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

Dec 2011 - Oct 2013

Hadoop v1

Hadoop v2 (2.2.0)
## Hadoop Versions – Simplified

<table>
<thead>
<tr>
<th>Hadoop 1</th>
<th>Hadoop 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.1 (Aug 2013)</td>
<td>2.2.0 (Oct 2013)</td>
</tr>
</tbody>
</table>
## Feature Matrix

<table>
<thead>
<tr>
<th>Component</th>
<th>Feature</th>
<th>V1</th>
<th>v2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDFS</td>
<td><strong>NameNode High Availability</strong></td>
<td></td>
<td>X</td>
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<tr>
<td></td>
<td>Namnode federation</td>
<td></td>
<td>X</td>
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<tr>
<td></td>
<td>Snapshots</td>
<td></td>
<td>X</td>
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<td></td>
<td>NFS v3 access to HDFS</td>
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<td>X</td>
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<td></td>
<td>Improved IO</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Processing</td>
<td>MapReduce v1</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td><strong>YARN (MapReduce v2)</strong></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Other</td>
<td>Kerberos security</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Next : HDFS High Availability
HDFS Architecture (V1)
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
  - $\Rightarrow$ 0.23 failure / year / cluster

- [http://www.slideshare.net/Hadoop_Summit/hdfs-namenode-high-availability](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)
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

Option 1) external filer

Option 2) Quorum Journal

Name Node 1 (active)

Filer

Name Node 2 (passive)

Data Node

Data Node

Data Node

Data Node
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 multiple namenodes
HDFS Federation

Namenode 1

pool 1

DataNode 1

DataNode 2

DataNode 3

Namenode 2

pool 2

Blocks
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 federation
  - Snapshots
HDFS Snapshots

- Wait, doesn’t HDFS make 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
- Periodic 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)

V2 Features

- HDFS
  - Namenode HA
  - Namenode federation
  - 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 federation
  - 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!)

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)
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

Hadoop v1

MRV1
1) Processing
2) Resource management

HDFS

Hadoop v2

mapreduce
YARN (resource management)

other

HDFS
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

- 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

Node 1
- mr1 app master
- mr2 container 2
- mr1 container 1

Node 2
- mr2 app master
- mr2 container 3
- mr1 container 2

Node 3
- mr1 container 4
- mr2 container 1
- mr1 container 3
Writing A YARN Application

V2 Features

- **HDFS**
  - Namenode HA
  - Namenode federation

- **Processing**
  - YARN
So Which Hadoop Should I Use?

- **Hadoop v1**
  - Field-tested
  - Compatible with lots of other components

- **Hadoop v2 – new, shiny**
# Hadoop Distributions

<table>
<thead>
<tr>
<th>Distribution</th>
<th>Hadoop v1</th>
<th>Hadoop v2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloudera</td>
<td>CDH 3.x / CDH 4.x</td>
<td>CDH 5.x</td>
</tr>
<tr>
<td>Horton Works</td>
<td>HDP 1.x</td>
<td>HDP 2.x</td>
</tr>
<tr>
<td>Intel</td>
<td>Intel Hadoop</td>
<td></td>
</tr>
<tr>
<td>Pivotal</td>
<td>HD</td>
<td></td>
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</tbody>
</table>
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?
The SNIA Education Committee thanks the following individuals for their contributions to this Tutorial.

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