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Hadoop 3 is coming – what's new and what's next?

About Wei-Chiu

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Agenda

The Problem
What is Hadoop
Major Hadoop 3 Features
What's Next?

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“Data helps solve problems”

- Anne Wojcicki

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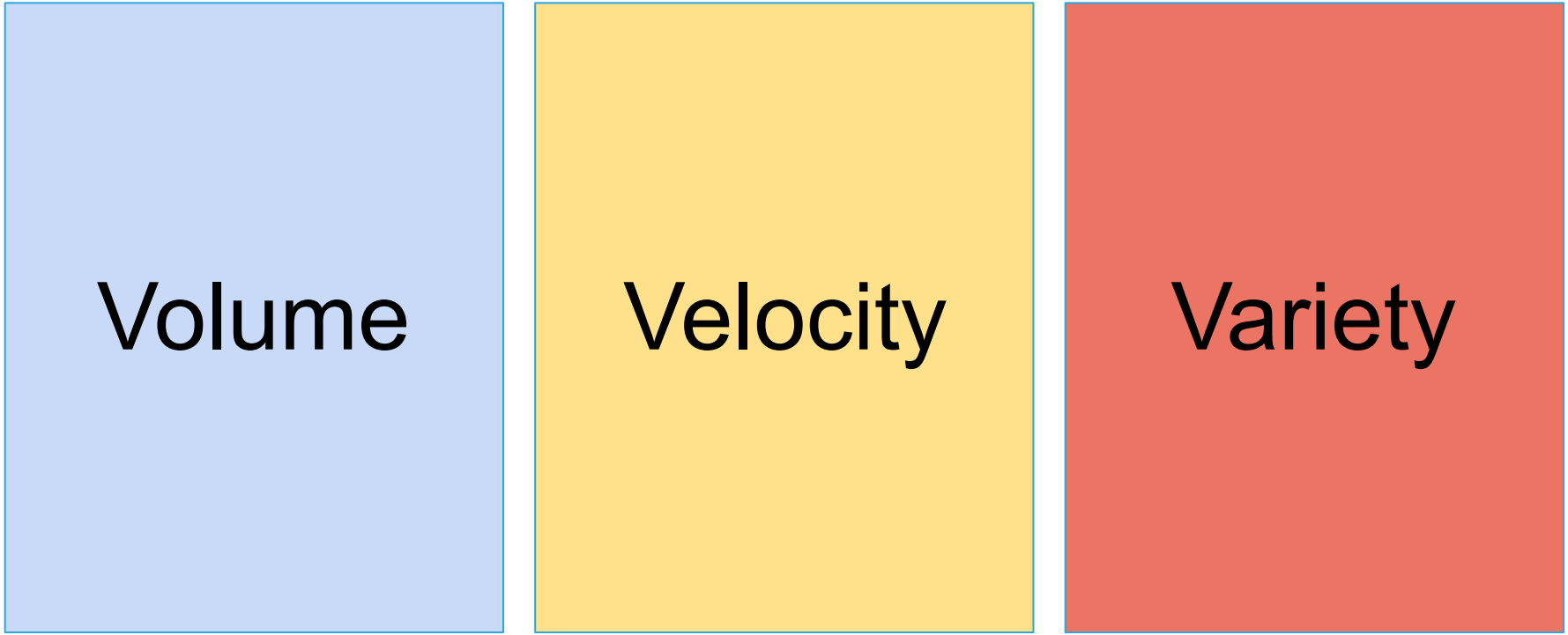
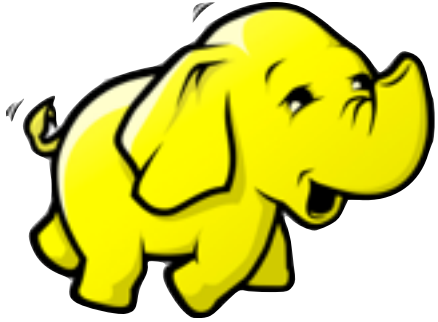
Big Data - 3Vs



Apache Hadoop



The de facto Big Data Analytics platform

A distributed framework to support large scale computation on commodity hardware

- Petabyte+ storage, 1,000+ compute nodes
- Inspired by Google
- Originally developed by Yahoo!, donated to Apache Software Foundation.
- Open source :)
- 183 committers, thousands contributors

Apache Hadoop

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Cloudera

Commercializes Hadoop* technology
Open source, open culture
CDH - Cloudera's Distribution for Hadoop
- Platform. Open source

Cloudera Manager (CM), Cloudera Navigator, Key Trustee
- Cluster management, monitoring. Proprietary

*Hadoop and its associated projects

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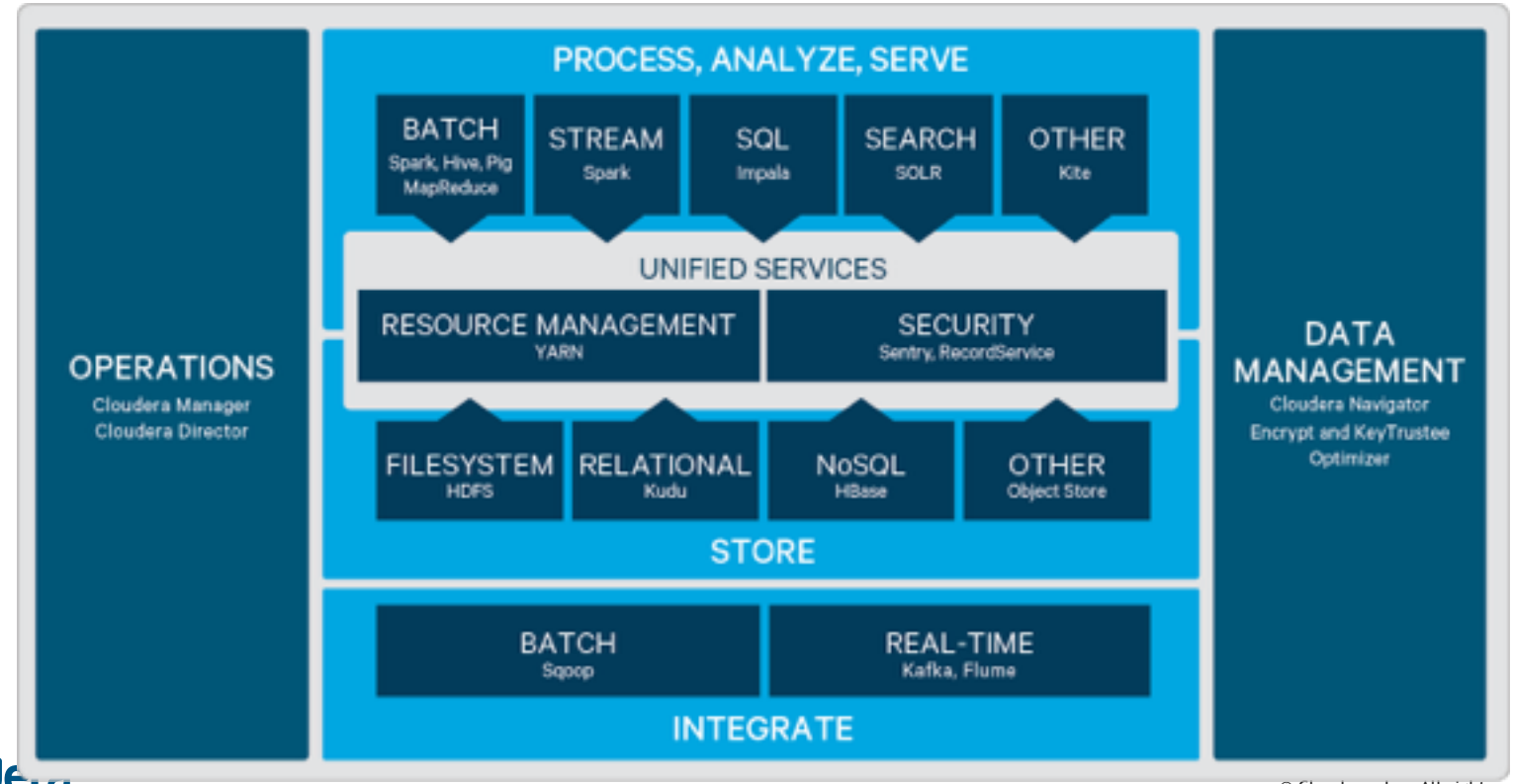
Hadoop Ecosystem



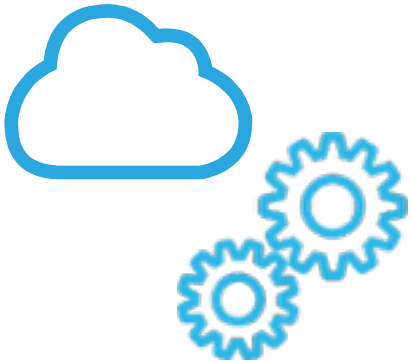
Well, data itself is a problem ...

