YARN, the Apache Hadoop Platform for Streaming, Realtime and Batch Processing

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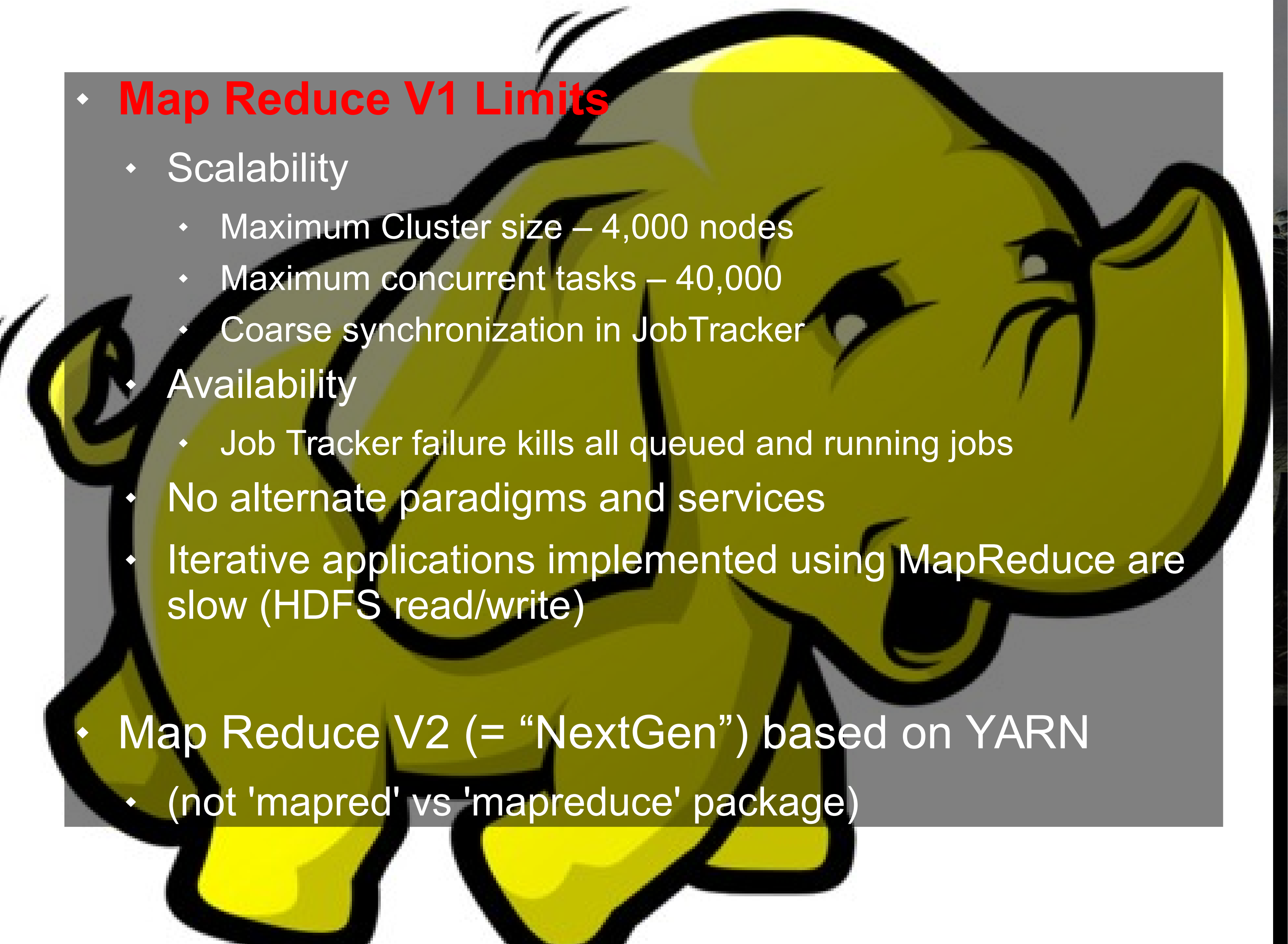
Eric Charles (@echarles)

- Java Developer
- Apache Member
  - Apache James Committer
  - Apache Onami Committer
  - Apache HBase Contributor

Worked in London with Hadoop, Hive, Cascading, HBase, Cassandra, Elasticsearch, Kafka and Storm

