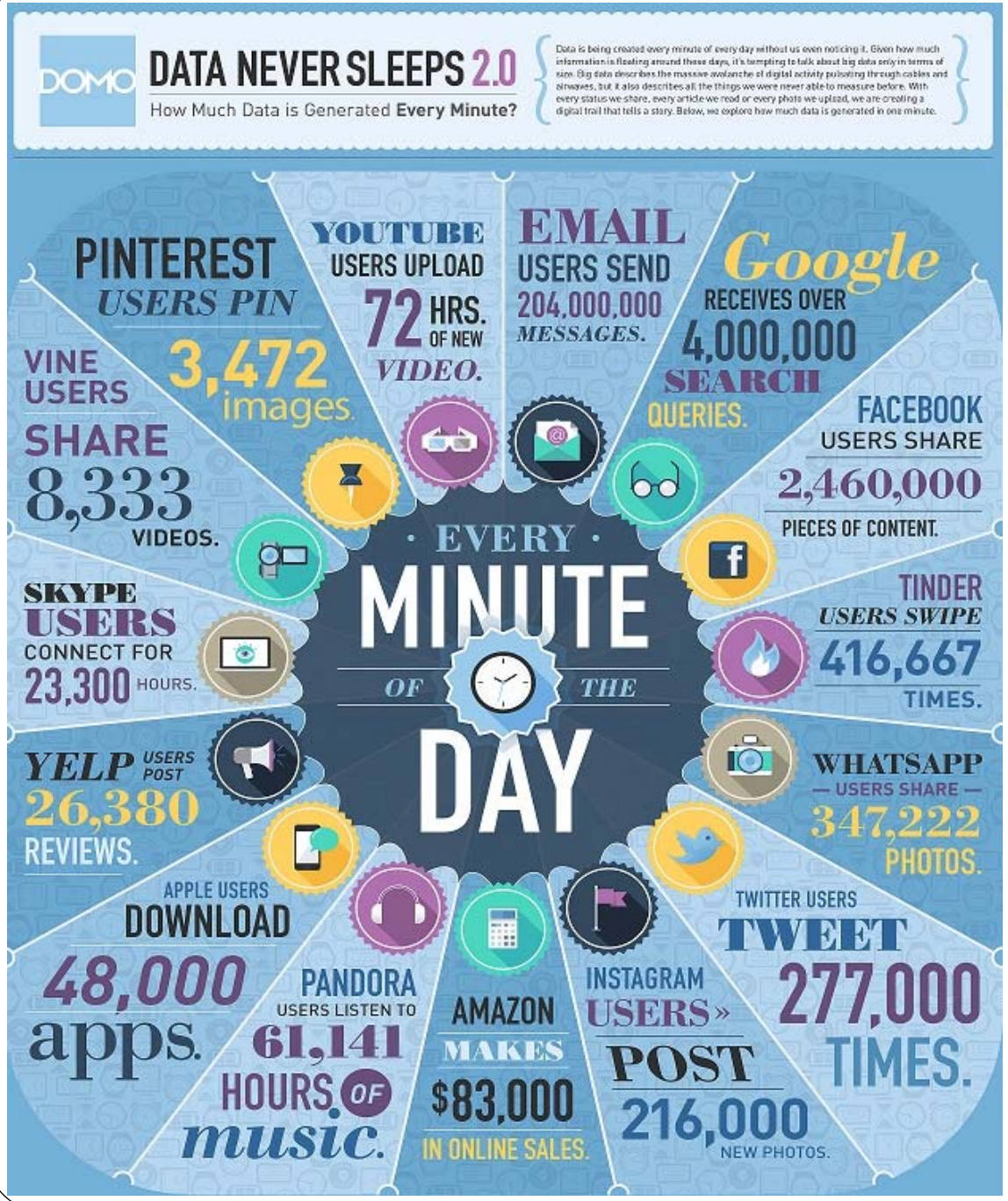
APACHE

HBASE



Typical size of data you deal with on a daily basis



Google™

Processes

More than 161 Petabytes of raw data a day

https://aci.info/2014/07/12/the-data-explosion-in-2014-minute-by-minute-infographic/

- On average, 1MB-2MB per minute
- few times, exceeded a 3MB per-minute average (**RARE**)
- its system processes 500+ terabytes of data each day
- 105 TB – data scanned(30 min)

RDBMS ???

- Fixed schema based design
- Good for small to medium volume applications
- Not designed to handle heterogeneous data
- Not designed to handle mixed workload
- Not designed to scale

Err… NO.


SOLUTION

Hadoop

- Build based on Google infrastructure (GFS, Map-Reduce papers published 2003/2004), Hadoop is a software framework for distributed storage and distributed processing for large amounts of data.(needs to shortened to a single line)
- Java/Python/C interfaces, several projects built on top of it
- Open-source implementation of 2 key ideas
  - HDFS: Hadoop distributed file system
  - Map-Reduce: Programming Model
- Problems:
  - Data accessible only in a sequential manner and lacked random read/write access

What is Hbase?

- Open source clone of Google's Bigtable and is written in Java.
- Distributed column-oriented wide column store on top of HDFS
- Real time read/write random-access
- Not Relational and does not support SQL

- But can work with very large datasets
  - Billions of rows, millions of columns

- Originally created in PowerSet in 2007
- Used in : Yahoo, Microsoft, Adobe, Twitter, …

HBase History

Year	Event
Nov 2006	Google released the paper on BigTable.
Feb 2007	Initial HBase prototype was created as a Hadoop contribution.
Oct 2007	The first usable HBase along with Hadoop 0.15.0 was released.
Jan 2008	HBase became the sub project of Hadoop.
Oct 2008	HBase 0.18.1 was released.
Jan 2009	HBase 0.19.0 was released.
Sept 2009	HBase 0.20.0 was released.
May 2010	HBase became Apache top-level project.

Features

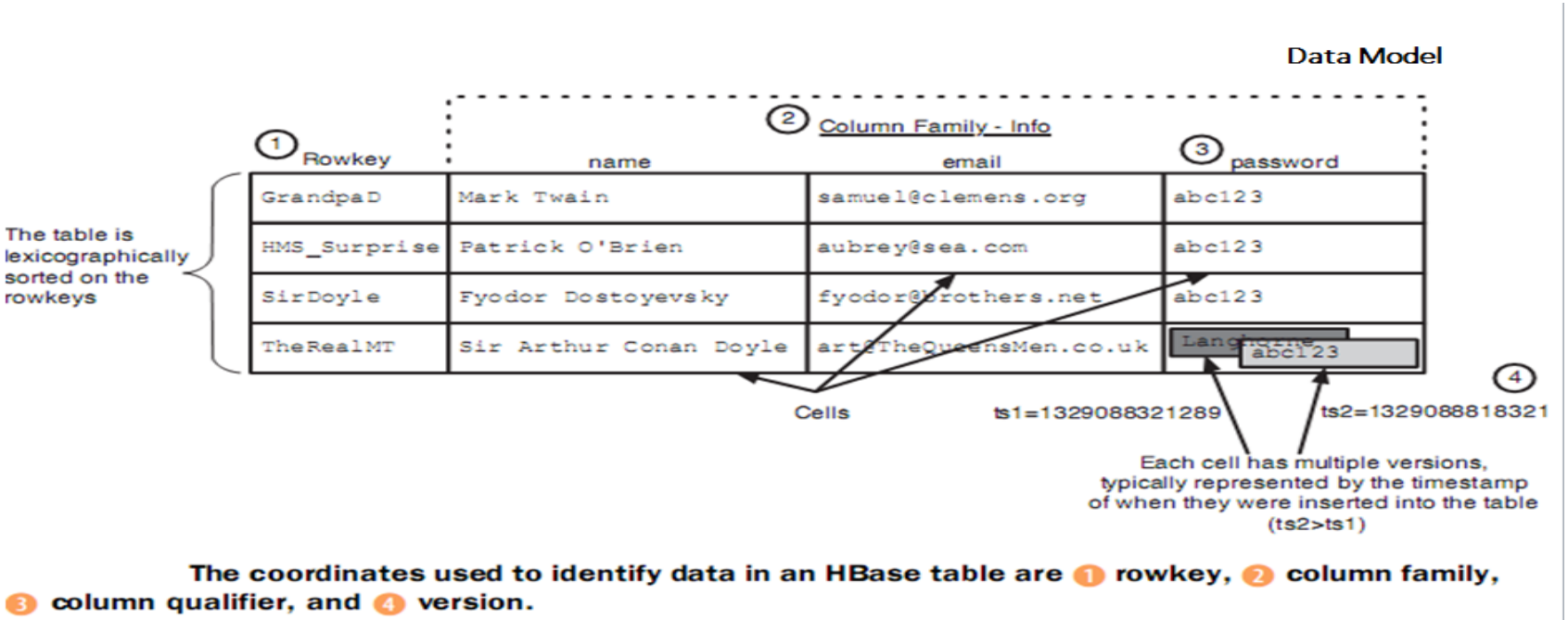
- Horizontally scalable
- Automatic Failover
- Automatic Shading
- Integration with Map Reduce framework
- Stores and retrieves data with random access
- It doesn't care about data types
- It doesn't enforce relationships within your data
- It is designed to run on a cluster of computers, built using commodity hardware

Storage Mechanism

- Hbase is a Column-Oriented Database.
- Tables in it are sorted by rows

Row-Oriented Database	Column-Oriented Database
It is suitable for Online Transaction Process (OLTP).	It is suitable for Online Analytical Processing (OLAP).
Such databases are designed for small number of rows and columns.	Column-oriented databases are designed for huge tables.