Clusters becoming larger

Storage: reduce storage cost
Compute: much larger cluster

More enterprise adoption

High availability
High performance
Seamless experience



New applications

More cloud usage
Ease of development

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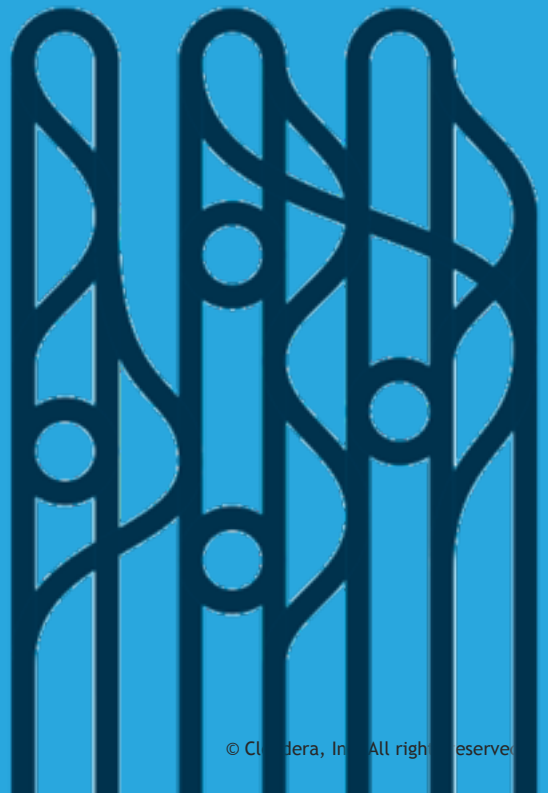
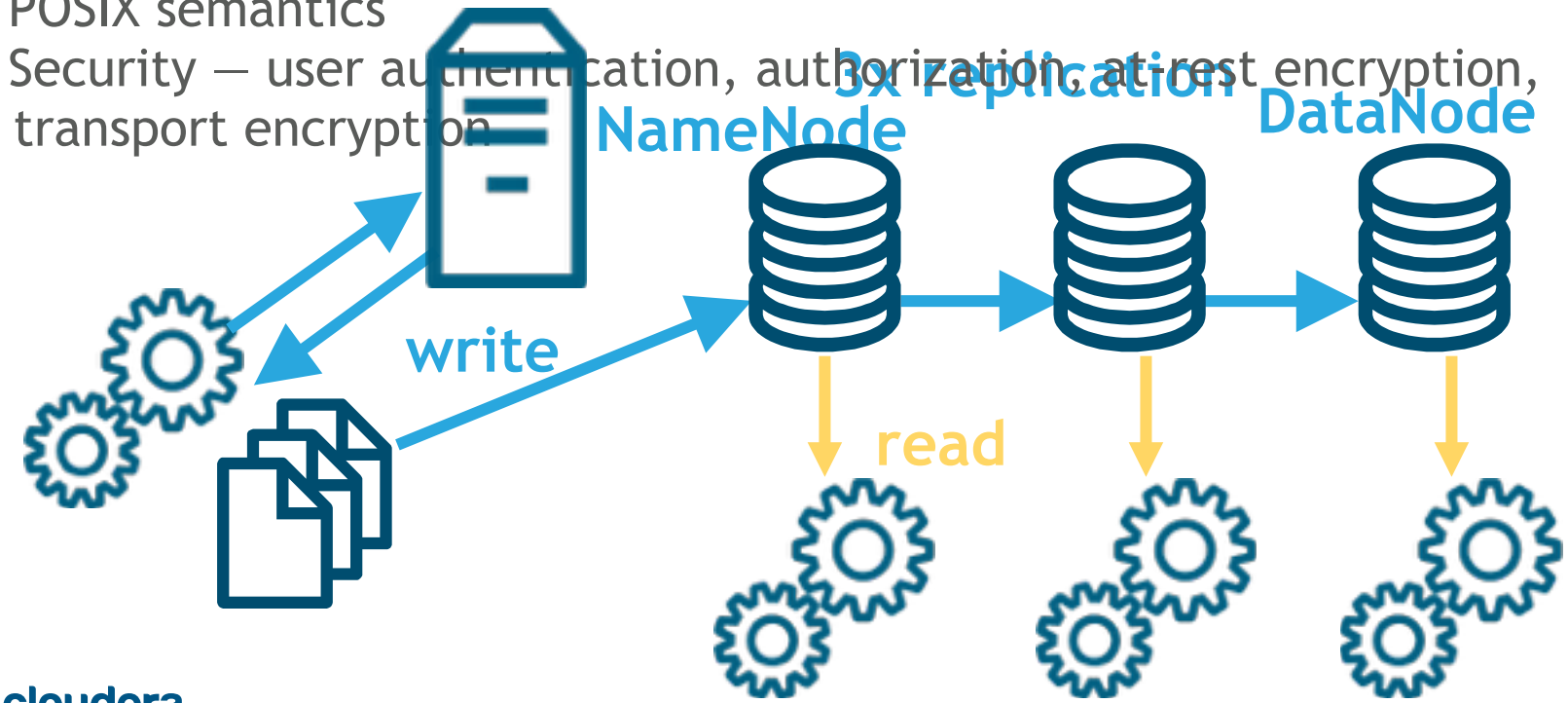
HDFS Erasure Coding



Hadoop Distributed File System

A fault tolerant, highly scalable storage system
POSIX semantics
Security — user authentication, authorization, at-rest encryption, transport encryption



Hadoop Distributed File System

Advantage

- Failure tolerant

But

- 3x storage cost
- 3x datacenter space
- 3x power consumption

How to reduce storage overhead?

Erasure Coding 101

- Parity bit
  - XOR
  - If X is lost, X can be reconstructed using Y and X ^ Y
  - 50% overhead ((3-2)/2)
  - Can tolerate one failure
- Reed-Solomon
  - RS(k,m) tolerates m failures in k data cells.
  - XOR = RS(2,1)