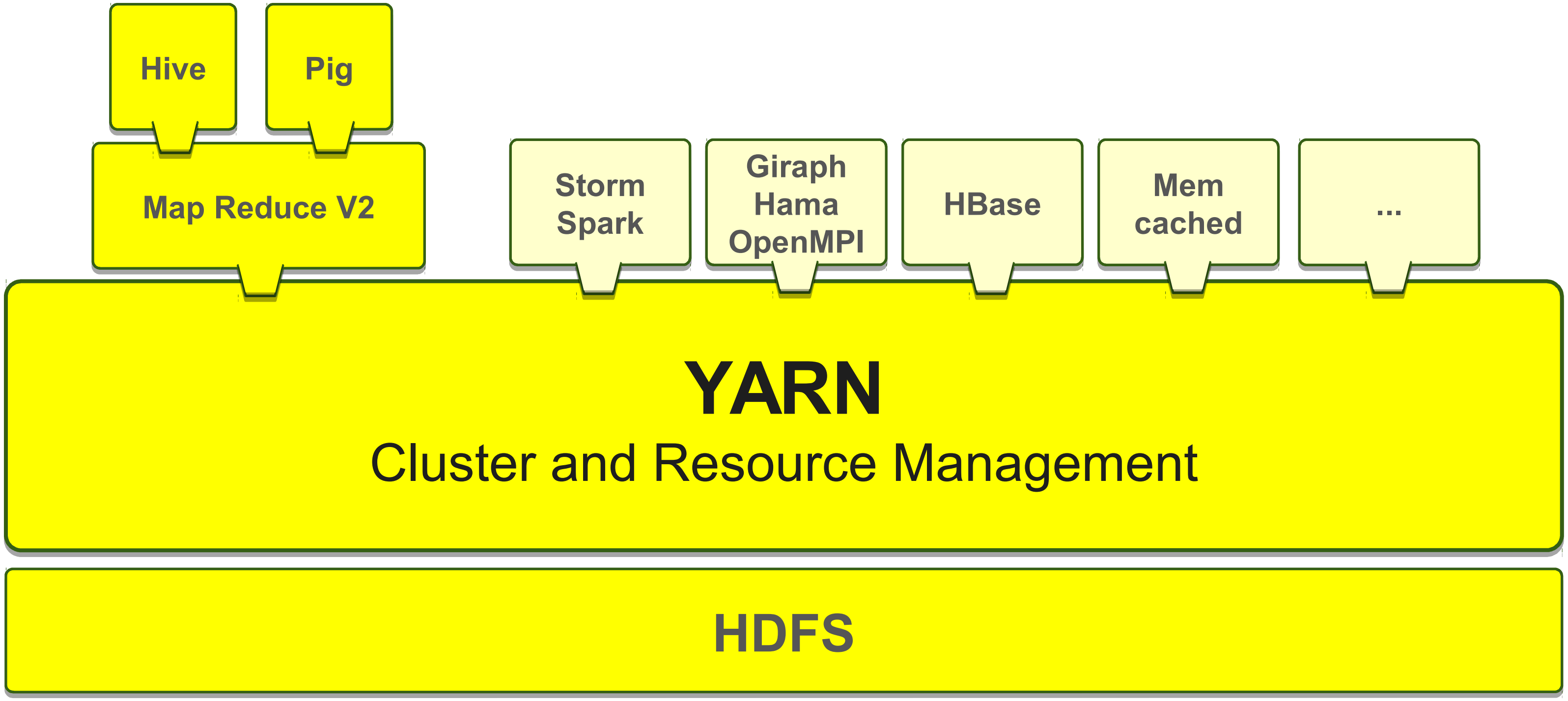
Just founded Datalayer



- **Map Reduce V1 Limits**
  - Scalability
    - Maximum Cluster size – 4,000 nodes
    - Maximum concurrent tasks – 40,000
    - Coarse synchronization in JobTracker
  - Availability
    - Job Tracker failure kills all queued and running jobs
  - No alternate paradigms and services
  - Iterative applications implemented using MapReduce are slow (HDFS read/write)
- Map Reduce V2 (= “NextGen”) based on YARN
  - (not 'mapred' vs 'mapreduce' package)

YARN as a Layer

All problems in computer science can be solved
by another level of indirection
– *David Wheeler*



Hive

Pig

Map Reduce V2

Storm
Spark

Giraph
Hama
OpenMPI

HBase

Mem
cached

...