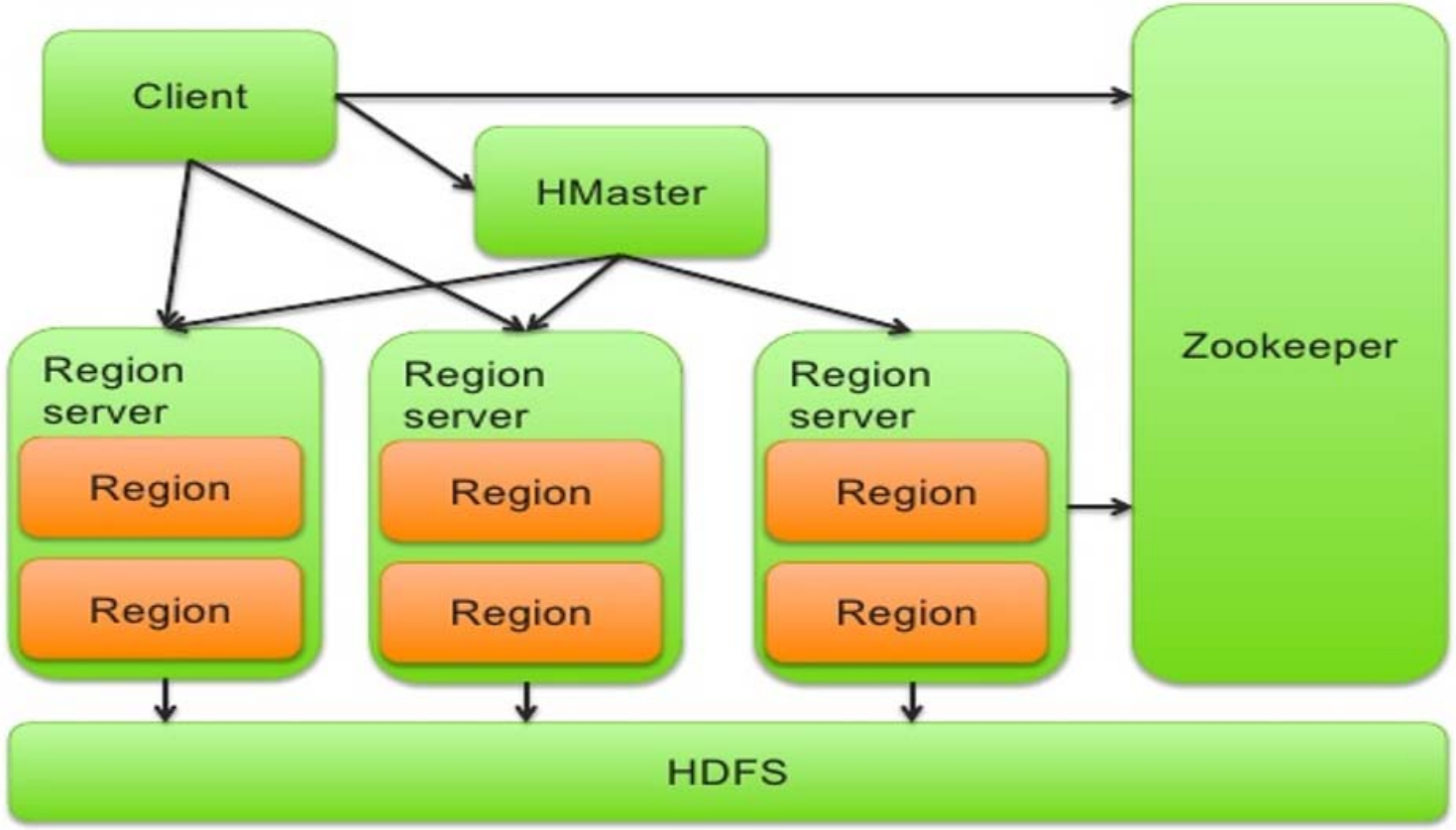
Data Model



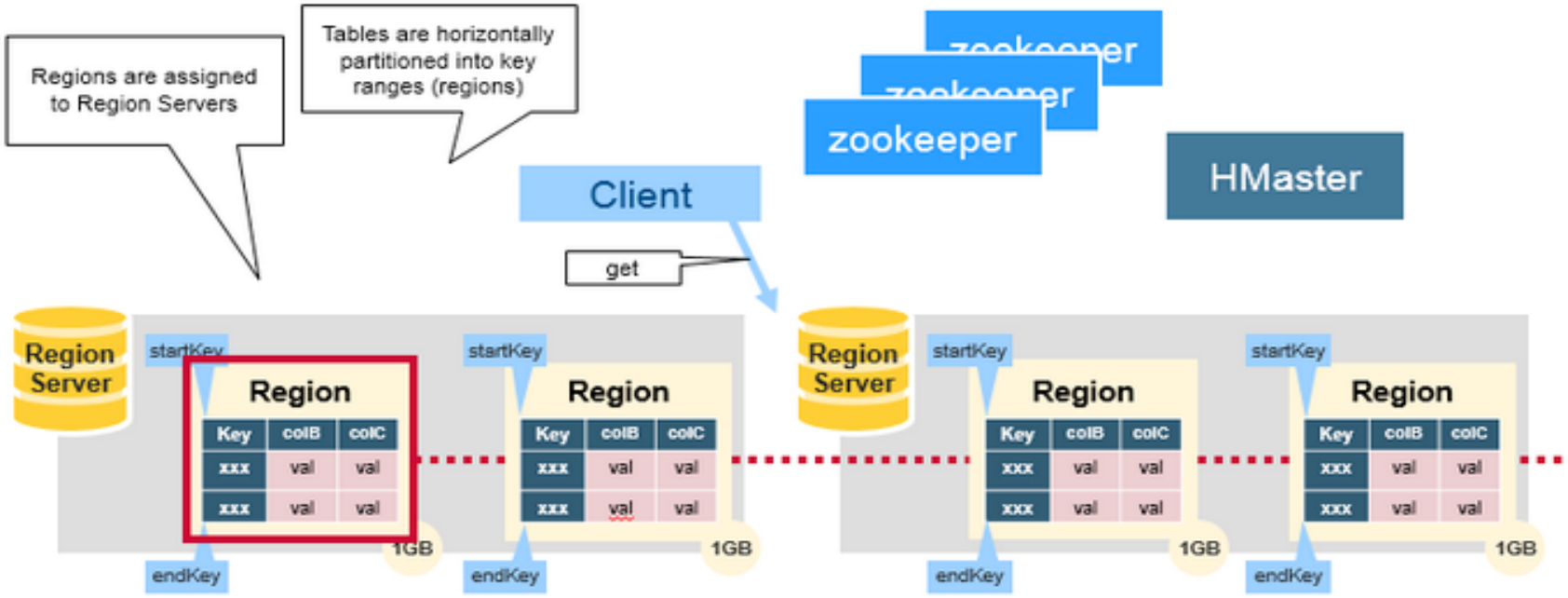
The coordinates used to identify data in an HBase table are 1 rowkey, 2 column family, 3 column qualifier, and 4 version.

- **Table** is a collection of rows.
- **Row** is a collection of column families.
- **Column family** is a collection of columns.
- **Column** is a collection of key value pairs.
- A **cell** is a combination of row, column family, and column qualifier, and contains a value and a timestamp, which represents the value's version.
- A **timestamp** is written alongside each value, and is the identifier for a given version of a value.