X	Y	X ⊕ Y
0	0	0
0	1	1
1	0	1
1	1	0

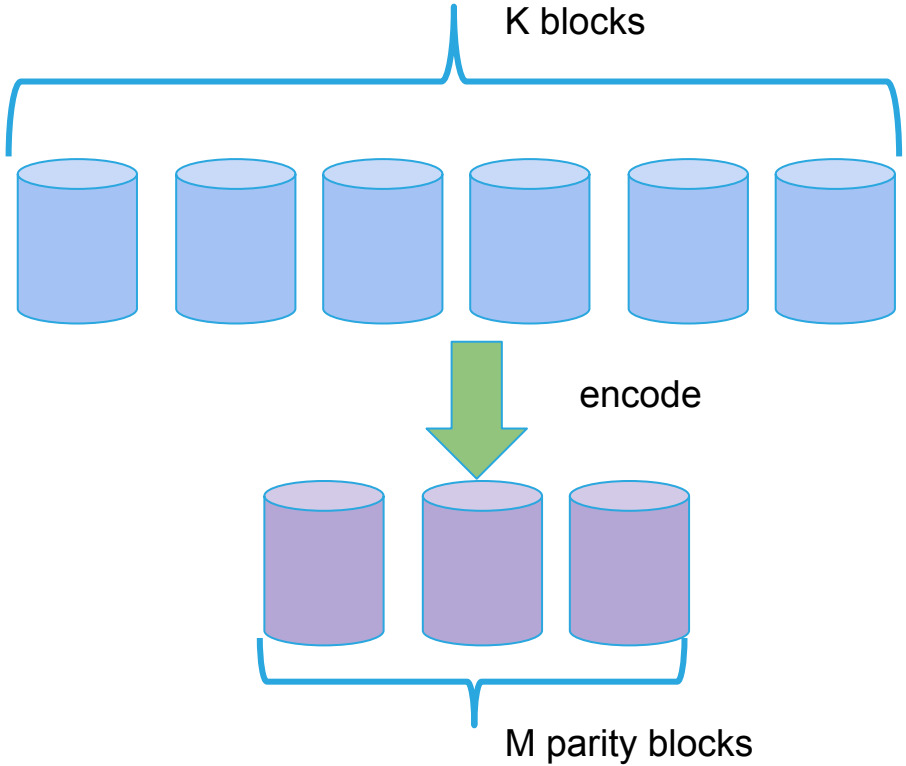
Erasure Coding 101

Reed-Solomon

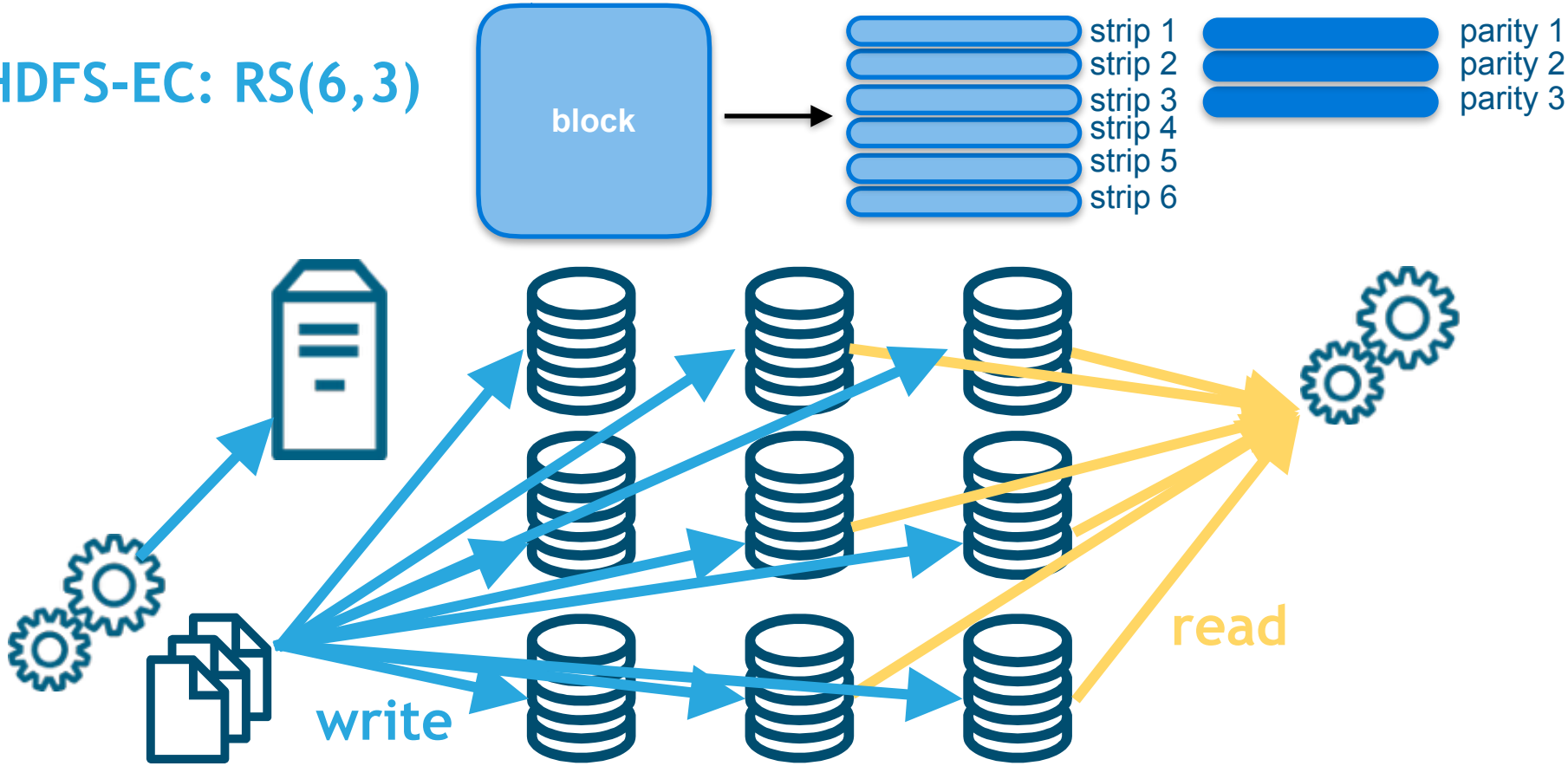
- Compute parity bits for redundancy
- Blocks can be reconstructed after failures
- Configurable durability v.s. storage overhead

RS(6,3)