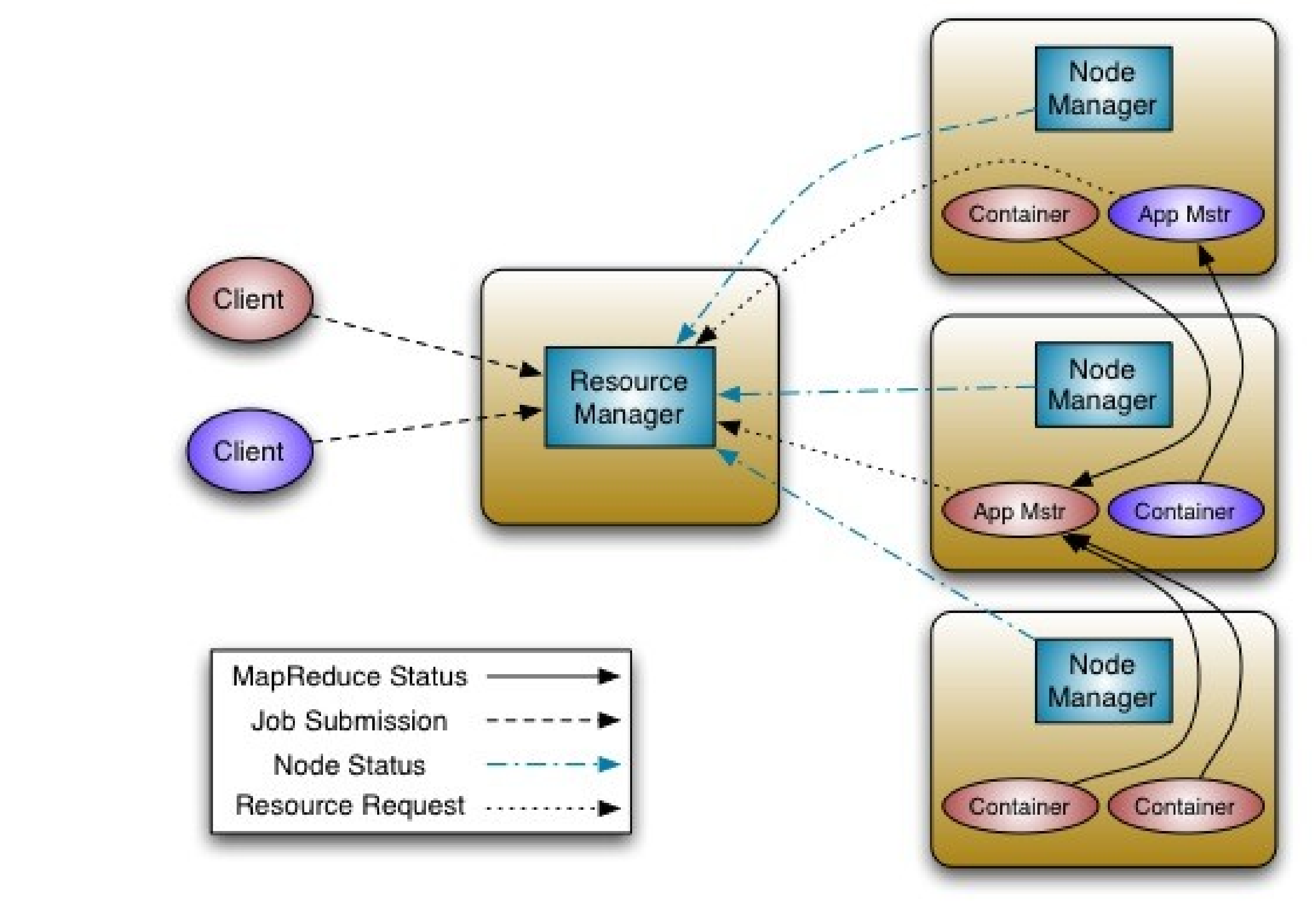
YARN
Cluster and Resource Management

HDFS

YARN a.k.a. Hadoop 2.0 separates
the **cluster and resource management**
from the
processing components