Architecture



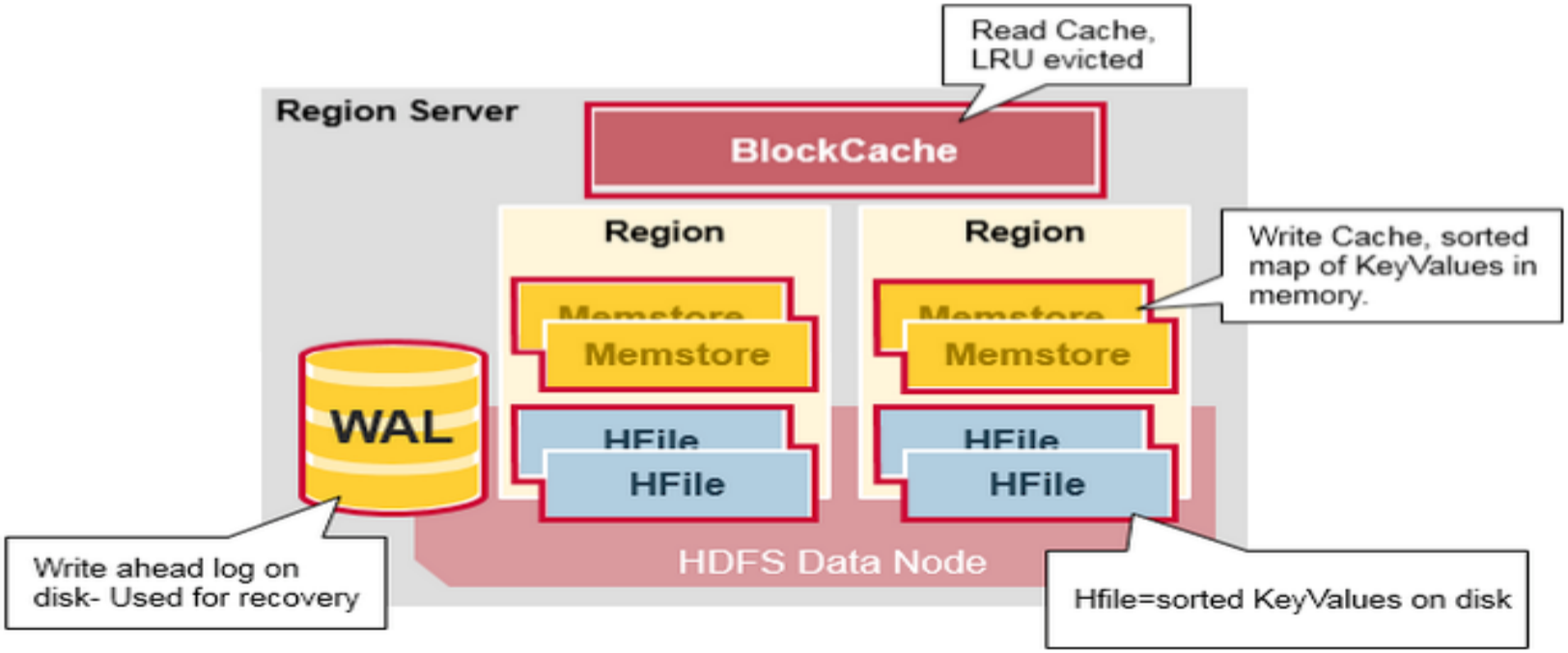
Regions

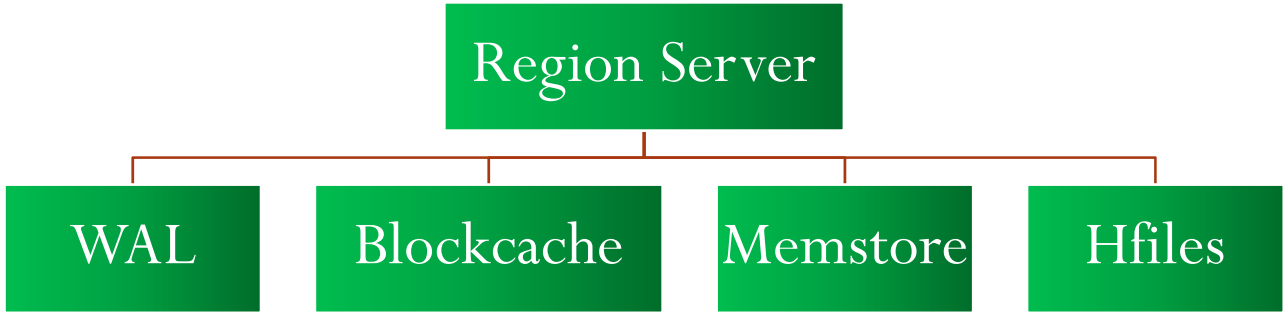


HBase tables are divided horizontally by row key range into "Regions"

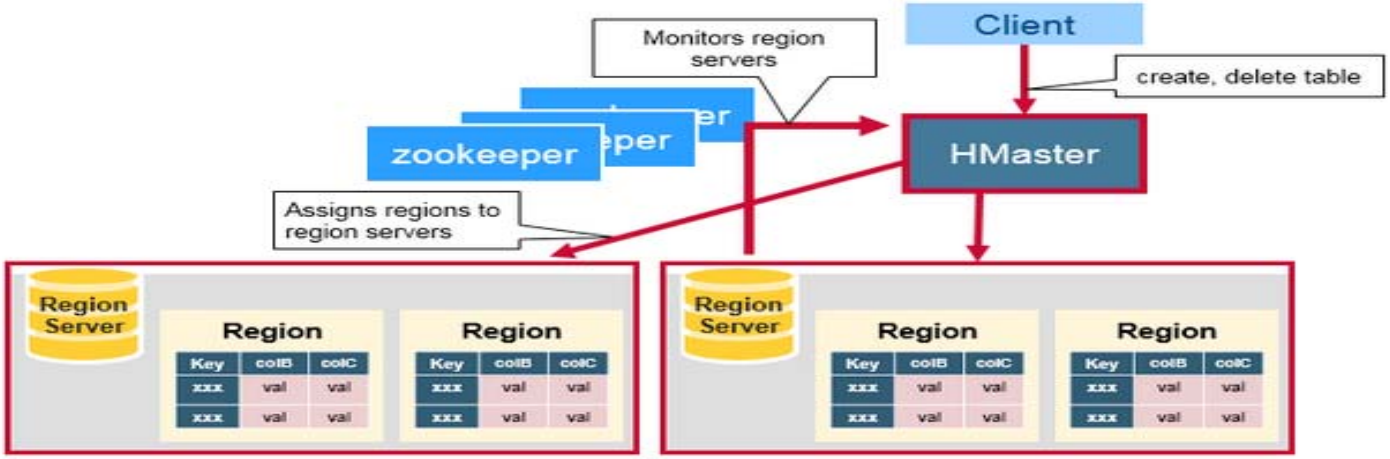
Regions are assigned to the nodes in the cluster, called "Region Servers"

Region Server





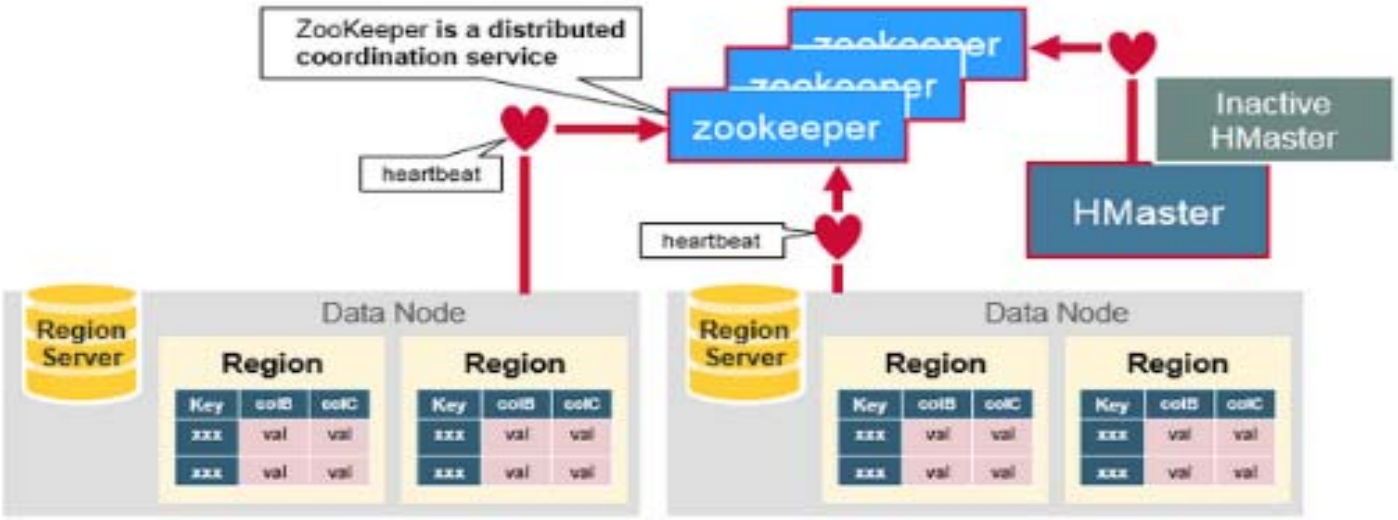
HMaster



The master is responsible for the following:

- Coordinating the region servers
- Admin functions

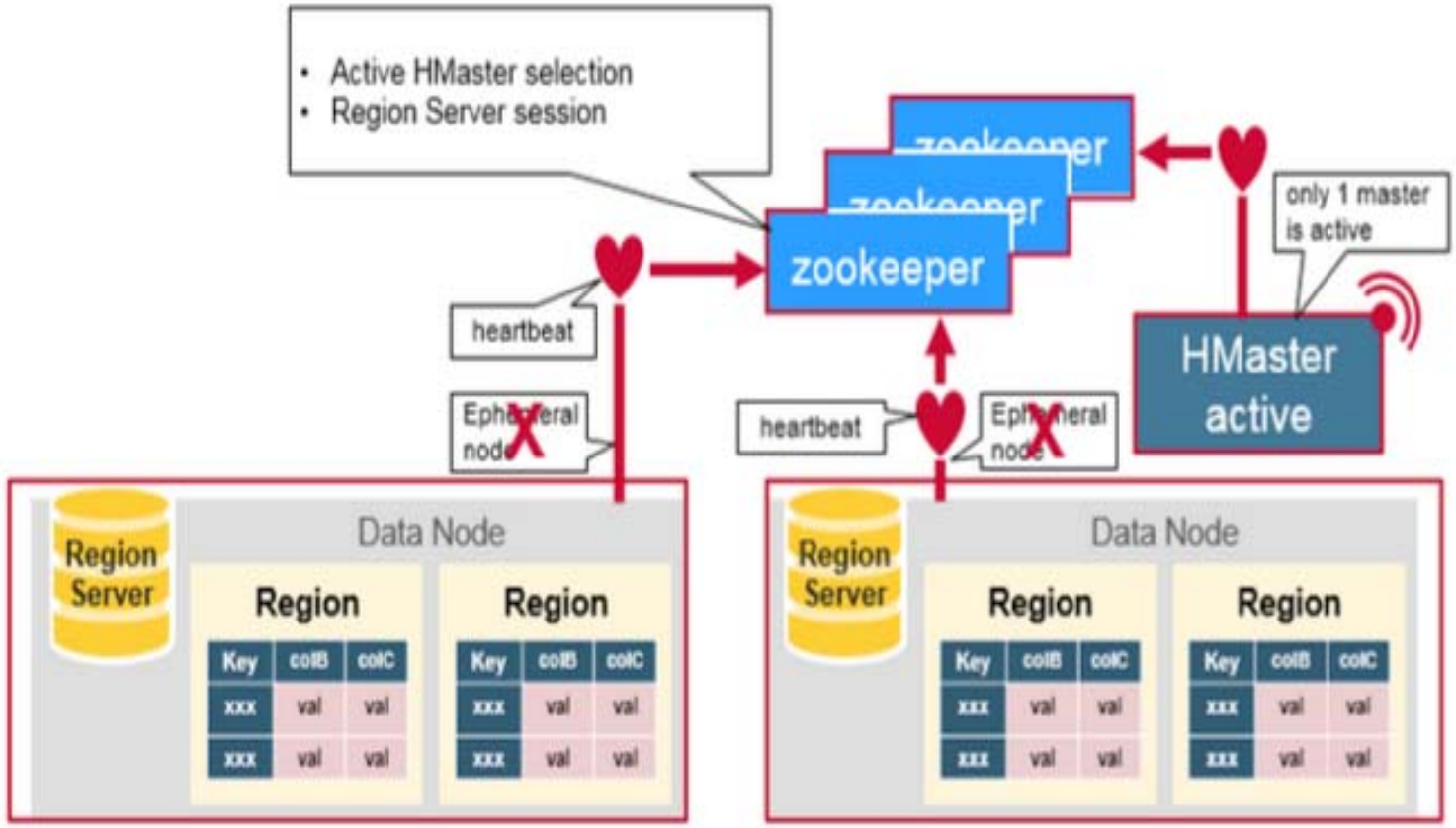
Zookeeper



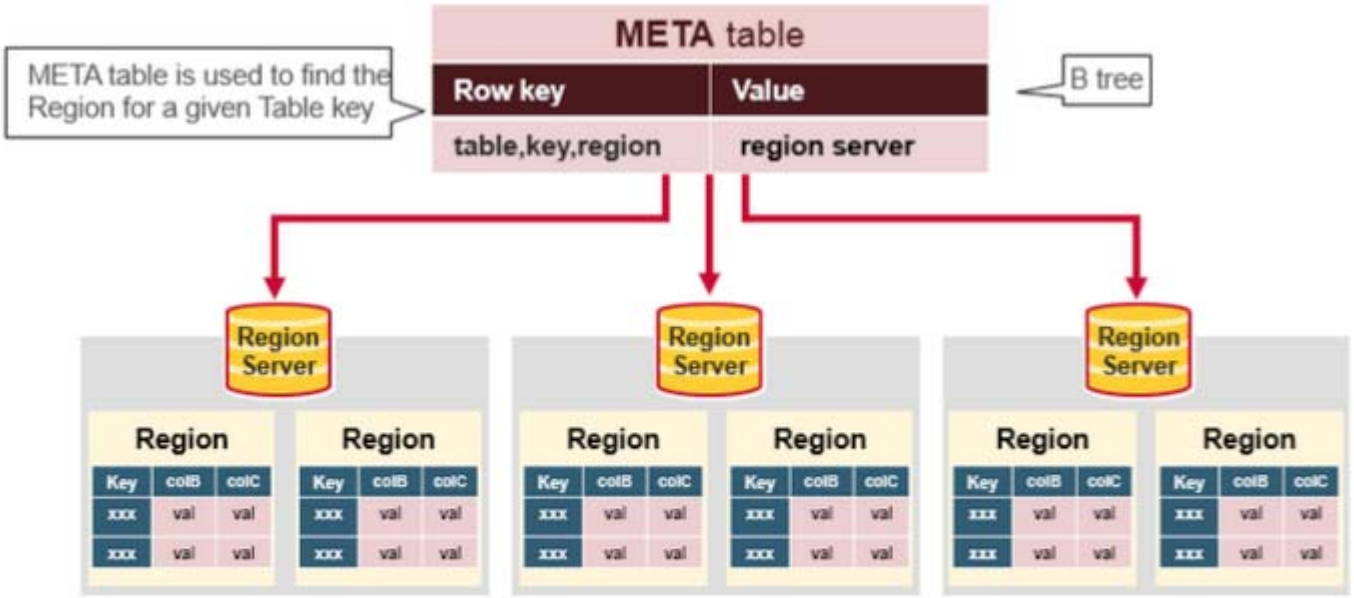
Zookeeper has the following functions:

- Acts as a distributed coordination service to maintain server state in the cluster.
- Maintains which servers are alive and available, and provides server failure notification.

How do they work together?

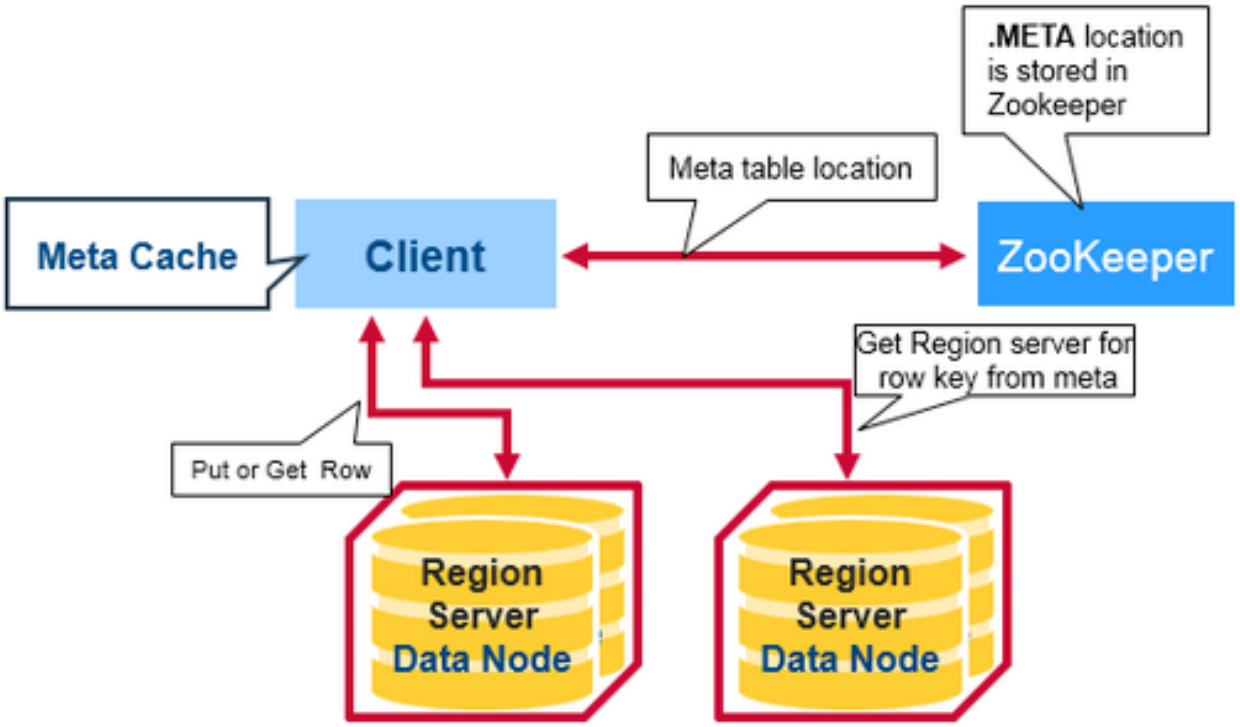


META Table

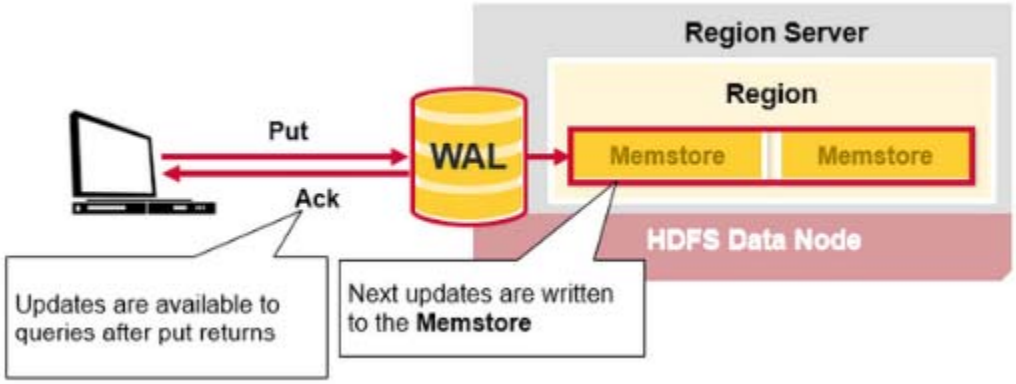


META table is an HBase table that keeps a list of all regions in the system.