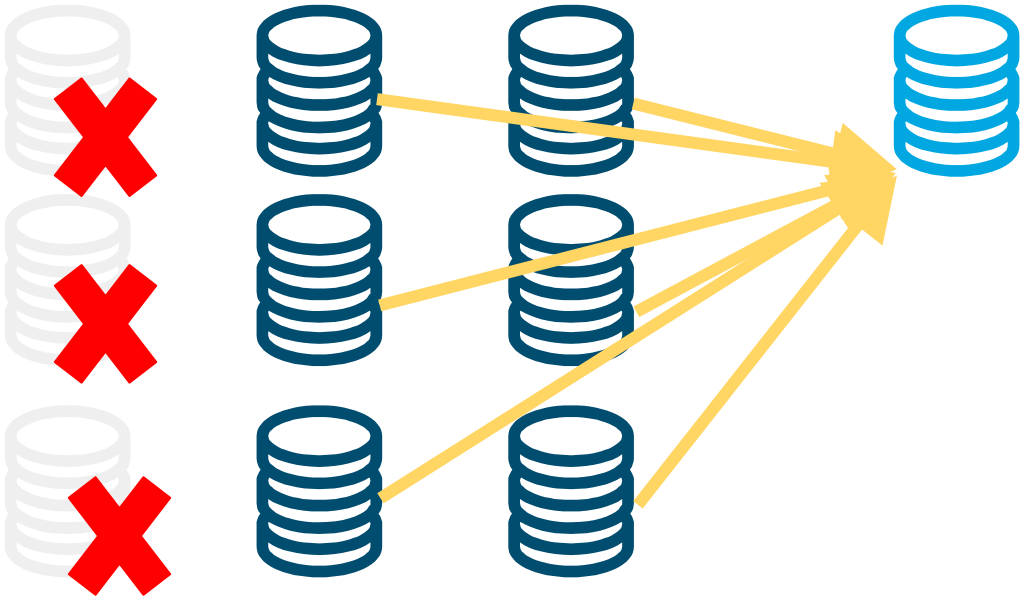
- = 50% storage overhead
- (9-6)/6

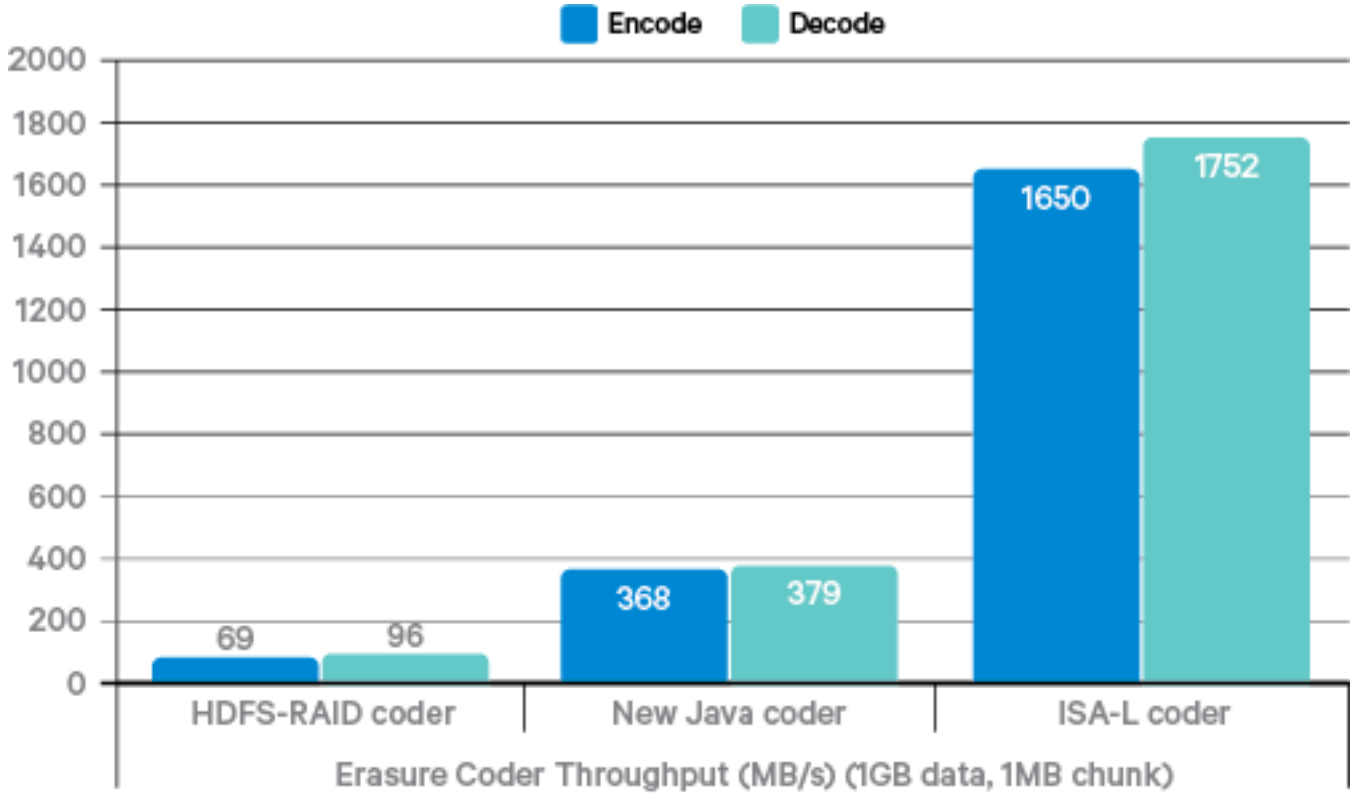


HDFS-EC: RS(6,3)



HDFS-EC: Failure Handling





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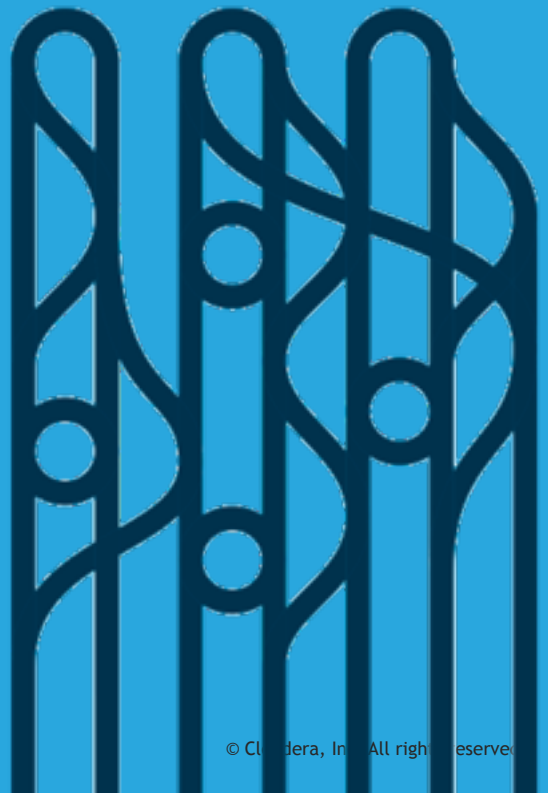
YARN Federation

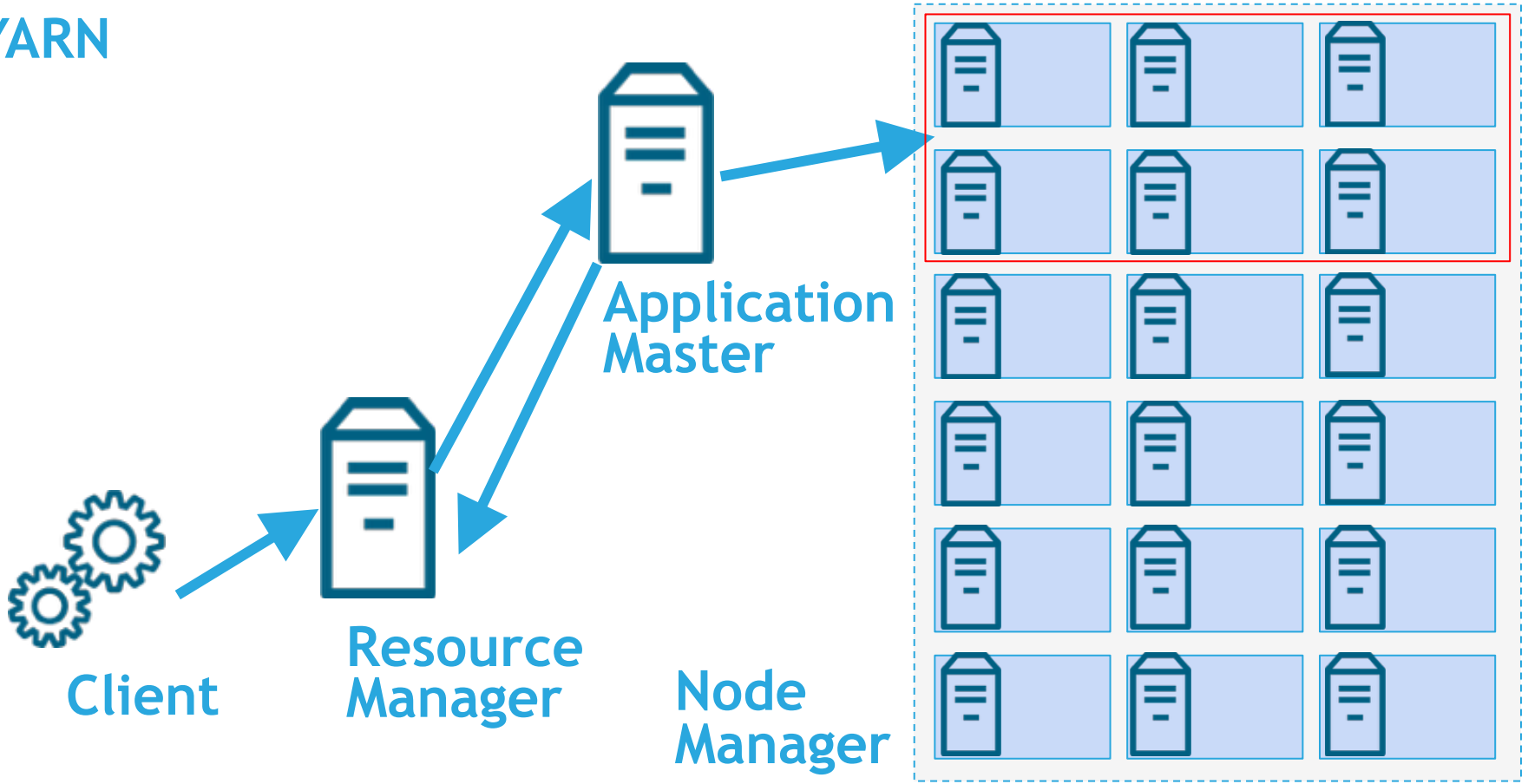


YARN

A resource management framework for Hadoop clusters

- Highly scalable, 4000 - 8000 nodes in production
- Hive, Oozie, Spark, …
- HBase