Components

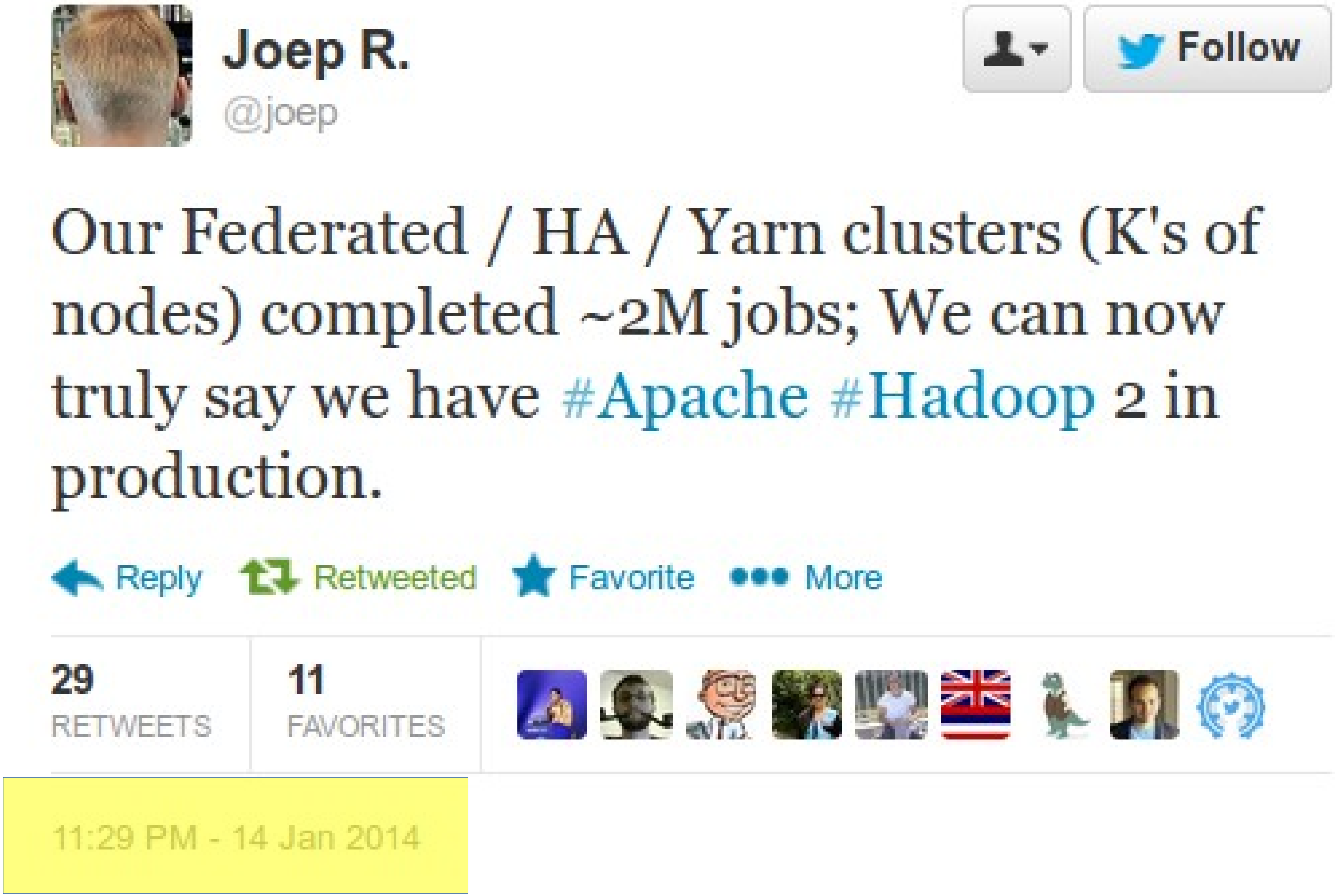
- A global Resource Manager
- A per-node slave Node Manager
- A per-application Application Master running on a Node Manager
- A per-application Container running on a Node Manager



Yahoo! has been running 35000 nodes of YARN in production for over 8 months now since begin 2013

[http://strata.oreilly.com/2013/06/moving-from-batch-to-continuous-computing-at-yahoo.html]

Twitter



Joep R.
@joep

Our Federated / HA / Yarn clusters (K's of nodes) completed ~2M jobs; We can now truly say we have #Apache #Hadoop 2 in production.

