Hadoop 2 : New and Noteworthy

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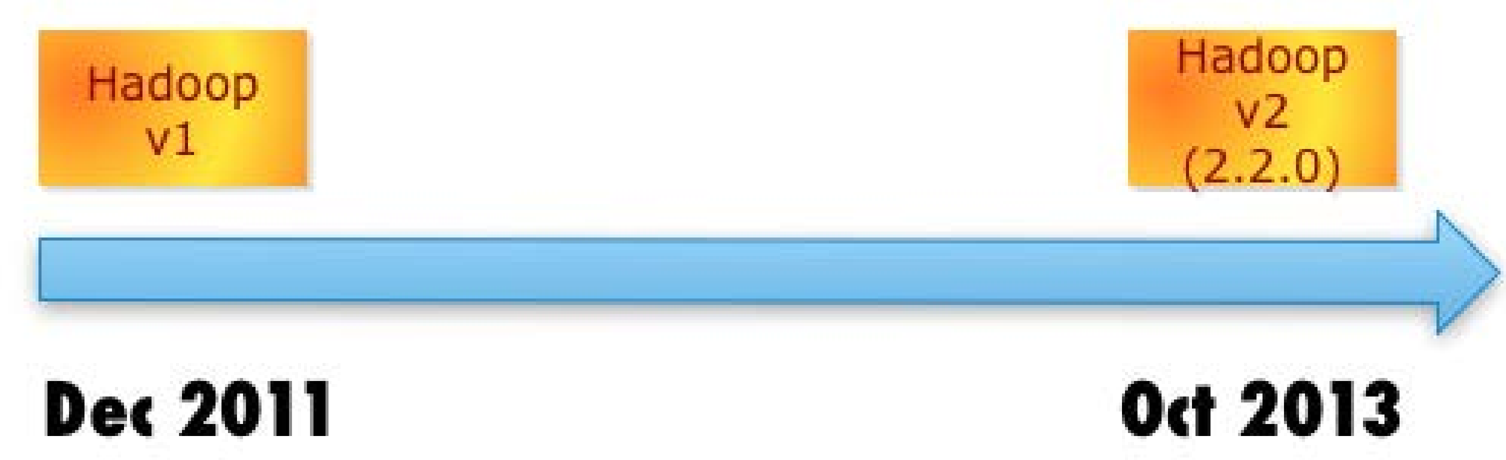
Abstract

- Hadoop 2 : New And Noteworthy Features
  - This session will appeal to Data Center Managers, Development Managers, and those that are looking for an overview of ‘whats new’ in Hadoop 2 platform. The session will highlight some of the notable features in Hadoop 2.

Quick Poll

- How many of you are NEW to Hadoop?
- How many of you are USING Hadoop?

Hadoop Timeline



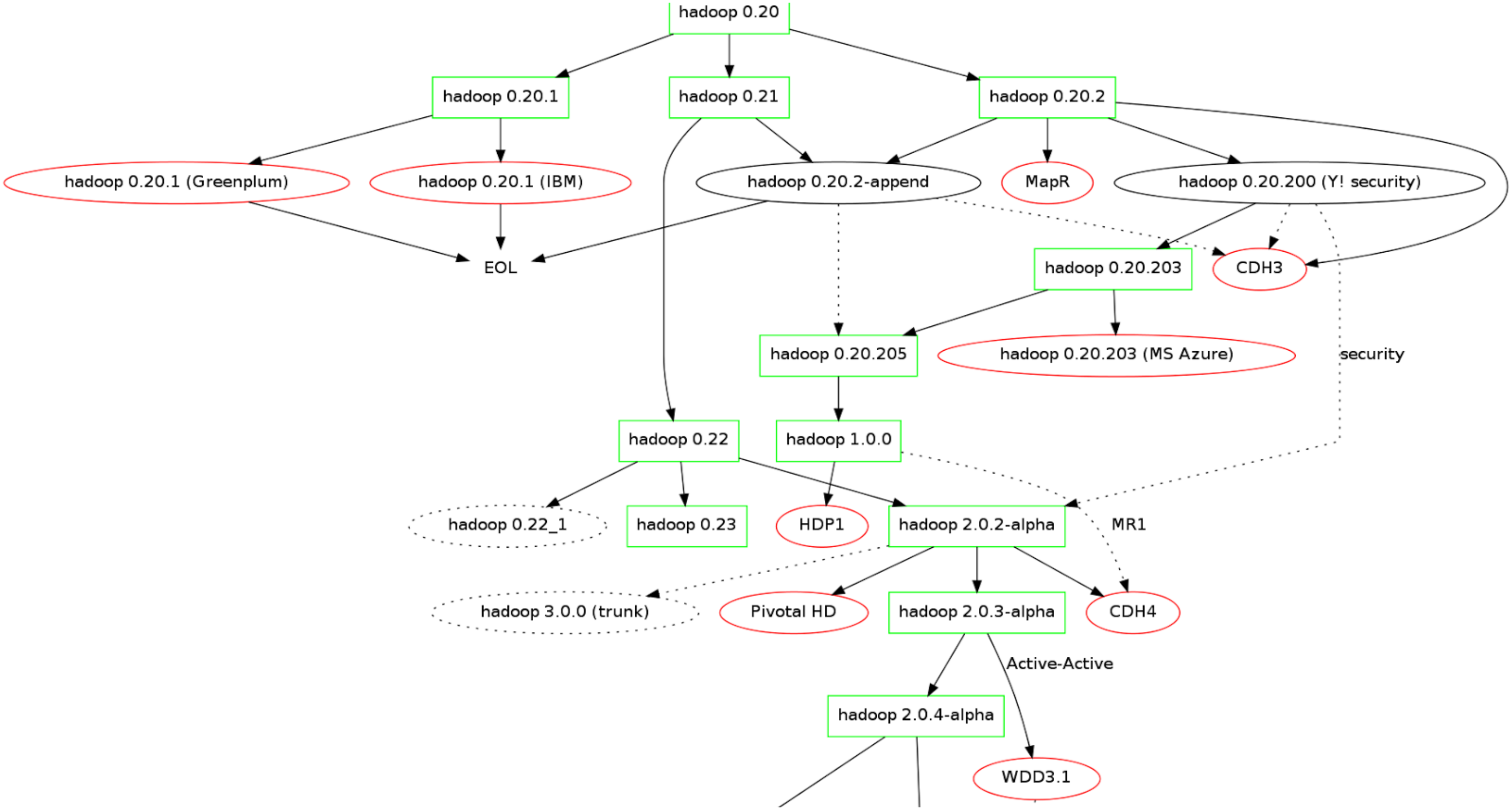
Hadoop v1

Hadoop v2 (2.2.0)