YARN

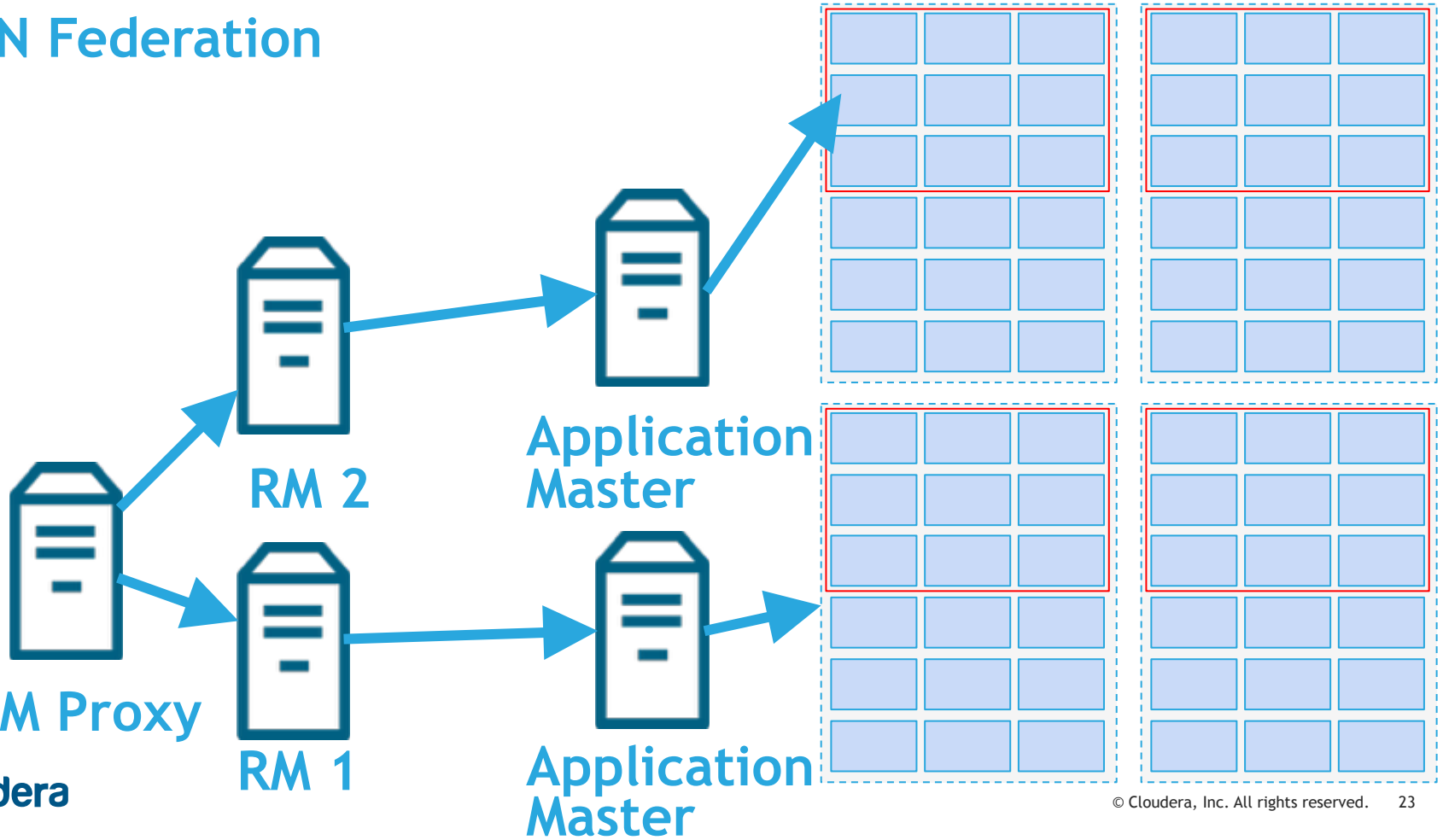


YARN Federation

Developed by Microsoft
Extreme scale

- 100,000 compute nodes
- Resource Manager becomes the bottleneck

YARN Federation



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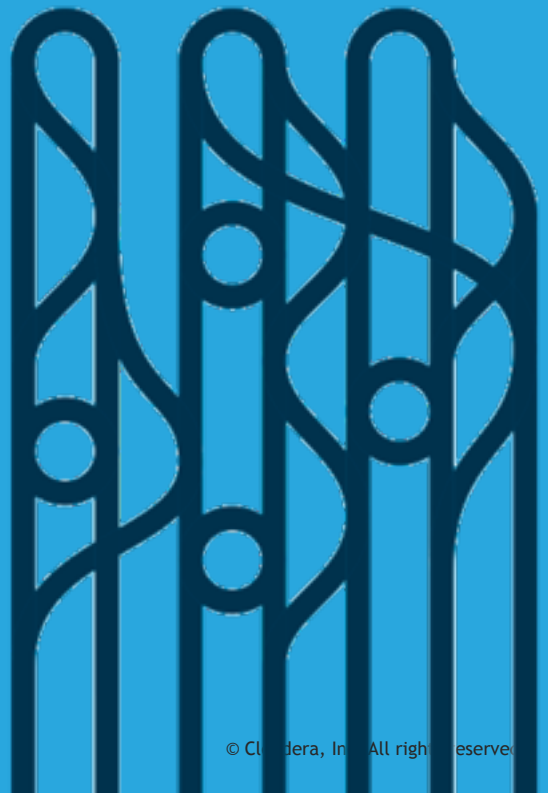
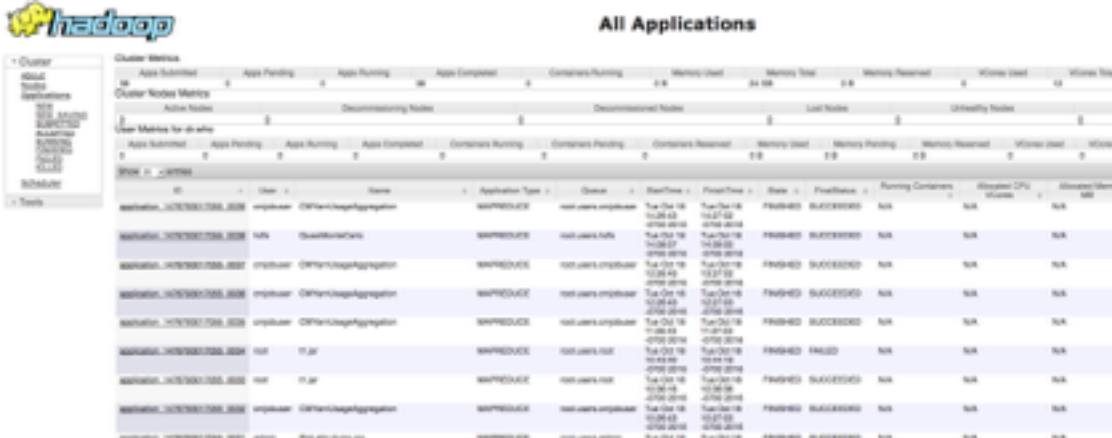
YARN Timeline Service v2



Job History Server

- Keeps track of job progress
  - Collect or retrieve information of MapReduce jobs
- Extensibility
  - MR only
- Usability
  - No YARN level events
  - Metrics can only be retrieved after job terminates