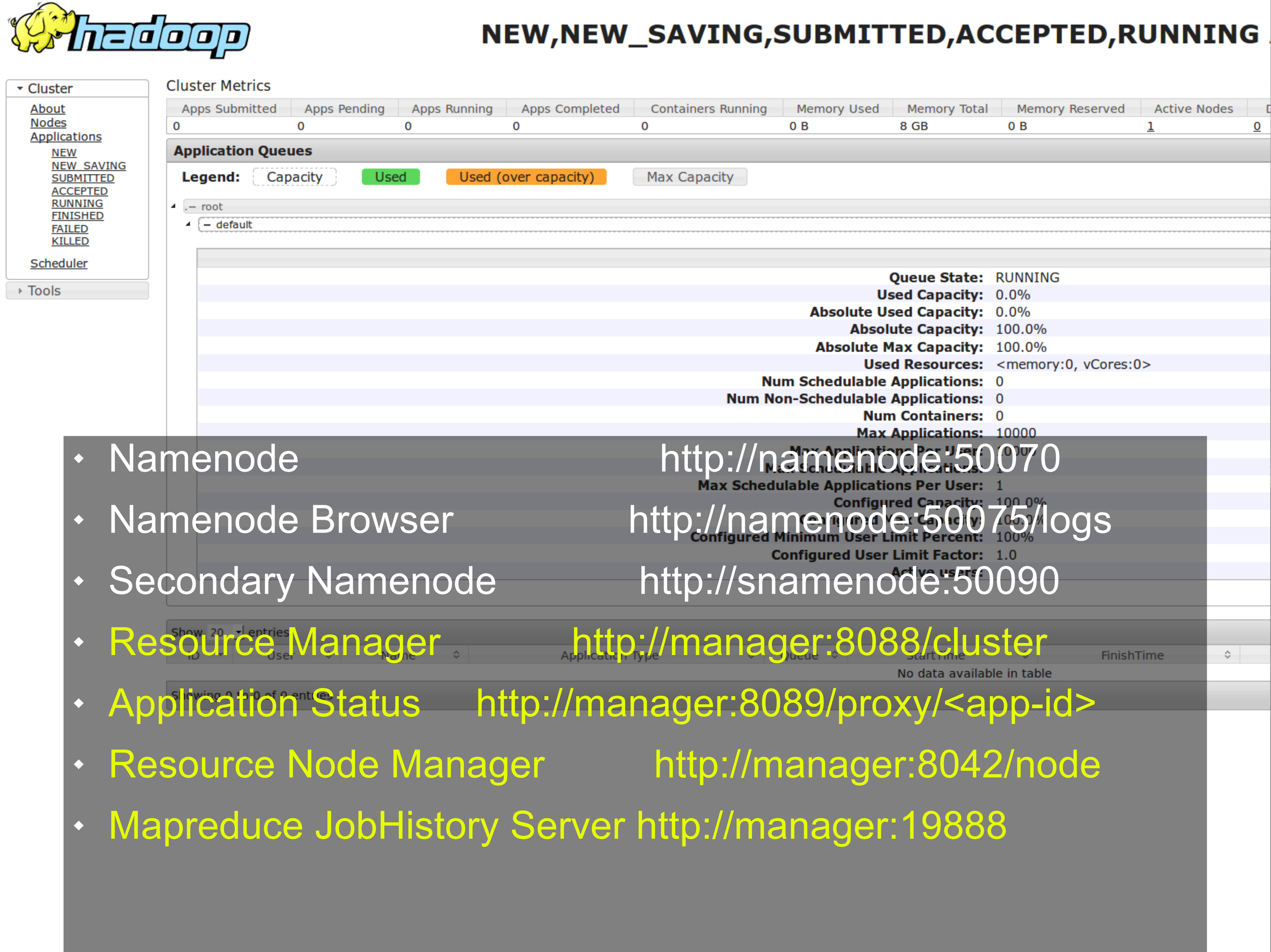
29 RETWEETS

11 FAVORITES

11:29 PM - 14 Jan 2014

Get It!

- Download
  - http://www.apache.org/dyn/closer.cgi/hadoop/common/
- Unzip and configure
  - mapred-site.xml
    - mapreduce.framework.name = yarn
  - yarn-site.xml
    - yarn.nodemanager.aux-services = mapreduce_shuffle
    - yarn.nodemanager.aux-services.mapreduce_shuffle.class = org.apache.hadoop.mapred.ShuffleHandler



NEW,NEW_SAVING,SUBMITTED,ACCEPTED,RUNNING

- Cluster
  - About
  - Nodes
  - Applications
    - NEW
    - NEW_SAVING
    - SUBMITTED
    - ACCEPTED
    - RUNNING
    - FINISHED
    - FAILED
    - KILLED
  - Scheduler
- Tools