First Read or Writes

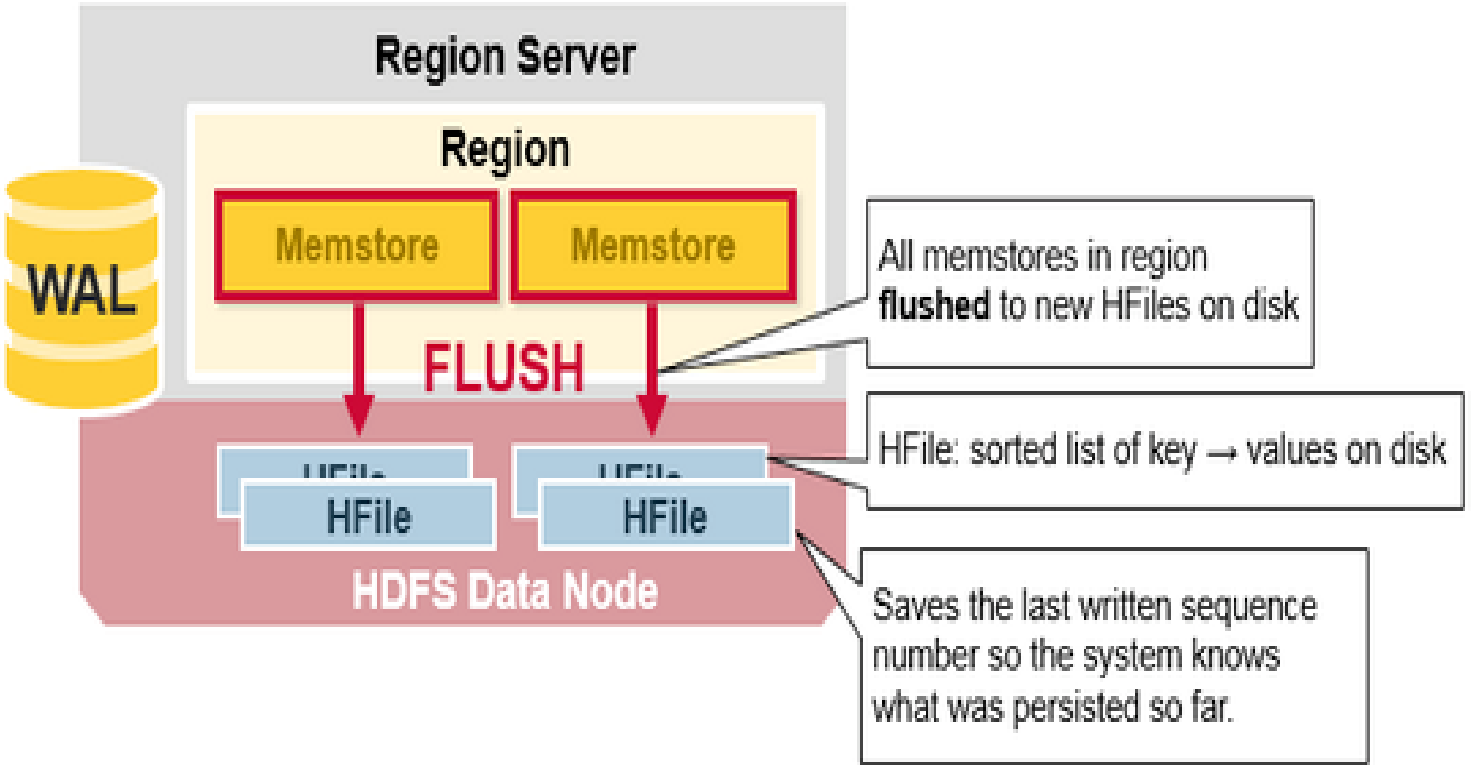


Log Structured Merge Tree Approach



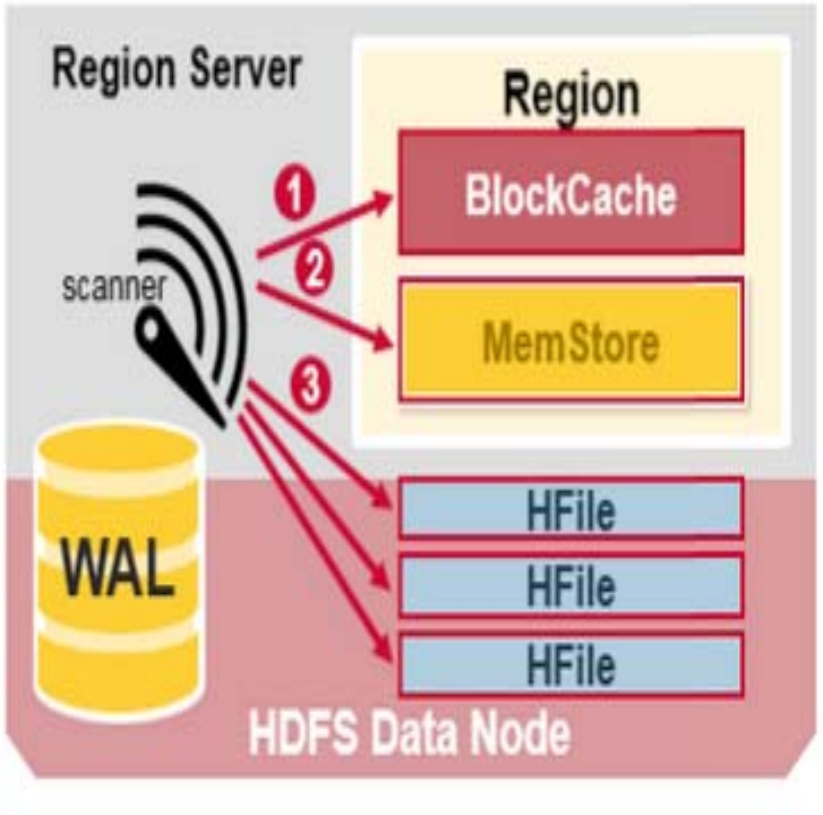
Client issues put request → Data is written on WAL → Data is placed on Memstore → Ack returns to client

