

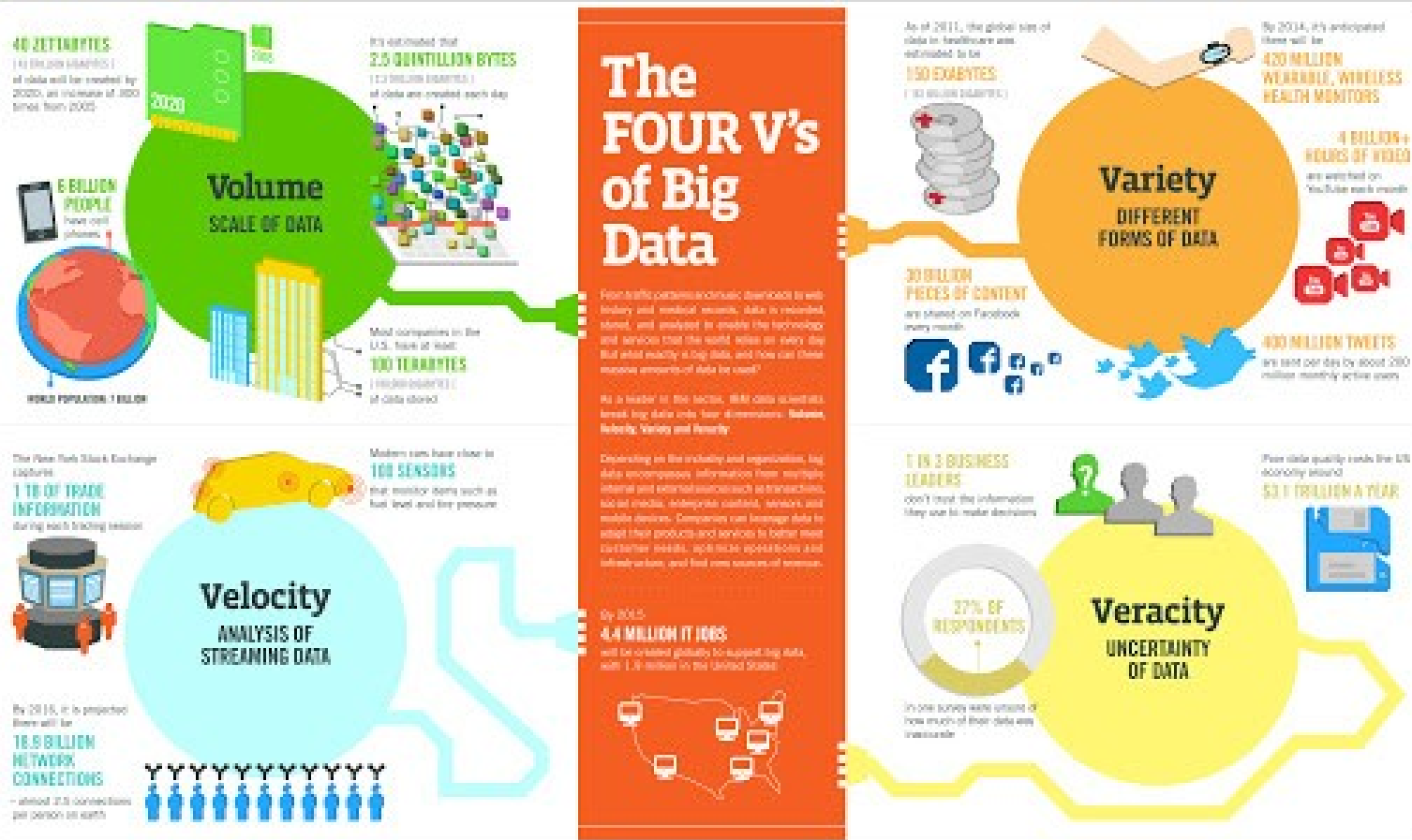
Apache Hadoop Ecosystem

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Big Data



Sources: Business Global Institute, Twitter, Cisco, Statista, IDC, SAS, IBM, BIPTCC, BIA

IBM

- More data usually beats better algorithms!
- Need of Scalable and Distributed Data Management Systems

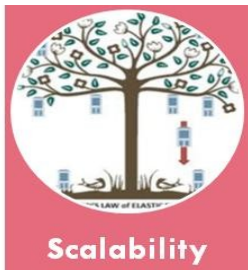
System Requirements



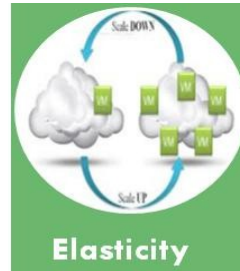
- Response time (CRUD, OLTP)
- Processing Time (analytics: data mining, OLAP workloads)