Cluster Metrics

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	Active Nodes
0	0	0	0	0	0 B	8 GB	0 B	1

Application Queues

Legend: Capacity | Used | Used (over capacity) | Max Capacity

- root
  - default

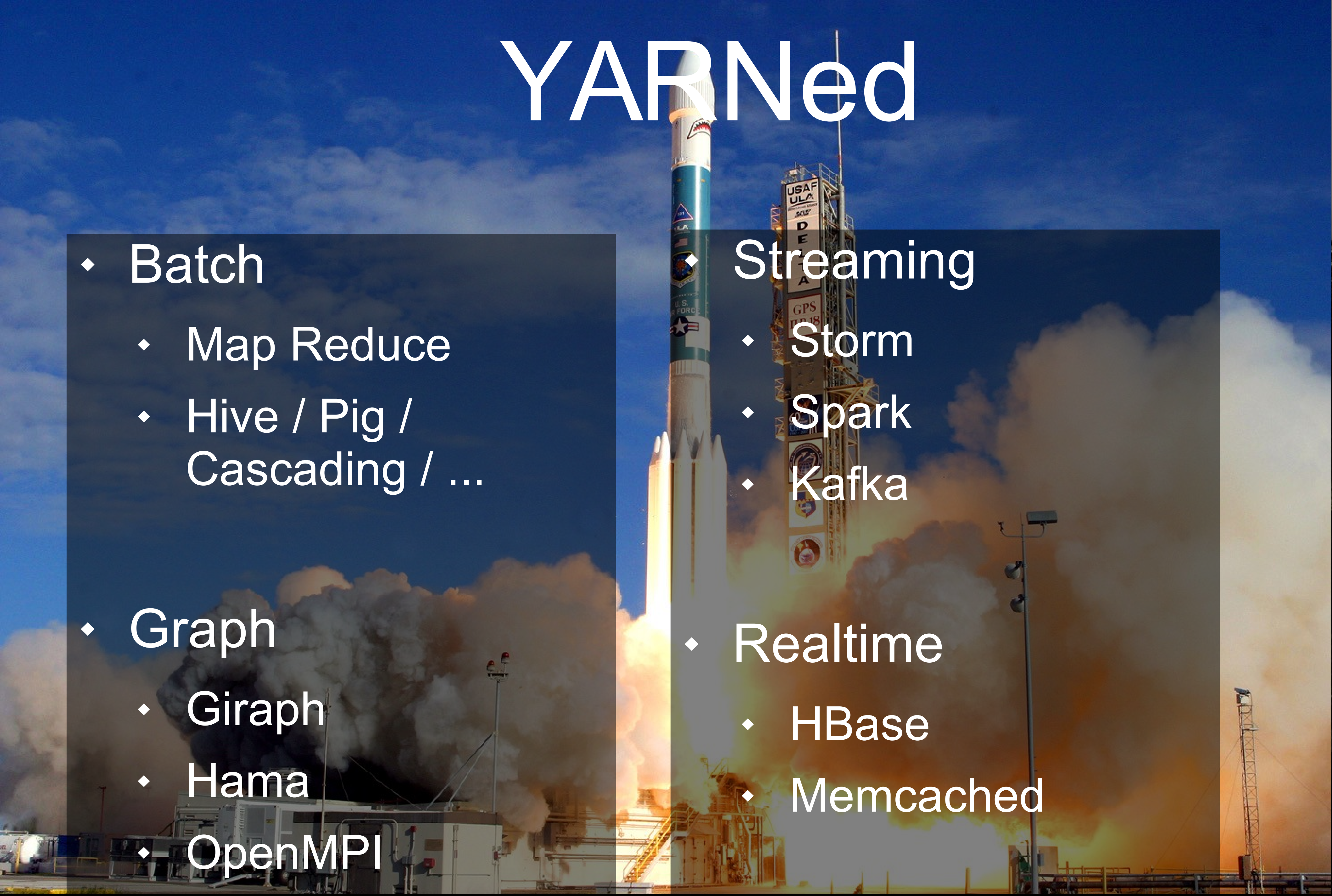
Queue State:	RUNNING
Used Capacity:	0.0%
Absolute Used Capacity:	0.0%
Absolute Capacity:	100.0%
Absolute Max Capacity:	100.0%
Used Resources:	<memory:0, vCores:0>
Num Schedulable Applications:	0
Num Non-Schedulable Applications:	0
Num Containers:	0
Max Applications:	10000
Max Schedulable Applications Per User:	1
Configured Capacity:	100.0%
Configured Minimum User Limit Percent:	100%
Configured User Limit Factor:	1.0
Active users:	