Dec 2011

Oct 2013

Hadoop Versions – ☺



Hadoop Versions – Simplified

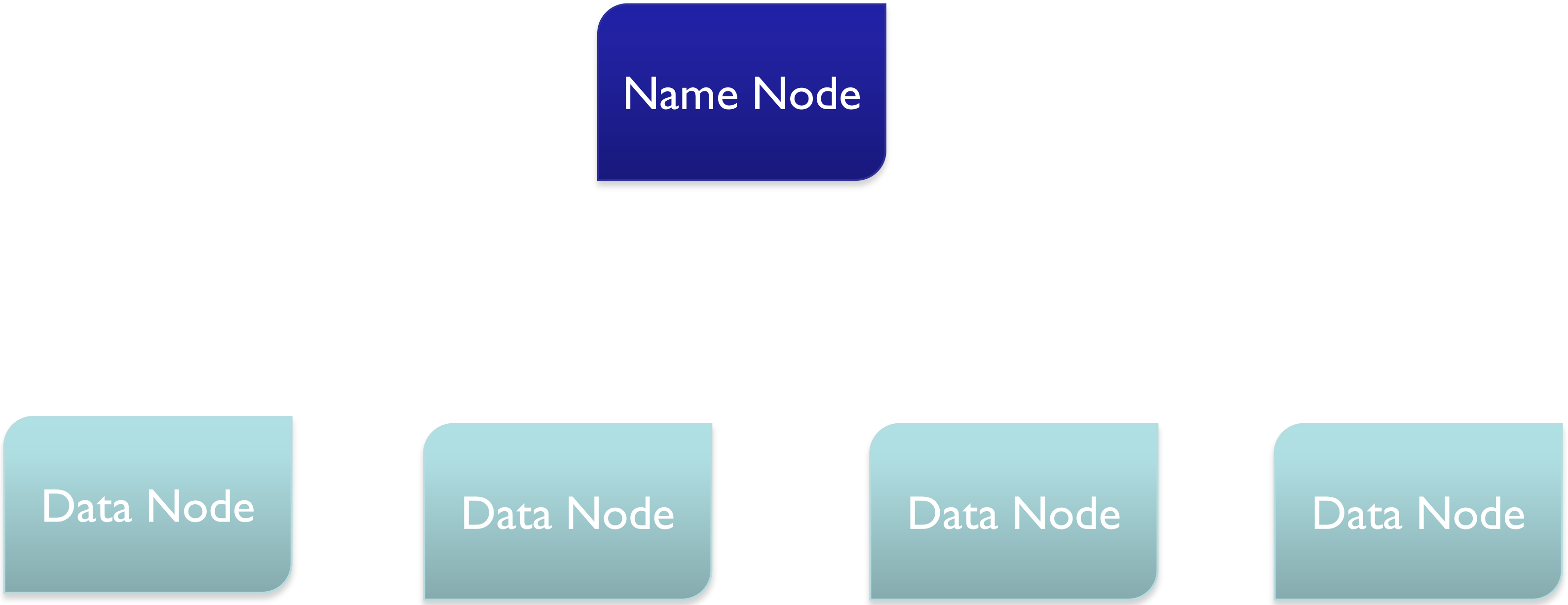
Hadoop 1	Hadooop 2
1.2.1 (aug 2013)	2.2.0 : (oct 2013)

Feature Matrix

Component	Feature	V1	v2
HDFS	NameNode High Availability		X
	Namenode federation		X
	Snapshots		X
	NFS v3 access to HDFS		X
	Improved IO		X
Processing	MapReduce v1	X	
	YARN (MapReduce v2)		X
Other	Kerberos security	X	X

Next : HDFS High Availability

HDFS Architecture (V1)



Name Node High Availability

- HDFS has (had) a ONE NameNode/ many Datanode design
- This leads to ‘Single Point of Failure’ (SPOF) for Name Node

Namenode Is Very Important In A Cluster

Is Hadoop NN Failure A Big Deal?

- At Yahoo study
  - 18 month study
  - 22 failure on 25 clusters
  - 0.58 failures per cluster per year
  - Only half of them would have benefited from HA
  - → 0.23 failure / year / cluster
- http://www.slideshare.net/Hadoop_Summit/hdfs-namenode-high-availability