- Continuity of service despite nodes' failures
 - » Data recovery
 - » Query/Job recovery



- System performance face to n times higher loads + n times hardware capacities



- Automatic provisioning and relinquish of resources
- Storage: bucket split/merge



- Cost in-premises
- Cost at a CSP

System Categorization

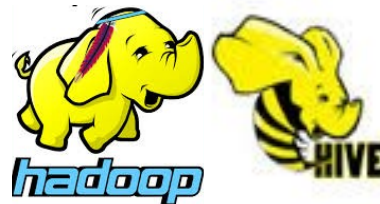
Classical

Columnar

MapReduce

Dataflow

Array DB



Graph DB

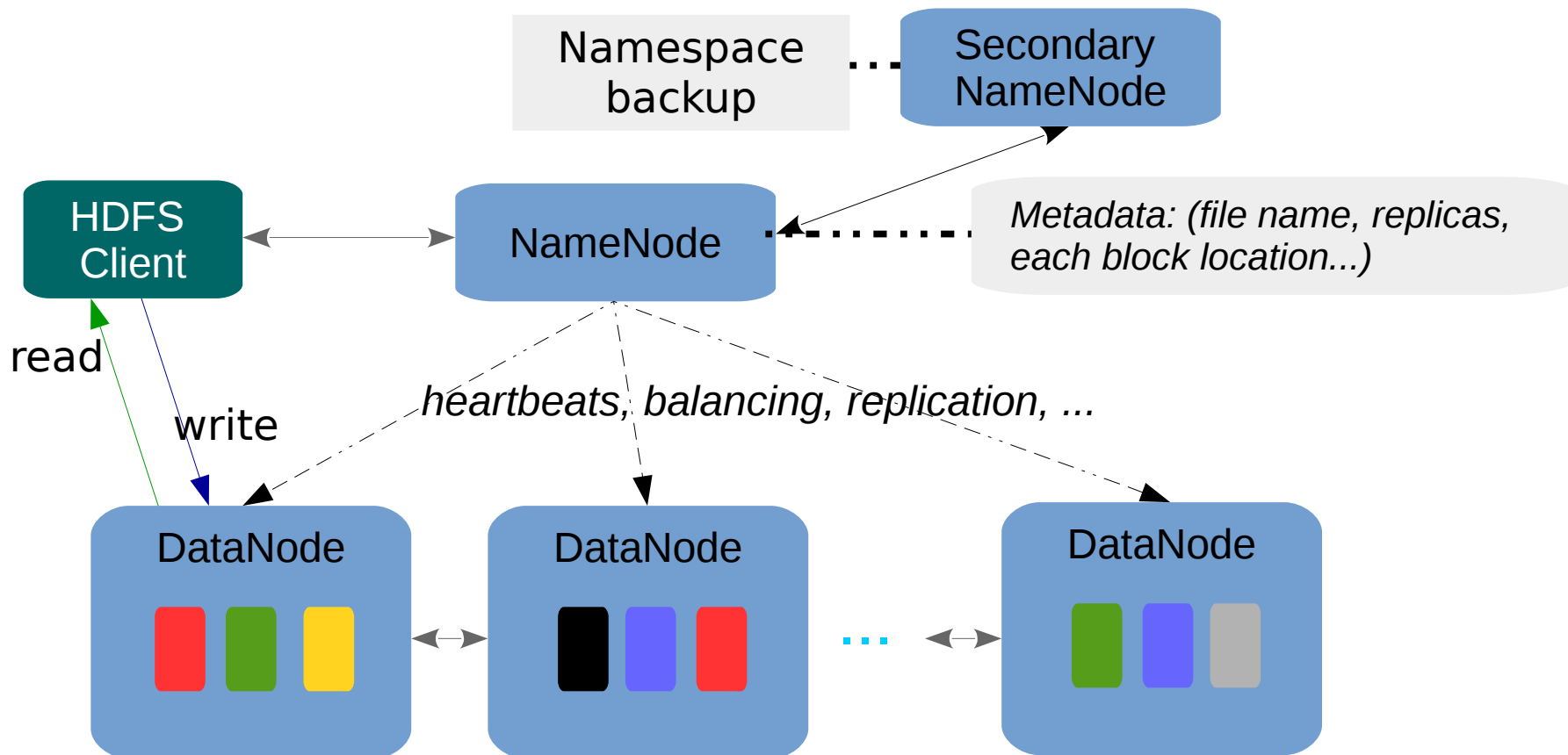
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Ecosystem