Show 20 entries

ID	User	Name	Application Type	Queue	StartTime	FinishTime
No data available in table						

Showing 0 to 0 of 0 entries

- Namenode http://namenode:50070
- Namenode Browser http://namenode:50075/logs
- Secondary Namenode http://snamenode:50090
- Resource Manager http://manager:8088/cluster
- Application Status http://manager:8089/proxy/<app-id>
- Resource Node Manager http://manager:8042/node
- Mapreduce JobHistory Server http://manager:19888



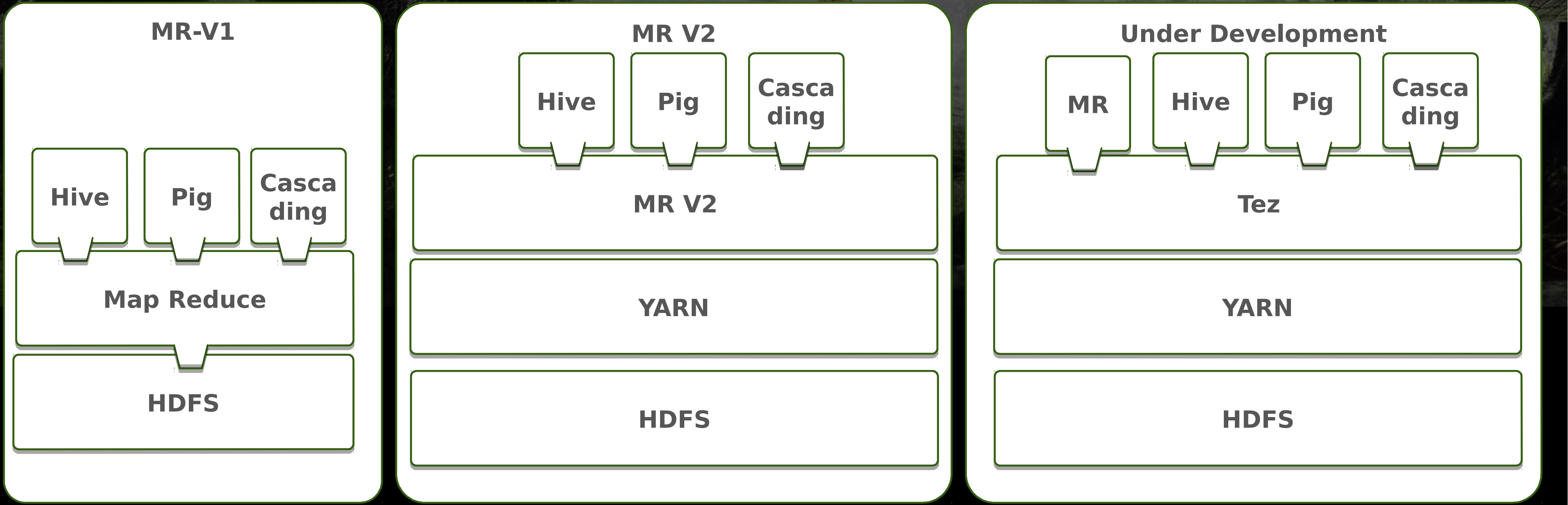
YARNed

- Batch
  - Map Reduce
  - Hive / Pig / Cascading / ...
- Graph
  - Giraph
  - Hama
  - OpenMPI
- Streaming
  - Storm
  - Spark
  - Kafka
- Realtime
  - HBase
  - Memcached

Batch

Apache Tez : Fast response times and extreme throughput to execute complex DAG of tasks

"The future of #Hadoop runs on #Tez"