HBase Region Flush

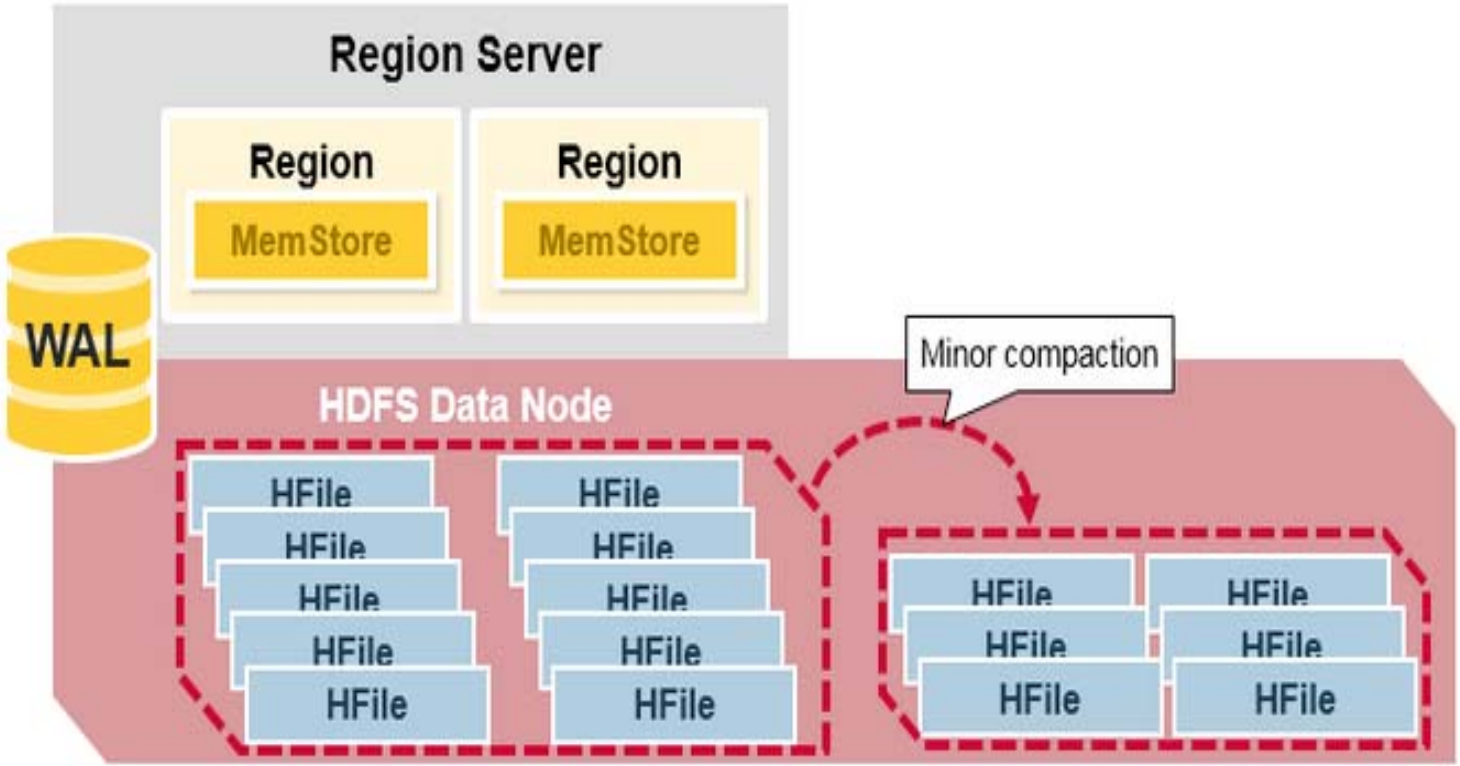


Read Merge

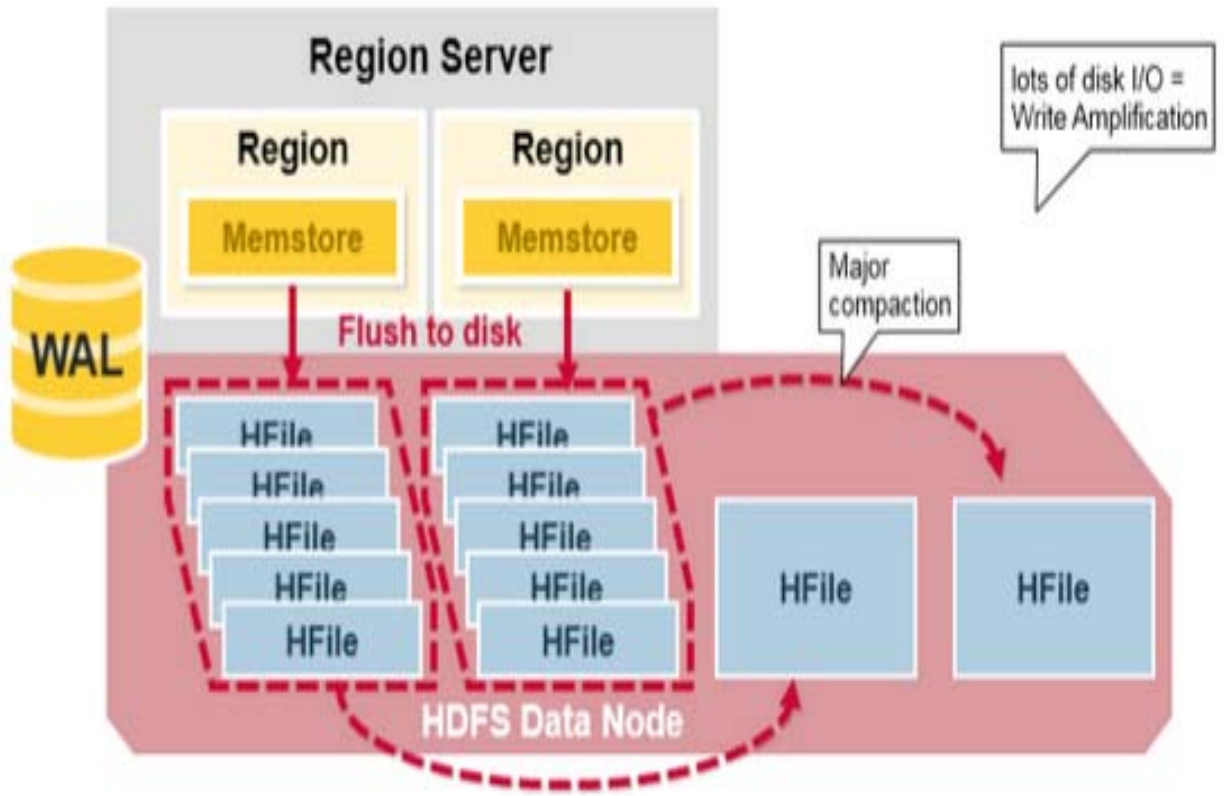
1. First the scanner looks for the Row KeyValues in the Block cache
2. Next the scanner looks in the MemStore
3. If all row cells not in MemStore or blockCache, look in HFiles



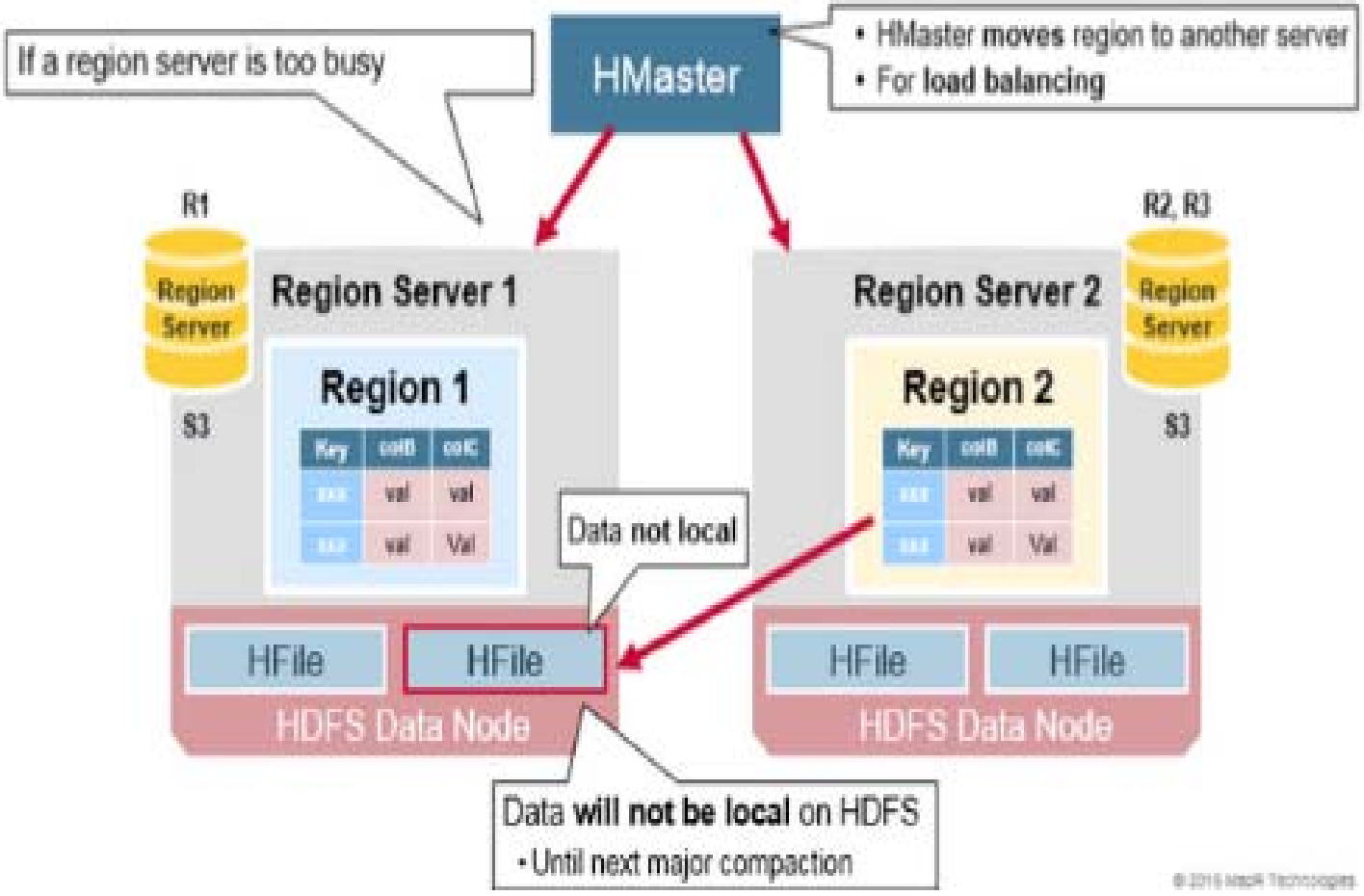
Minor Compaction



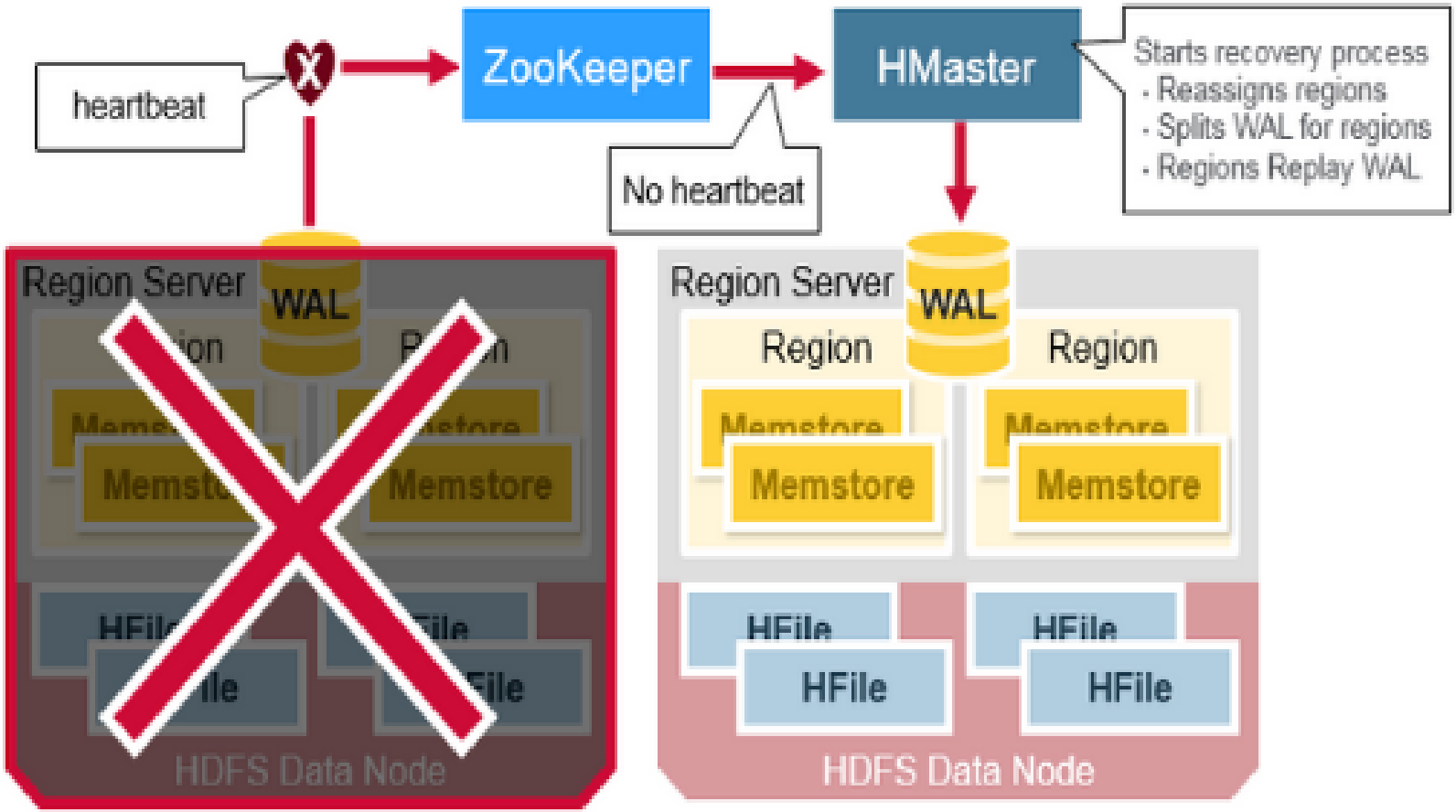
Major Compaction



Load Balancing



Crash Recovery



Accessing hbase

- **Hbase Shell**
- **JAVA API**
- **Apache Thrift** – software framework allows other languages to access Hbase over thrift by connecting to thrift server that interfaces with the java client

Hbase api

Types of access:

- Get: Gets a row's data based on the row key.
- Put: Inserts a row with data based on the row key.
- Scan: Finding all matching rows based on the row key.
- Delete : delete a specific cell in a table.