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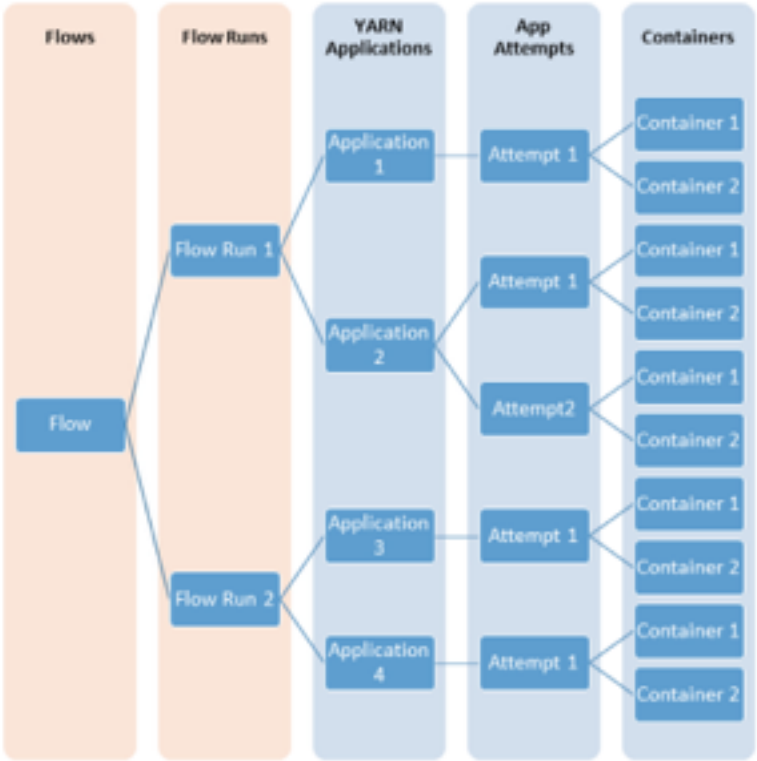
Application Timeline server v2

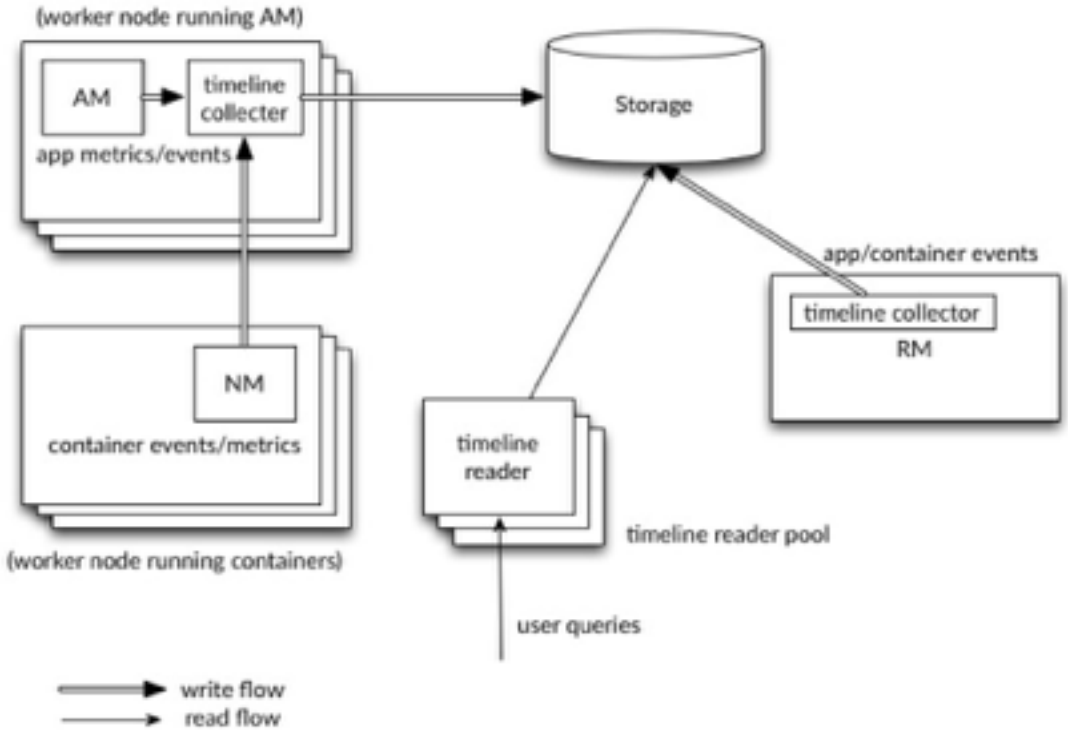
- Development led by Twitter
- Usability
  - Flow: logical group of applications
- Scalability
  - HBase
- Use cases
  - Analyze application performance.
  - Cluster capacity planning.



ASTv2 Architecture

Use HBase for storage
Use cases:

- Analyze application performance.
- Cluster capacity planning.



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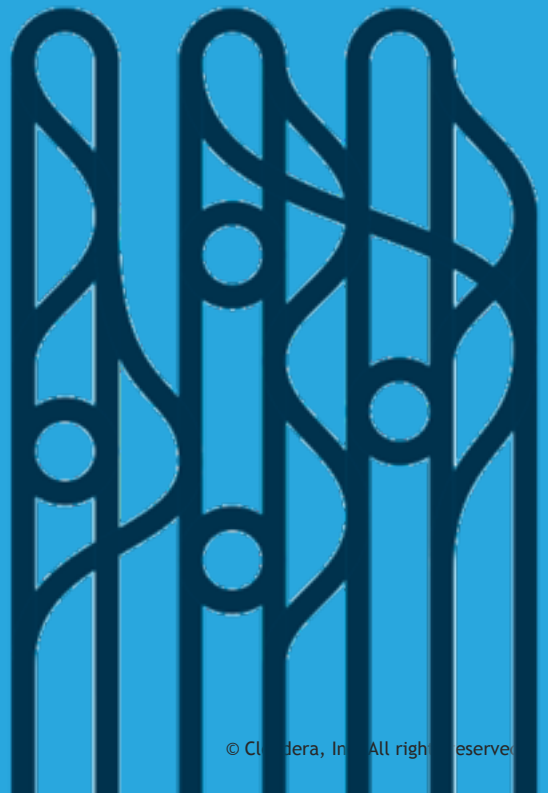
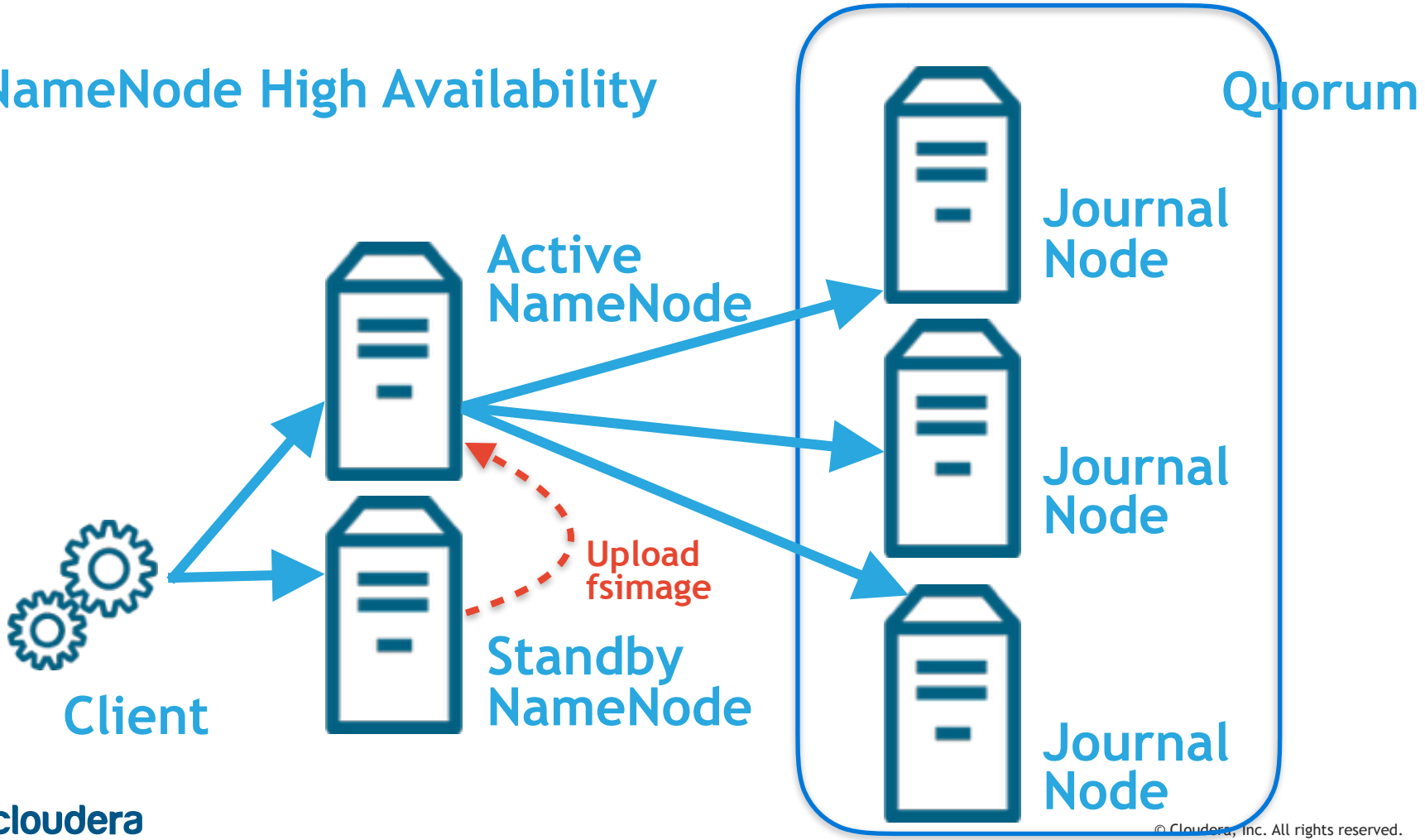
HDFS Multi Standby NameNodes