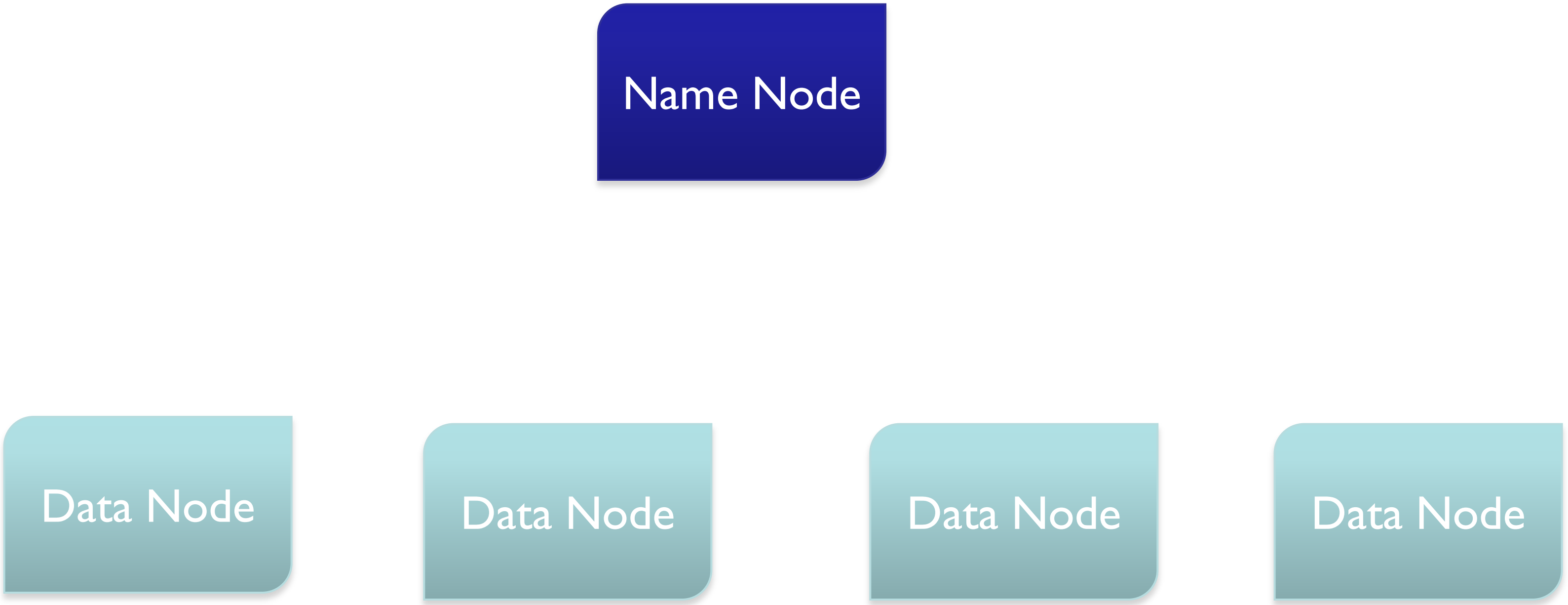
Still Needs To Be Fixed

- Downtime may be acceptable for batch workloads
- But not acceptable for running real time workloads like HBase that depend on HDFS
  - Downtime (even minutes) is not acceptable
- Make Hadoop more Enterprise friendly

How Do We Fix A Single Namenode Failure?

- Have two Namenodes !
- One ACTIVE and another PASSIVE
- When Active NN fails, Passive one will take over
- Fail over can be automated

HDFS Architecture (v1)



Name Node

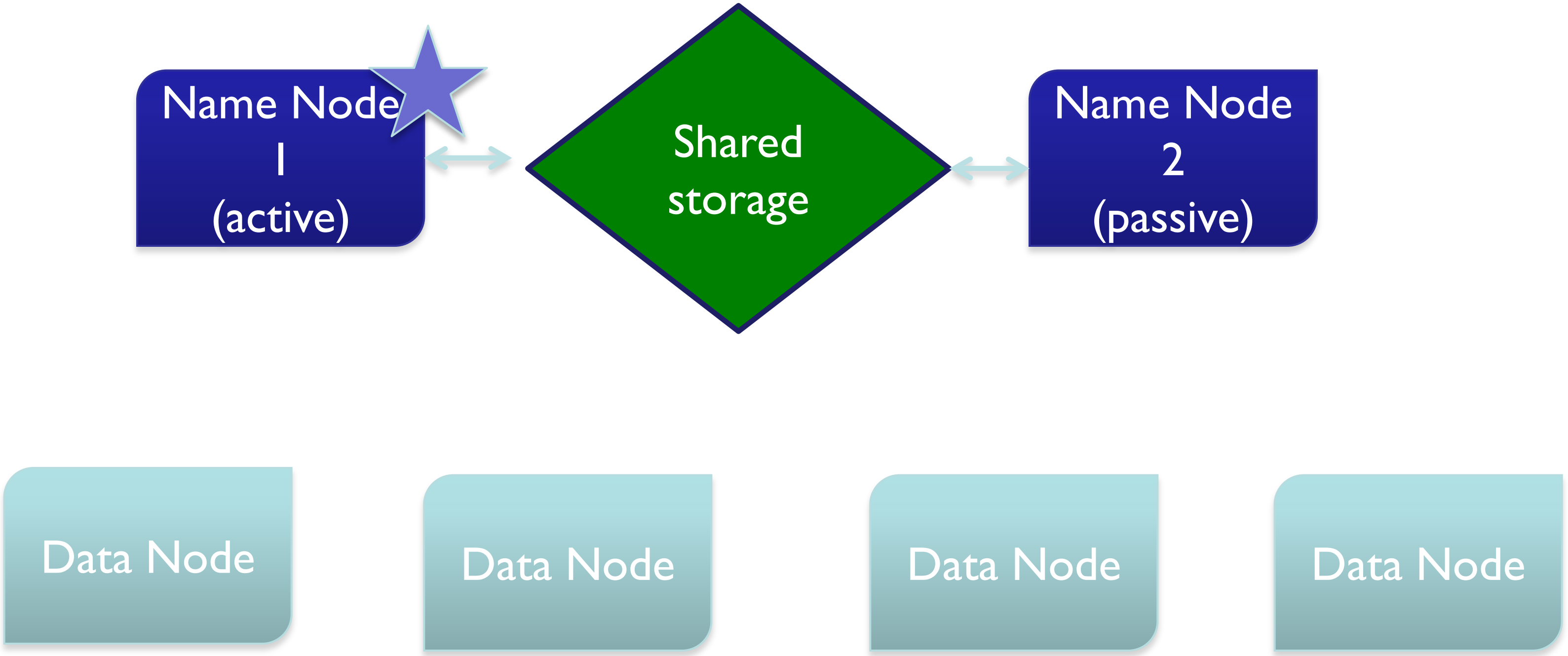
Data Node

Data Node

Data Node

Data Node

NameNode HA (V2)



Name Node 1 (active)

Shared storage

Name Node 2 (passive)