Creating a Table using HBase Shell

Create '<tablename>', '<columnfamily>'

Create 'emp','personal data','professional data'

Row key	Personal data	Professionl data

Verification : using list command

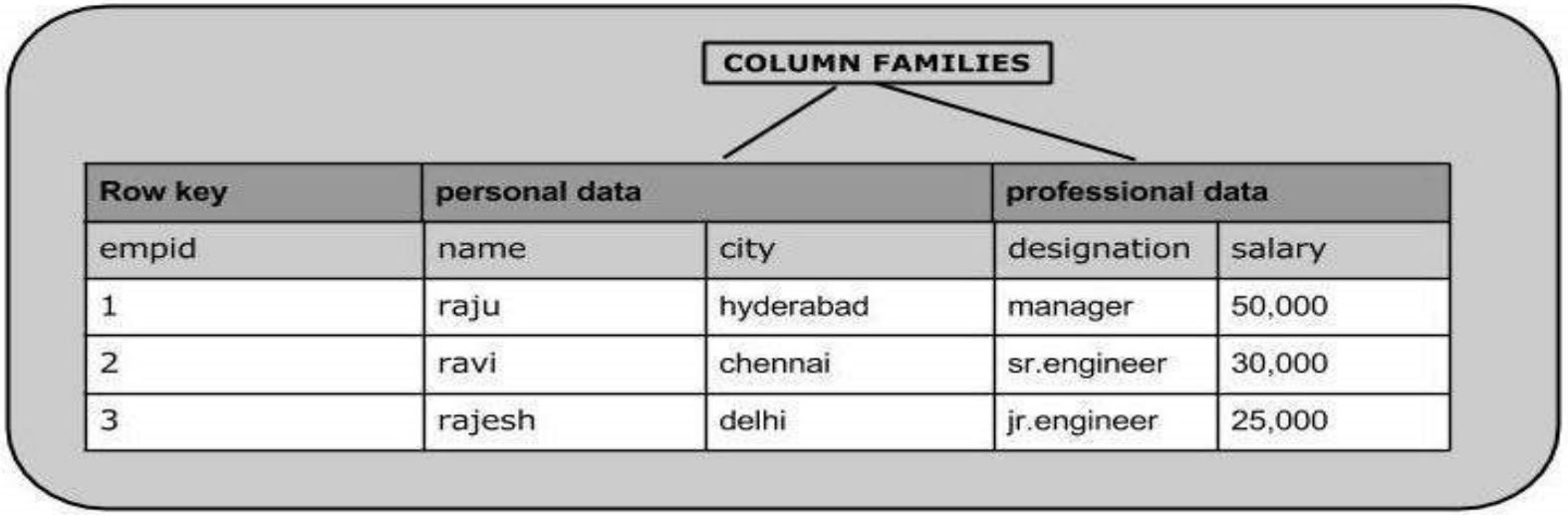
List

Table

emp

Inserting Data using HBase Shell

Put '<table_name>' , 'row1','<column family:colname>','value'



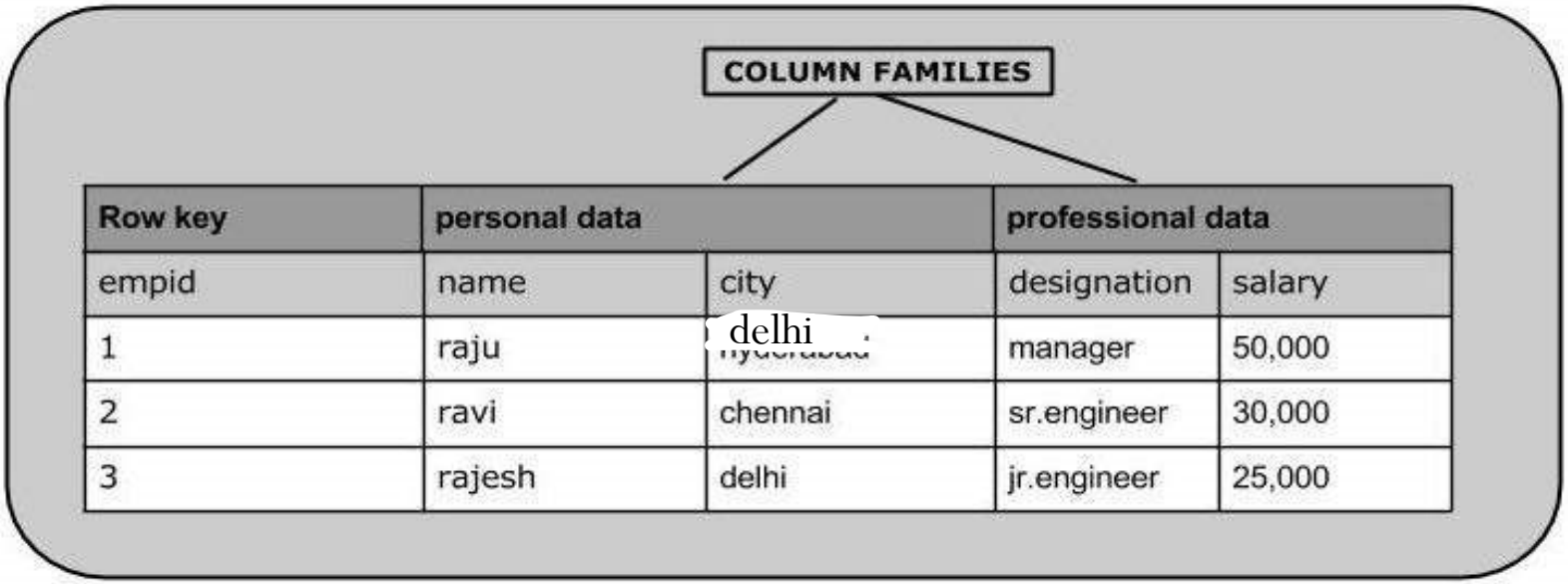
Row key	personal data		professional data	
empid	name	city	designation	salary
1	raju	hyderabad	manager	50,000
2	ravi	chennai	sr.engineer	30,000
3	rajesh	delhi	jr.engineer	25,000

Put 'emp','1', 'personal data:name','raju'

Updating Data using HBase Shell

Put '<table_name>' , 'row1','<column family:colname>','new value'

Put 'emp','1', 'personal data:city','delhi'



Row key	personal data		professional data	
empid	name	city	designation	salary
1	raju	delhi	manager	50,000
2	ravi	chennai	sr.engineer	30,000
3	rajesh	delhi	jr.engineer	25,000

Reading Data using HBase Shell

get‘<table_name>’ , ‘row1’

get‘emp’ , ‘1’

Output : All the information related to row1

Reading a Specific Column

get‘<table_name>’ , ‘rowid’, {COLUMN=‘columnfamily:columnname}

get‘emp’ , ‘row1’, {COLUMN=‘personal:name’}

Output : raju

Scan --- also used to view Hbase table **scan ‘<tablename>’**

Java API

Step 1: **Instantiate the Configuration Class create()**

Configuration conf = HbaseConfiguration.create();

Step 2: **Instantiate the HTable Class**

Htable htable = new Htable(conf,tableName);

Instantiate the Get Class get() method

Get get = new Get(toBytes("row1"));

Read the Data add() method

get.addfamily(personal data)

get.addfamily(personal data, name)

HBase - Security

- GRANT

  grant <user> <permissions>

  grant 'adb' 'RWXCA'

- REVOKE

  revoke<user>

- USER_PERMISSION

  user_permission <tablename>

R-Read Privilege
W-write privilege
X-execute privilege
C-create privilege
A-admin priviliege