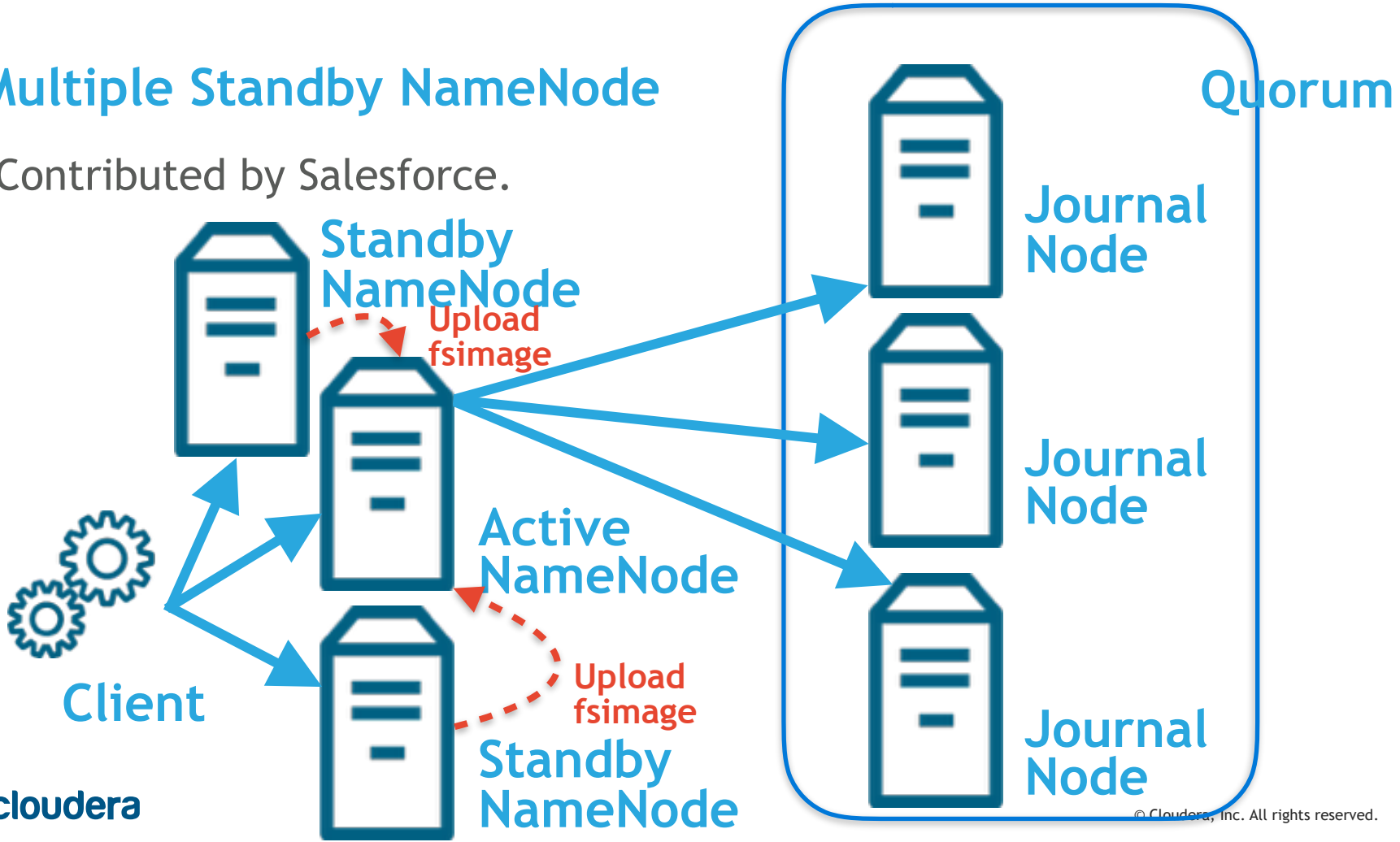


NameNode High Availability



Multiple Standby NameNode

Contributed by Salesforce.



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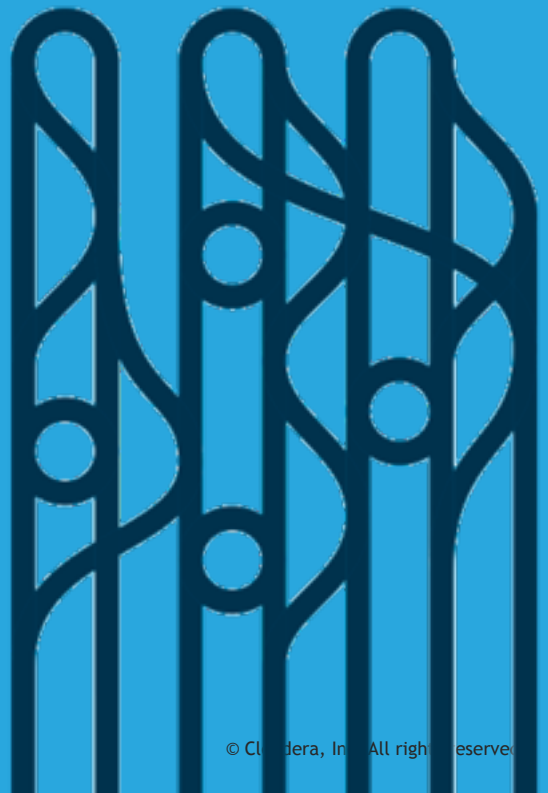
Classpath Isolation



Dependency Hell

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Dependency Hell

Hadoop was not initially designed as foundation of many applications.

- More applications depending on Hadoop
- harder for Hadoop to upgrade dependency libraries.
- Potential risk to break existing applications
- Increase exposure to security vulnerabilities

Classpath Isolation

- Separate client-side classpath from server-side

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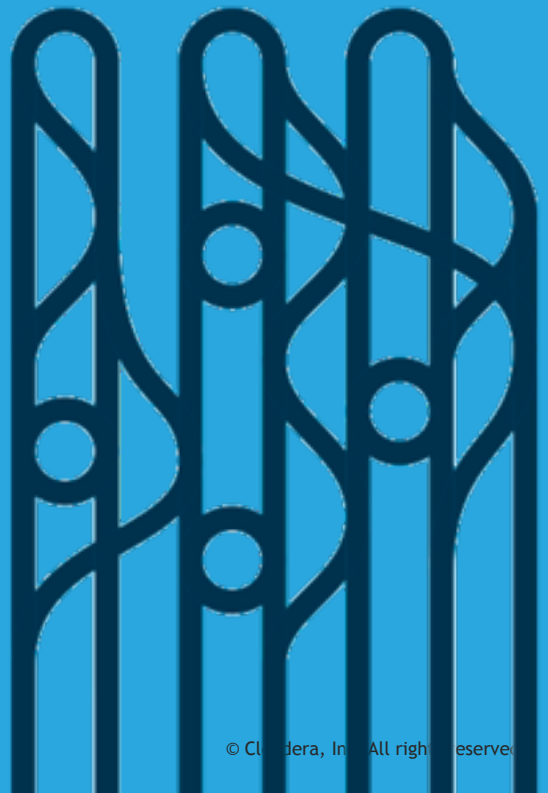
Cloud