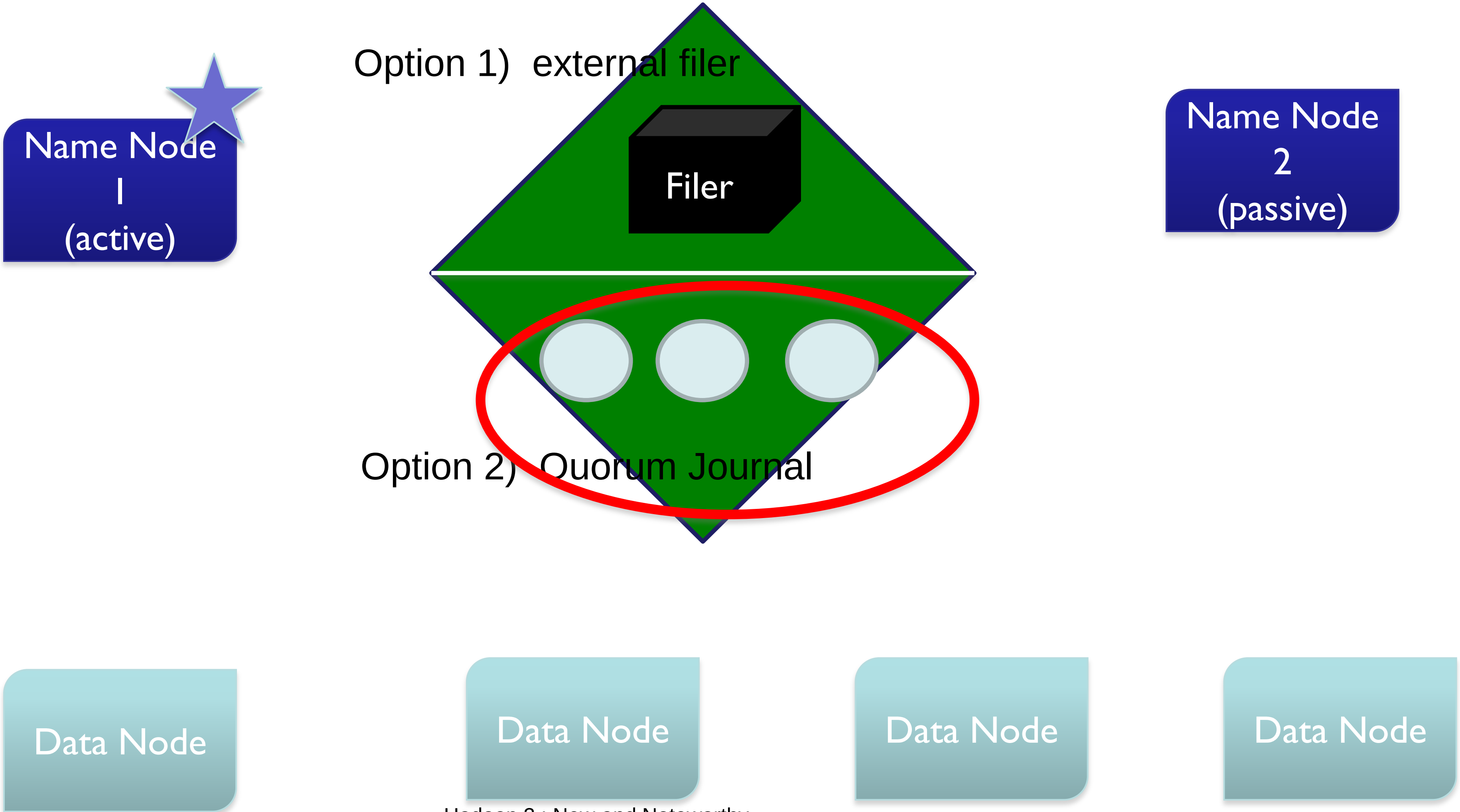
Data Node

Data Node

Data Node

Data Node

NameNode HA : Shared Storage



Namenode HA

- Namenode meta data is written to a shared storage (external filer or Quorum Journal Manager)
- Only ONE active NN can write to shared storage
- Passive NN reads and replays meta data from shared storage
- When Active NN fails, passive NN is promoted to active
  - Can be manual or automatic