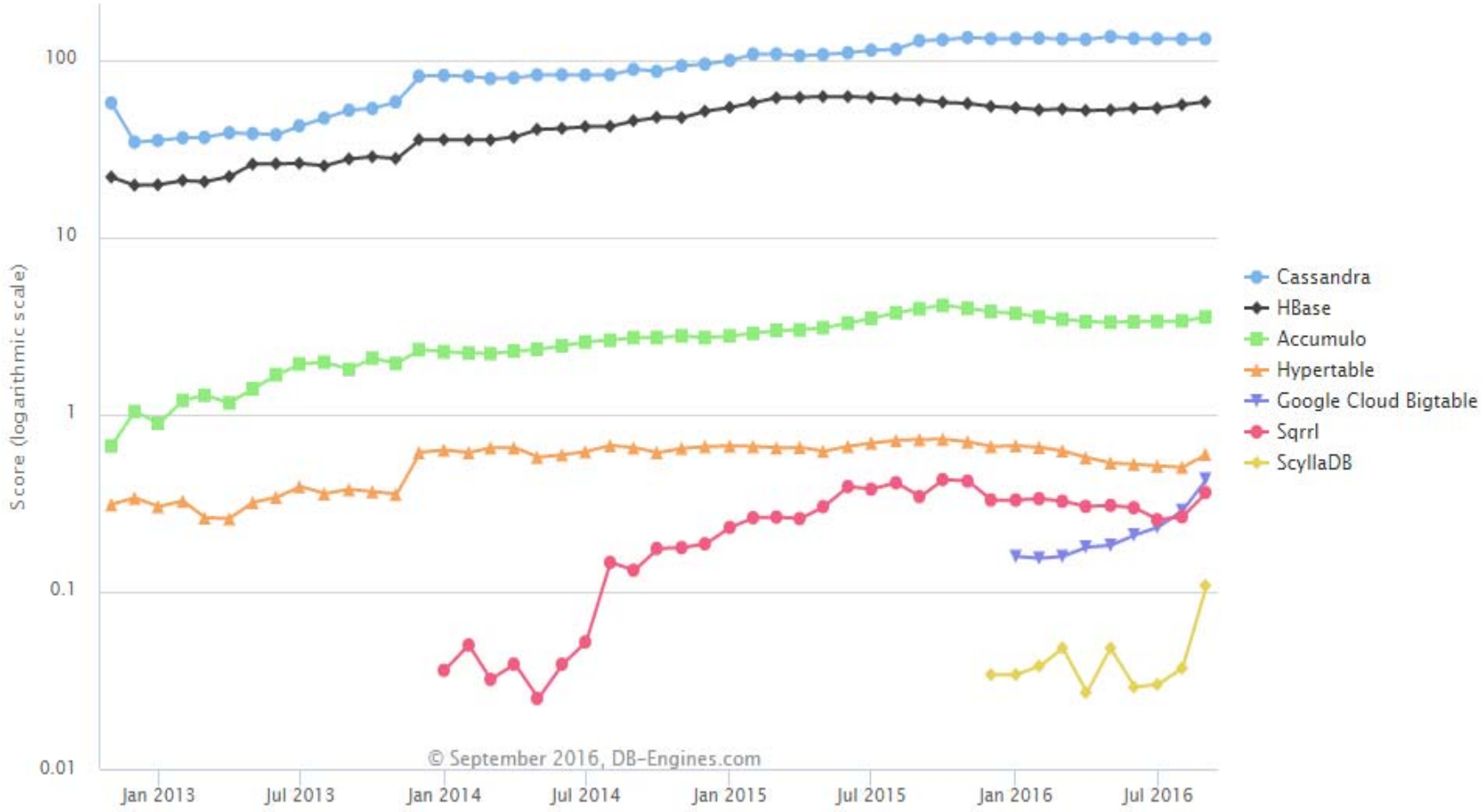
HBase vs. RDBMS

	RDBMS	Hbase
Data Layout	Row Oriented	Column Oriented
Transactions	Multi Row ACID	Single row Only
Query Language	SQL	Get/put/scan
Read/Write Throughput Limits	1000s queries/second	Millions of queries/second

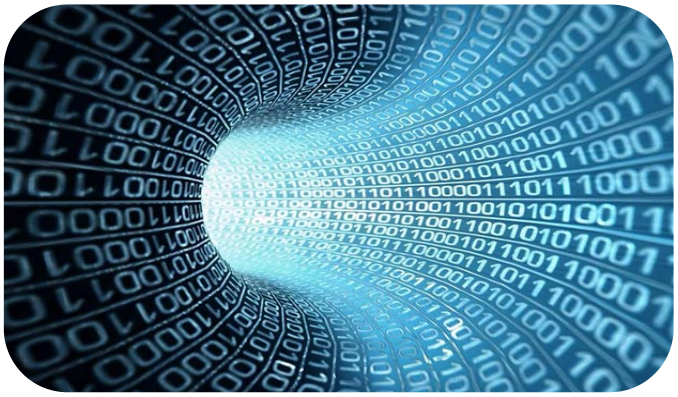
HBase is growing!!!


airbnb
amadeus
Adobe
imgur
Sears
NETFLIX
FLURRY
from YAHOO!

Ranking of Wide Column Stores



When to use Hbase?



While dealing with large amounts of data.

Not a replacement for RDBMS.

Having a use case that fits.

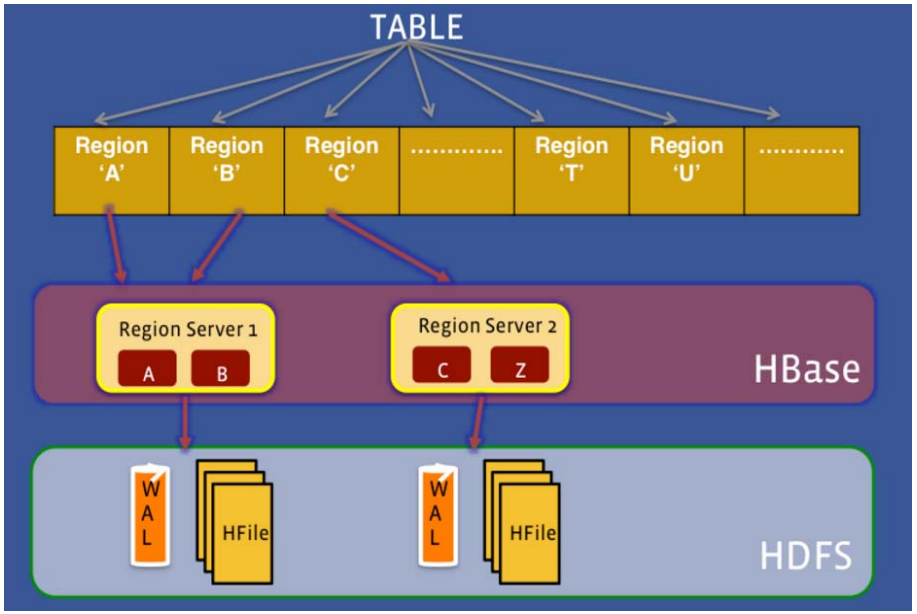
If you're ready for a lot of monitoring.

Why did Facebook use Hbase?

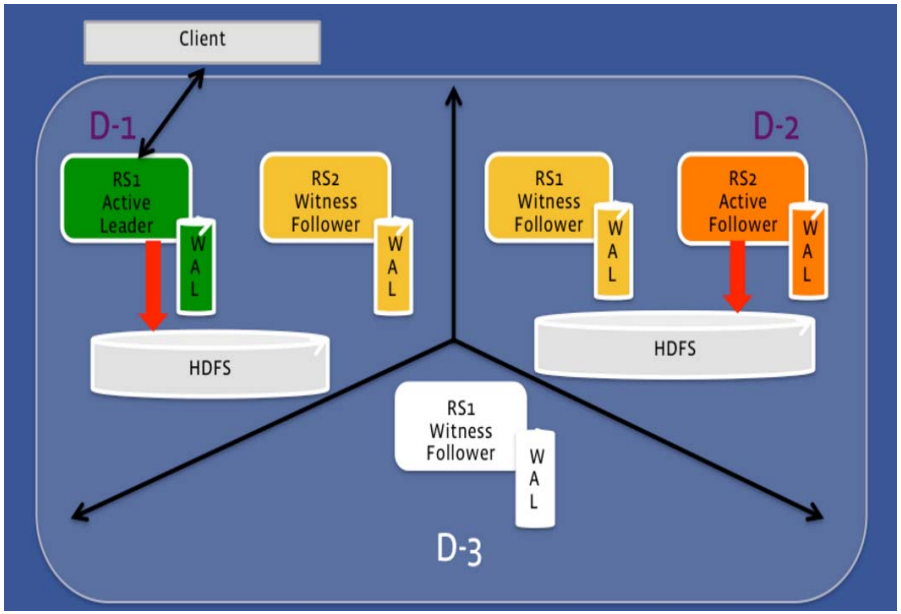
- Had over 350 million users
- Over 15 billion person to person messages per month
- To integrate email, IM, SMS, text messages.
- Hbase beat Apache Cassandra & MySQL.
- Hbase uses HDFS
- Haystack
- Zookeeper
- A major contributor too : Hydrabase

Evolution of Hbase: HydraBase

- To improve reliability
- It offers improved failover time



Problem



Solution

Why did TempoIQ ditch Hbase?

- Wrong use case
- Hbase as storage for sensor analytics data without proper configuration

Their Justification :

- Isolation
- Performance Variability – Compaction and Garbage collection
- Recovery scenarios

Piece of advice :

- Life could get a lot easier if you configure Hbase correctly from the beginning.

Some other use Cases:

- Runs 38 different hbase clusters
- Some clusters doing 5 million ops/sec
- To handle large number of queries per second
- Low read latency
- Wide Schema

- Hadoop Mapreduce + MySQL ☹
- Hbase ☺
- Wide Schema

GROUPON™

- Started Customer profiling
- Hbase to the rescue

goibibo.com

" HBase has earned a reputation for being rock-solid when properly stood up. In Cloudera's regular support reviews, we can see that HBase has continually reduced the number of tickets per deployed cluster. In fact, in the past year we've greatly increased the number of HBase deploys with no proportional increase in support incidents."

----Jonathan Hseieh, Tech Lead and Manager of the Apache HBase Team, Cloudera

"Our developers love working with HBase, since it uses really cool technology and involves working with "Big Data".We're working with something that most people can't imagine or never get the chance to work with. This is the leading edge of data storage technology, and we really feel like we're inventing the future in a lot of ways."

----Ryan Rawson, System Architect , StumbleUpon

APACHE HBASE