- **Sqoop:** designed for efficiently transferring bulk data between Apache Hadoop and structured datastores
- **Hama:** distributed engine for massive scientific computations such as matrix, graph and network algorithm (BSP)
- **HCatalog:** table mgmt layer for Hive metadata to other Hadoop applications
- **Mahout:** scalable machine learning library.
- **Ambari:** software for provisioning, managing, and monitoring Apache Hadoop clusters
- **Flume:** distributed service for efficiently collecting, aggregating, and moving large amounts of log data
- **Giraph:** iterative graph processing system
- **DRILL:** low latency SQL query engine for Hadoop
- **Oozie or TEZ:** workflow automation

Storage Architecture



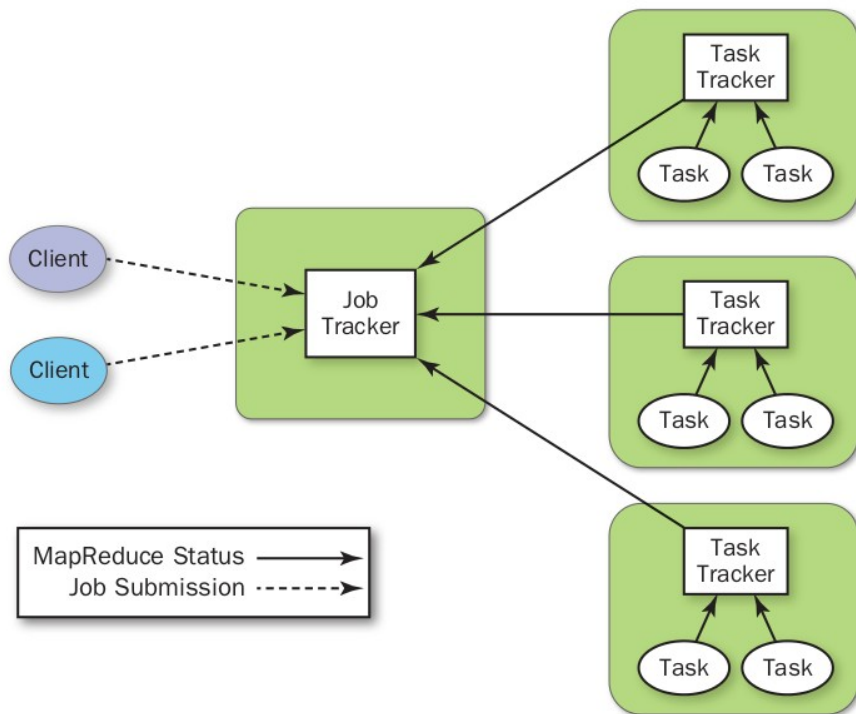
- » *HDFS client* asks the *Name Node* for metadata, and performs reads/writes of files on *DataNodes*.
- » *Data Nodes* communicate with each other for pipeline file reads and writes.

HDFS

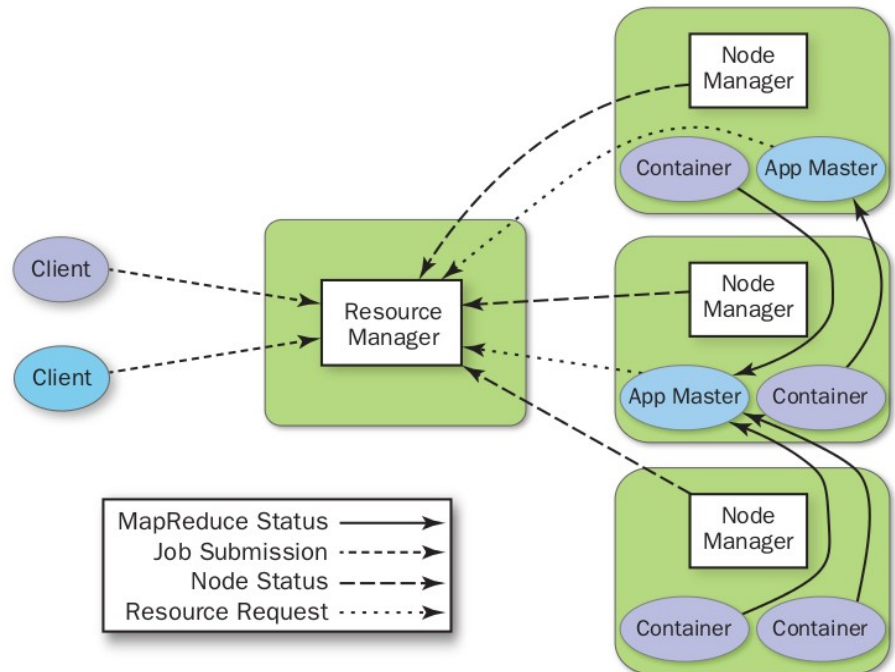
- Distributed File Systems
 - » Network File System (Sun Microsystems, 1984), ...
 - » Google File System (Google, 2000)
- Large scale distributed data intensive systems
 - » big data, I/O-bound applications
- Key properties
 - » High-throughput
 - » Large blocks: 256MB,.. versus common kilobyte range blocks (8KB, ..)
 - » Scalability
 - » Yahoo requirements for HDFS in 2006 were,
 - storage capacity: 10 PB,
 - number of nodes: 10,000 (1TB each),
 - number of concurrent clients: 100,000, ...
 - » K. V. Shvachko. *HDFS Scalability: the limits to growth*.
 - Namespace server capacities correlates to the storage capacity of hadoop clusters.
 - » High availability
 - » Achieved through blocks' replication