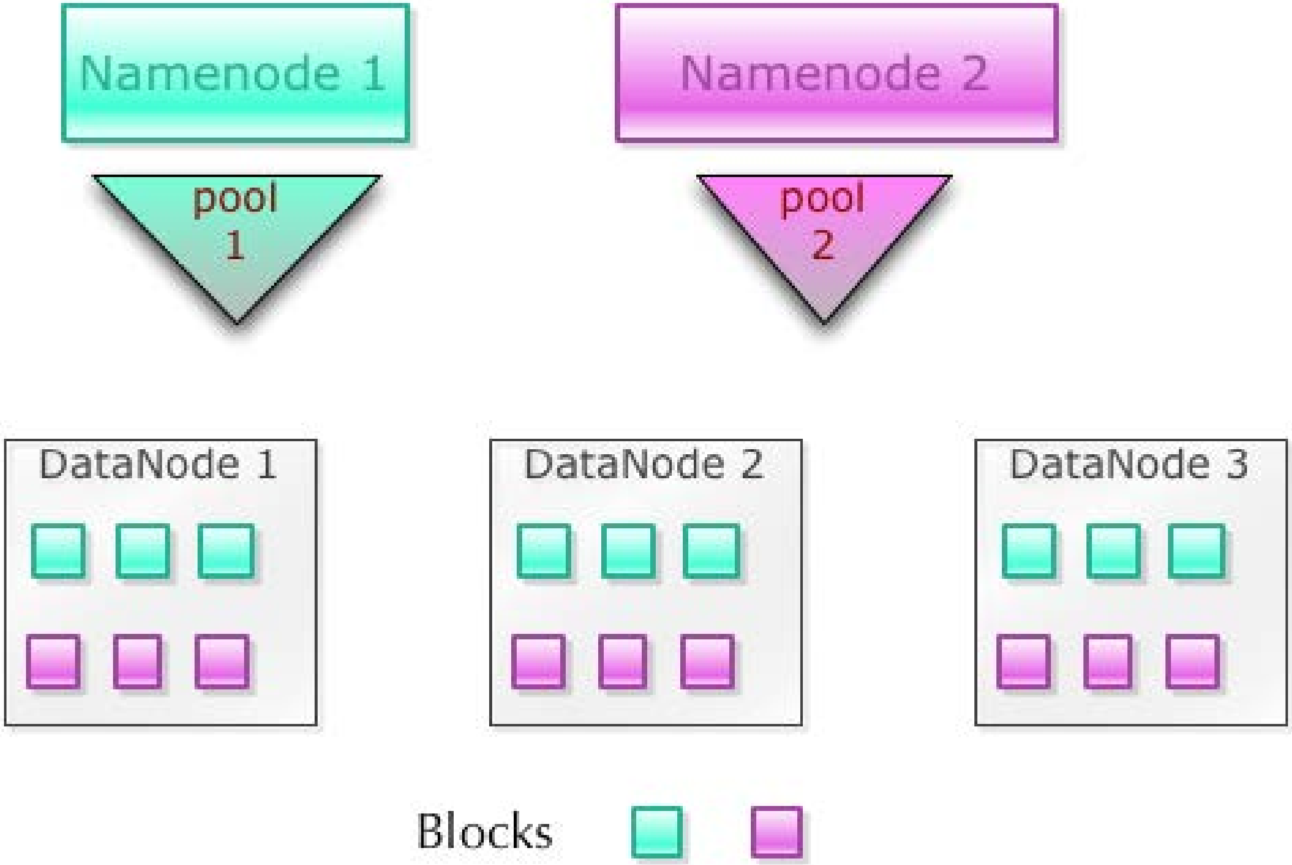
V2 Features

- HDFS
  - ~~Namenode HA~~
  - Namenode federation

Namenode Federation

- Namenode stores meta data in memory
- For large (very large) clusters, NN could exhaust memory
- Spread meta-data over mulitiple namenodes

HDFS Federation



HDFS Federation

- Now the namespace is divided
- /hbase → NN1
- /user → NN2
- /hive → NN3

HDFS Federation

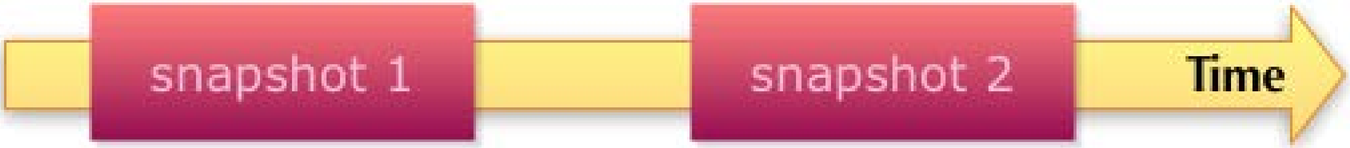
- Namespace is partitioned into ‘block pools’
- Datanodes are shared across cluster
  - They store blocks for different pools
- Datanodes send heart-beats to all NNs

V2 Features

- HDFS
  - ~~Namenode HA~~
  - ~~Namenode federati0n~~
  - Snapshots

HDFS Snapshots

- Wait, doesn’t HDFS makes replicas?
  - Yes
- But it doesn’t save you from :
  hdfs dfs –rm –r /data
- ‘Trash’ feature only works for CLI utilities
  - You can delete files using API.. Poof gone



HDFS Snapshots

- Recover from user errors, other disasters
- Peroidic snapshots
  - E.g : daily backups… keep them for 15 days
- Snapshotting is
  - Efficient (no data duplication, copy on write)
  - Fast
  - snapshot part of file system (not the whole thing)
- http://cdn.oreillystatic.com/en/assets/1/event/100/HDFS%20Snapshots%20and%20Beyond%20Presentation.pdf

V2 Features

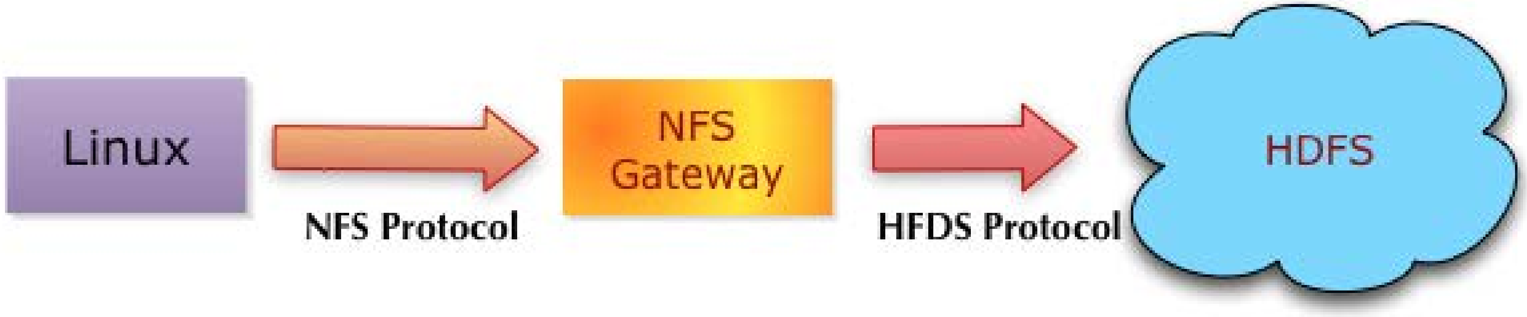
- HDFS
  - ~~Namenode HA~~
  - ~~Namenode federati0n~~
  - ~~Snapshots~~
  - NFSv3 access to HDFS

NFS Access to HDFS

- HDFS is a userland file system
  - Not a kernel file system
- So most linux programs can not read/write data to HDFS
  - We use ‘hdfs’ command line utils