Other features

- Cloud connectors
  - Microsoft Azure Data Lake filesystem
  - Aliyun Object Storage Service

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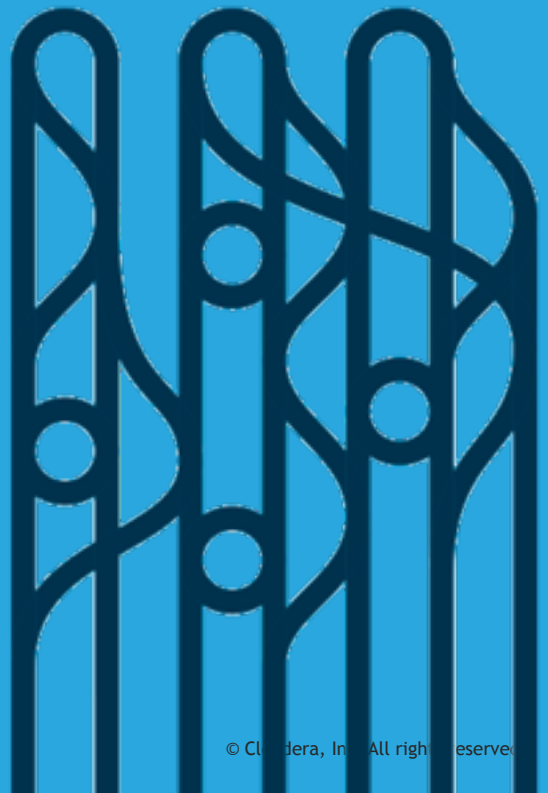
Misc.



Other features and incompatibility

- Shell script rewrite
- Requires Java 8
- Server ports
- Remove legacy features
  - S3 file system → S3A (recommended) or S3N
  - Hftp → webhdfs/httpfs
  - Bookkeeper Journal Manager → Quorum Journal Manager

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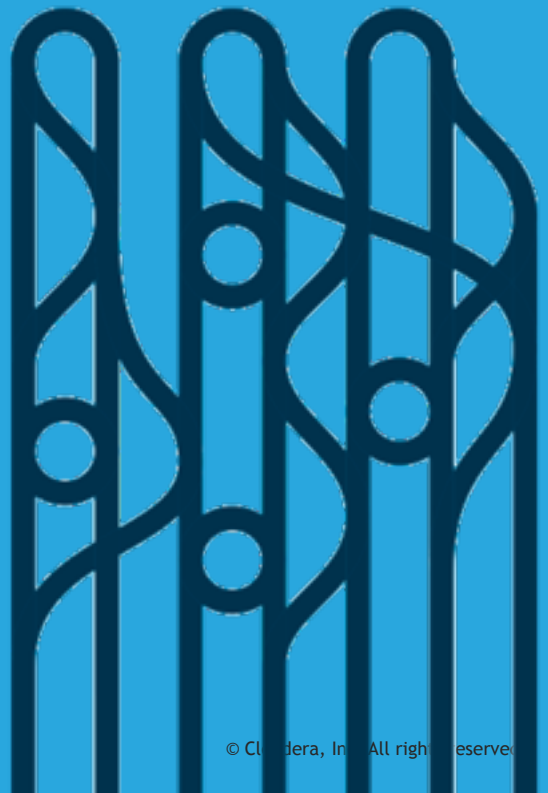
What's next?

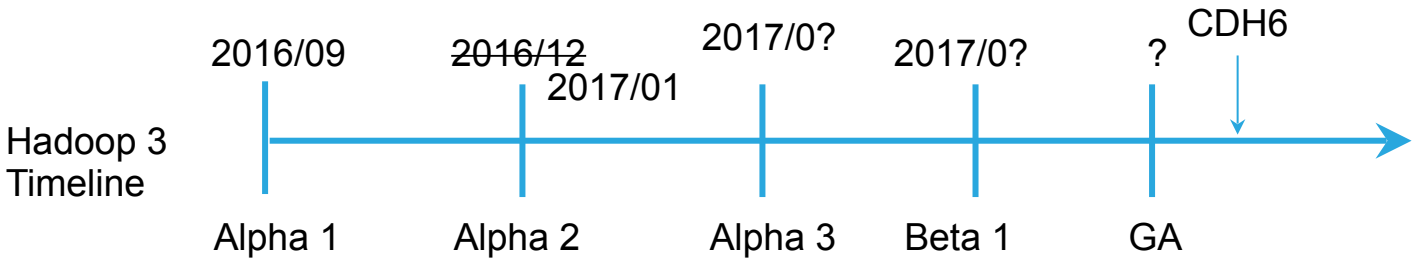


Now what?

Developers
- Use it early, test it early and file bug reports.

Administrators
- Test upgradability

Users
- Expect better user experience.



Future? Hadoop 4?

- We don’t know yet.
- Ozone (HDFS-7240)
  - Object store for HDFS
- HDFS over cloud (HDFS-9806)
- Emerging applications and use cases
  - Docker
  - Deep learning
- Hardware Trend
  - Cloud storage
  - Faster ethernet (40GBps), high density (> 100TB) storage node
  - Memory technology
  - Locality will not be a deciding factor.

Ozone (HDFS-7240)

Status quo

- NameNode is becoming a bottleneck
- A general file system may not suit the specific need of an application

Solution

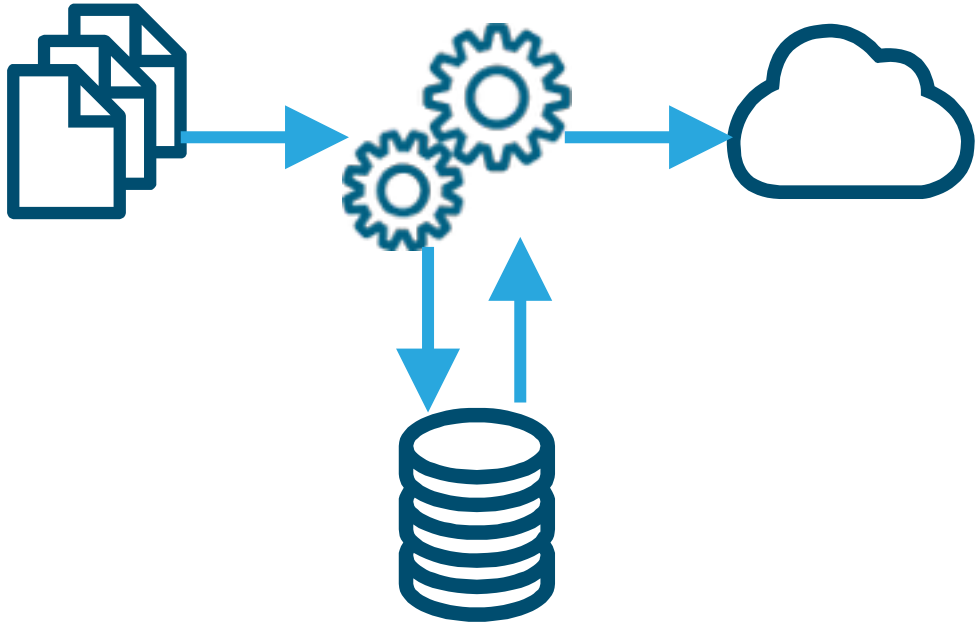
- Split HDFS namespace into blob stores

HDFS over Cloud (HDFS-9806)

Use case
- Use HDFS for temporary data
- Use cloud for permanent storage

The problem
- Data management
- Consistency

Solution
- HDFS as metastore and cache
- Cloud as backend data store



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Ask Bigger Questions

References

- Introduction to HDFS Erasure Coding in Apache Hadoop
- Enable YARN RM scale out via federation using multiple RM's
- Application Timeline Server - Past, Present and Future
- HDFS-6440 Support more than 2 NameNodes
- How-to: Use the New HDFS Intra-DataNode Disk Balancer in Apache Hadoop