Hadoop 0 | 1.x vs Hadoop YARN

Hadoop 0 | 1.x

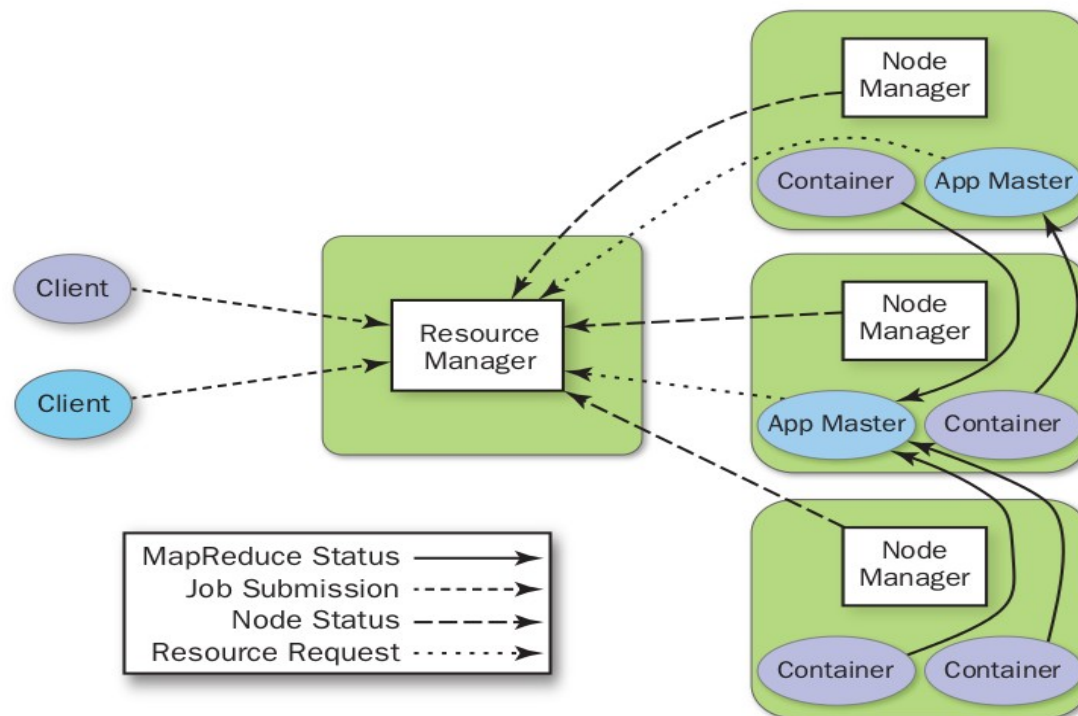


Hadoop YARN



- » Static resource allocation deficiencies
- » *Job Tracker* manages cluster resources and monitors MR Jobs

Hadoop YARN: Job Processing



- » *Application Master* manages the application's lifecycle, negotiates resources from the *Resource Manager*
- » *Node Manager* manages processes on the node
- » *Resource Manager* is responsible for allocating resources to running applications,
- » *Container* (YARN Child) performs MR tasks and has its CPU, RAM attributes

HDFS

- `hadoop dfs -help ls`
- `hadoop dfs -ls`
- `hadoop dfs -lsr`
- `hadoop dfs -mkdir /user/hadoop/dir1`
`/user/hadoop/dir2`
- `hadoop dfs -rm example.txt`
- `hadoop dfs -rmr /user/hadoop/dir`
- `hadoop dfs -copyFromLocal $HOME/dir1 dir1`

References

- Chuck Lam. *Hadoop in Action*. Manning. 2011.
- Tom White. *Hadoop: The Definitive Guide*. O'Reilly, Yahoo! Press. 2009. <https://github.com/tomwhite/hadoop-book/>