NFS Access to HDFS

- HDFS supports NFS protocol starting with v2
- NFS is done via gateway machine



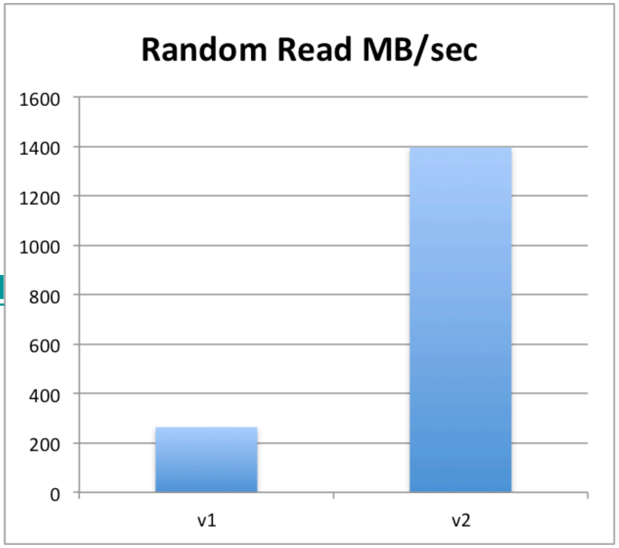
V2 Features

- HDFS
  - ~~Namenode HA~~
  - ~~Namenode federati0n~~
  - ~~Snapshots~~
  - ~~NFSv3 access to HDFS~~
  - Improved performance

HDFS Improved IO

- Lots of performance fixes from v1 → v2
- Quick comparison
  - Multi threaded random-read
  - HDFS v1 : 264 MB/sec
  - HDFS v2 : 1395 MB /sec (5x !)

Source : http://www.slideshare.net/cloudera/hdfs-u apache-hadoop-forum



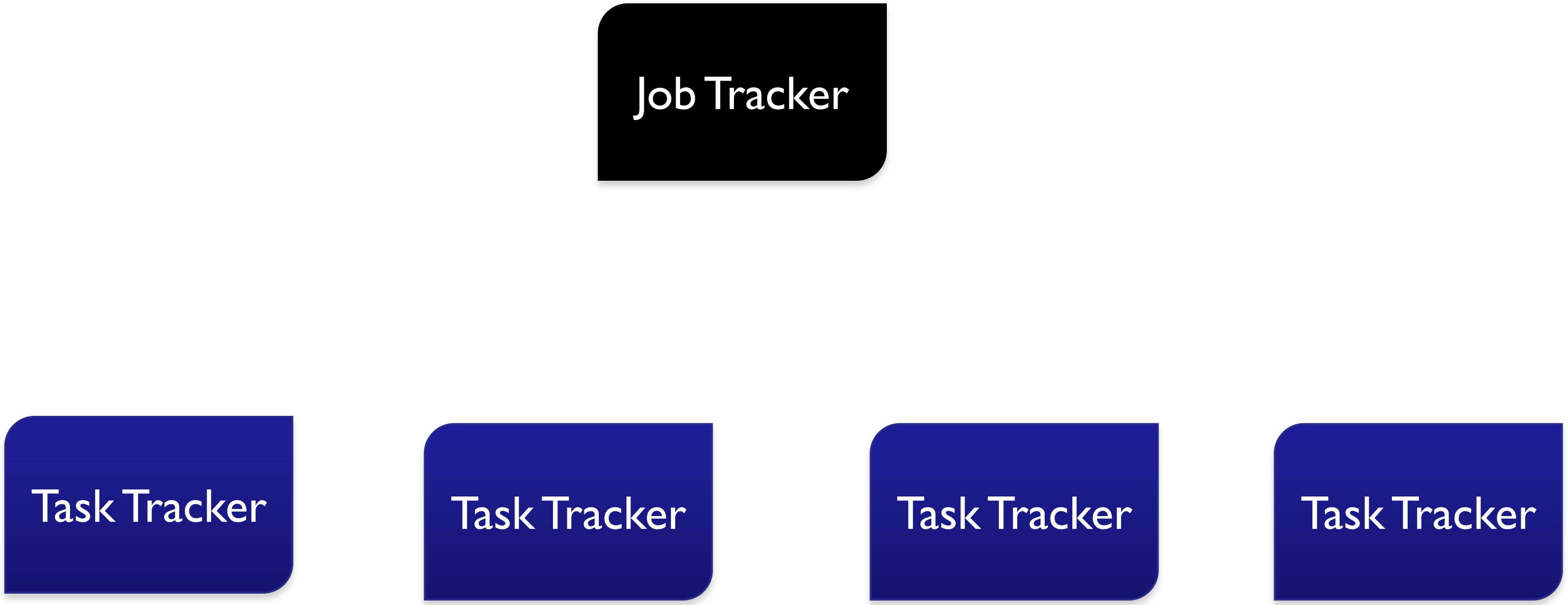
V2 Features

- ~~HDFS~~
- Processing
  - YARN

MapReduce V1

- MRV1 proved itself as a reliable batch processing framework!
- One Job Tracker (master) and many task tracker (workers)

MapReduce Architecture



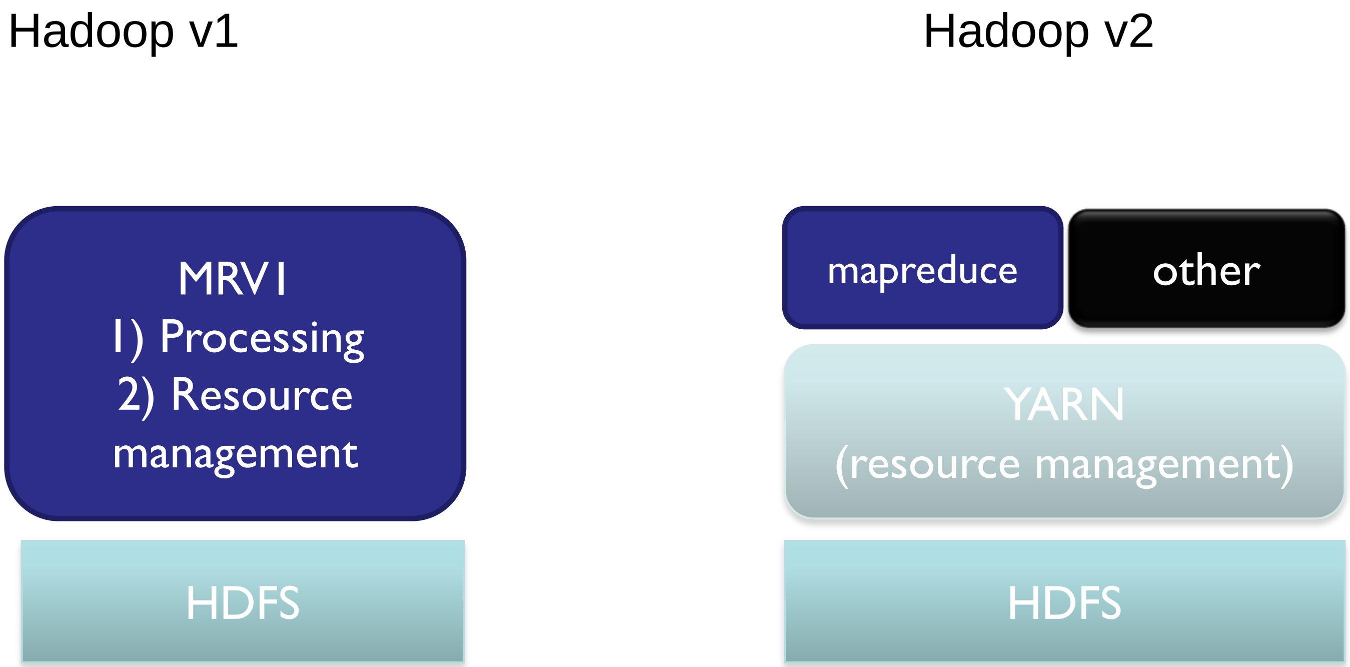
MRV1 Limitations

- Only supports one programming paradigm
  - Batch processing
- Alternate processing is hard to (or not possible) implement on top of MRV1
  - Real time processing
  - In-memory data

MRV1 Limitations

- Single Job Tracker (JT) → single point of failure
- JT Failure kills all running jobs (and queued jobs)
- JT started hit scalability limitations for very large clusters
  - 4,000 nodes

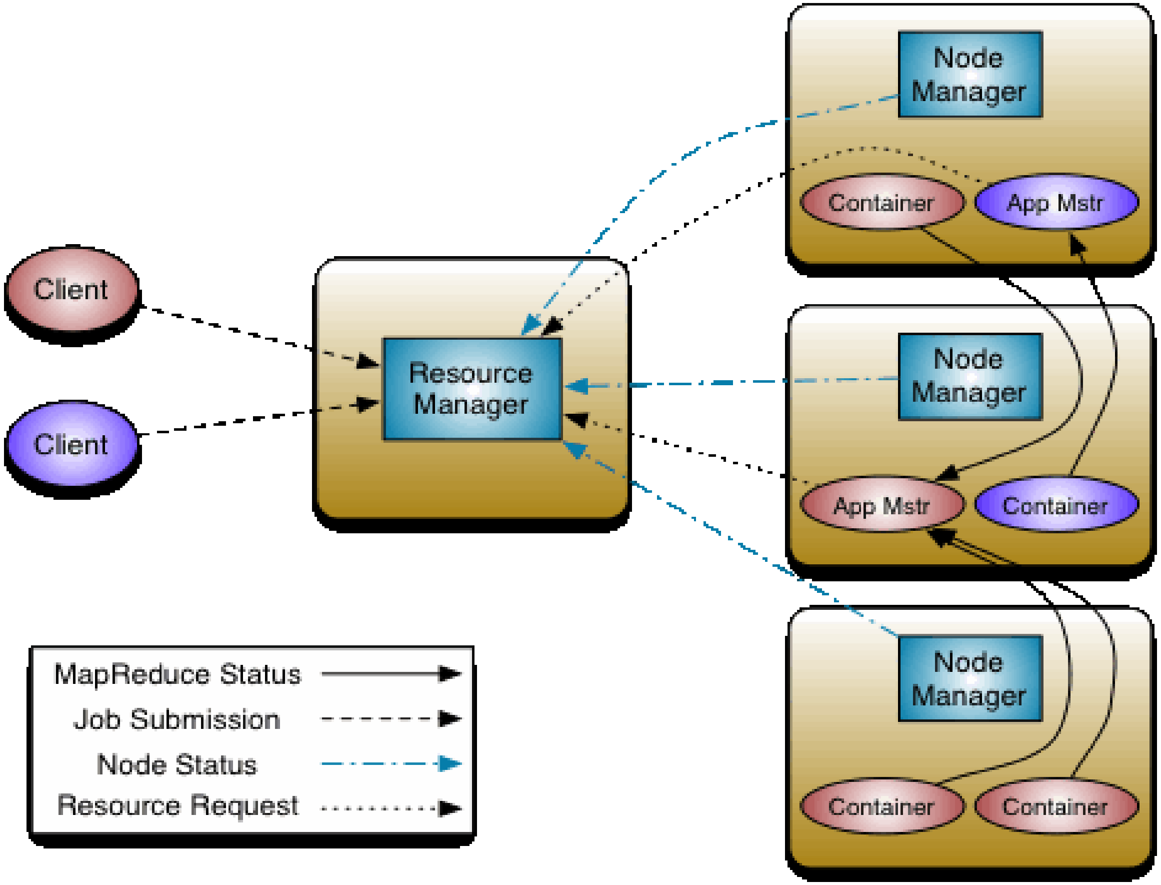
Looking Ahead



Yarn

- MRV1 did
  - Resource Management
  - And Processing
- Separate both out
- Yarn for resource management
- Mapreduce / other frameworks for processing
  - Now mapreduce is ‘just another app’

Yarn Architecture



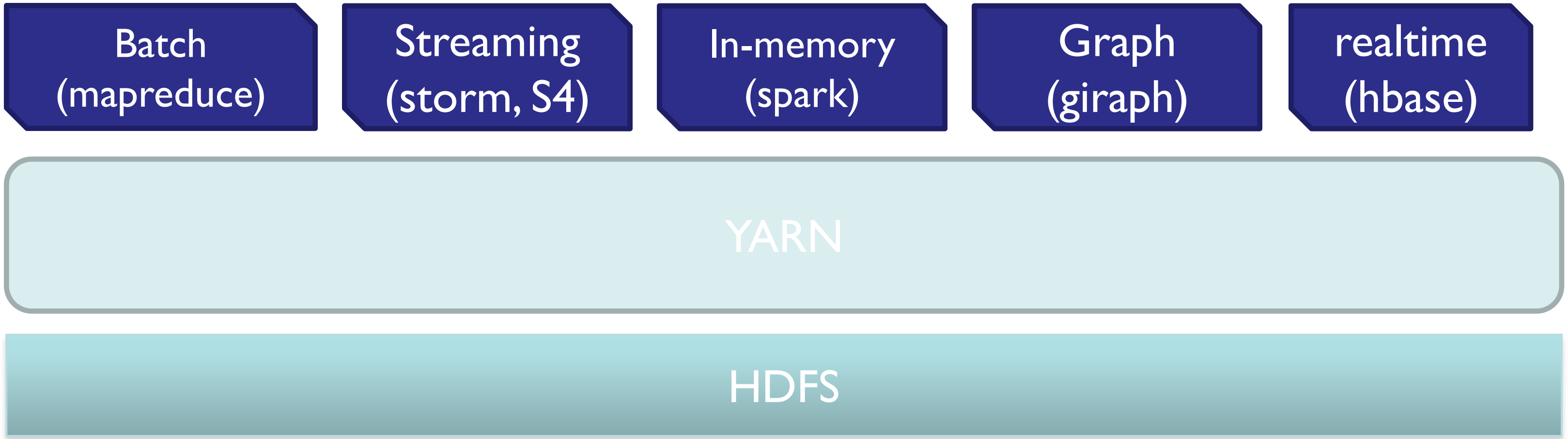
YARN Architecture

- resource manager : manages the resource for entire cluster
- node manager : manages resources a single node
- Containers : resource buckets (2 cpu + 8 G RAM)
- application masters : one for each application
  - batch mapreduce, storm …etc
  - Manages application scheduling and execution

Adoption of YARN

- Standard on Hadoop v2
- Already running at Yahoo at scale
- Lot of applications are already moving to YARN architecture

Apps on Yarn


Batch (mapreduce)
Streaming (storm, S4)
In-memory (spark)
Graph (giraph)
realtime (hbase)
YARN
HDFS

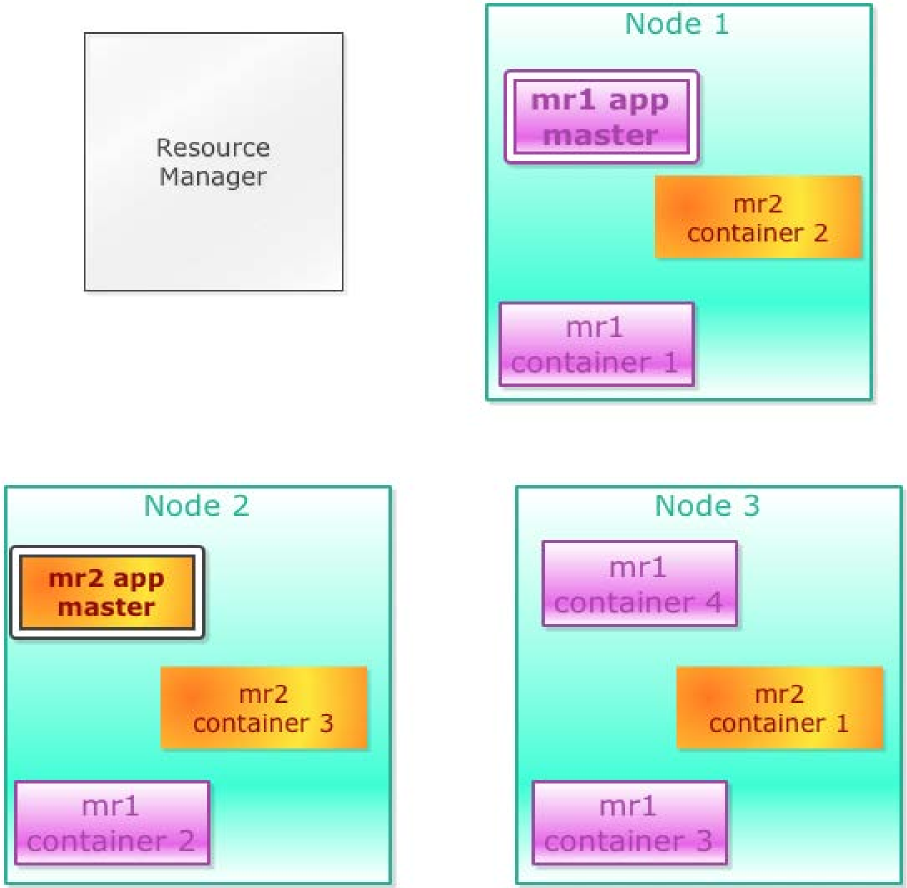
Apps on YARN

- Storm : real time event processing
- Giraph : graph processing (in memory)
- Spark : in-memory, iterative processing
- Hbase !

MapReduce on YARN

- MapReduce is NOT going anywhere
  - Works very well for batch processing
  - Proven
  - Lots of code out there
- No more single JobTracker
- Each MapReduce job runs an Application
- So failure one AppMaster only causes that job to fail
  - Other jobs are insulated

MapReduce on YARN



Writing A YARN Application

- http://hadoop.apache.org/docs/stable/hadoop-yarn/hadoop-yarn-site/WritingYarnApplications.html

V2 Features

- HDFS
  - ~~Namenode HA~~
  - ~~Namenode federati0n~~
- Processing
  - ~~YARN~~

So Which Hadoop Should I Use?

- Hadoop v1
  - Field-tested
  - Compatible with lots of other components
- Hadoop v2 – new, shiny

Hadoop Distributions

Distribution	Hadoop v1	Hadoop v2
Cloudera	CDH 3.x / CDH 4.x	CDH 5.x
Horton Works	HDP 1.x	HDP 2.x
Intel	Intel Hadoop	
Pivotal	HD	

Hadoop v2 + MRV1 ?

- You like to get all HDFS improvements
- But not ready to move from MRV1 to YARN yet…
- → Cloudera 4.x

Future…

- HDFS
  - Mirroring across data centers
  - Work well with SSD (solid state drives / flash drives)

If These Happen…

- I will be here to tell you about it ☺

Thanks & Questions?

Attribution & Feedback

The SNIA Education Committee thanks the following individuals for their contributions to this Tutorial.

Authorship History

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