MR-V1

- Hive | Pig | Cascading
- Map Reduce
- HDFS

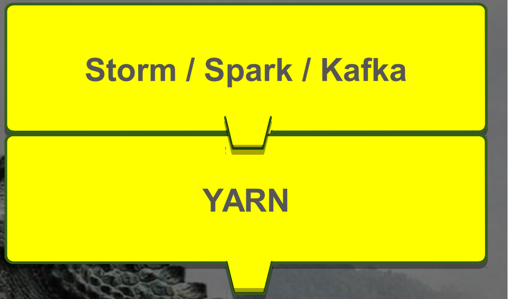
MR V2

- Hive | Pig | Cascading
- MR V2
- YARN
- HDFS

Under Development

- MR | Hive | Pig | Cascading
- Tez
- YARN
- HDFS

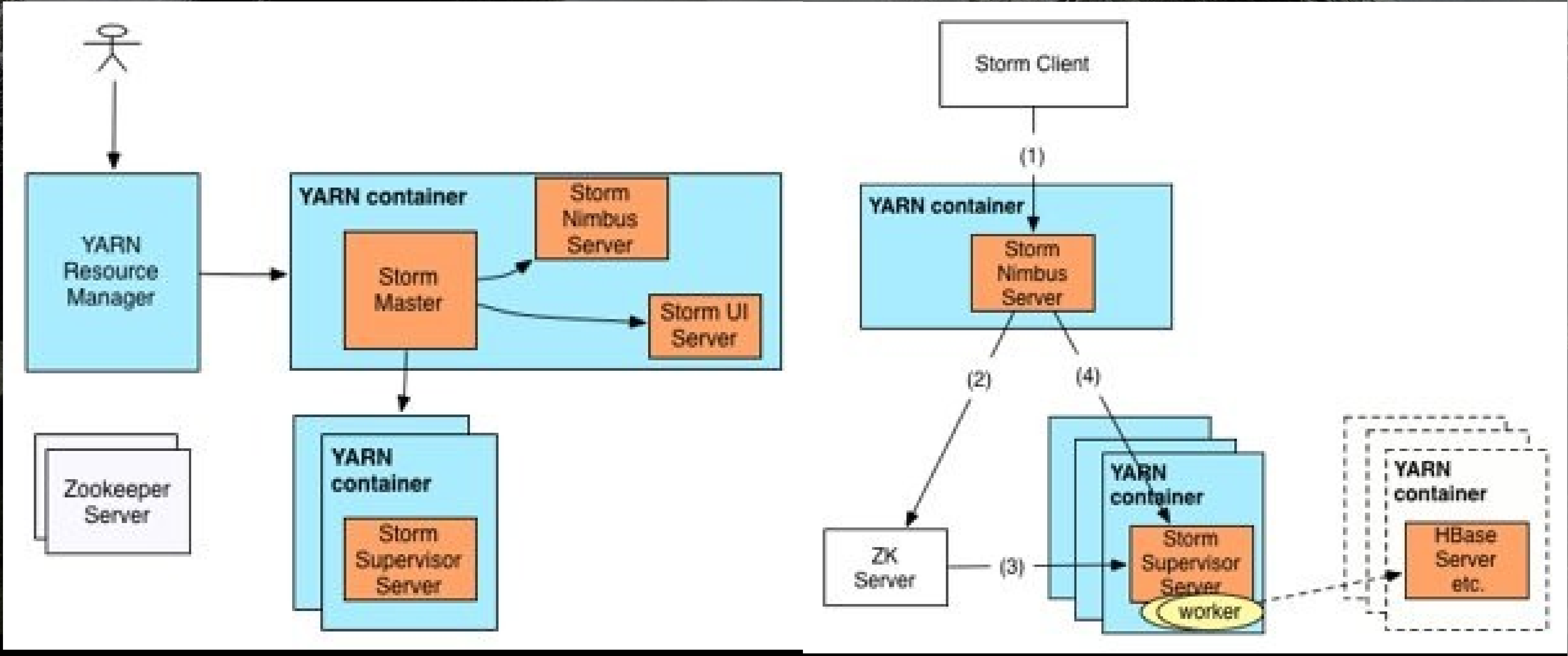
Streaming


Storm / Spark / Kafka

YARN

- Storm [https://github.com/yahoo/storm-yarn]
  - Storm-YARN enables Storm applications to utilize the computational resources in a Hadoop cluster along with accessing Hadoop storage resources such as HBase and HDFS
- Spark
  - Need to build a YARN-Enabled Assembly JAR
  - Goal is more to integrate Map Reduce e.g. SIMR supports MRV1
- Kafka with Samza [http://samza.incubator.apache.org]
  - Implements StreamTask
    - Execution Engine: YARN
    - Storage Layer: Kafka, not HDFS

@Yahoo!



From “Storm and Hadoop: Convergence of Big-Data and Low-Latency Processing | YDN Blog - Yahoo.html”

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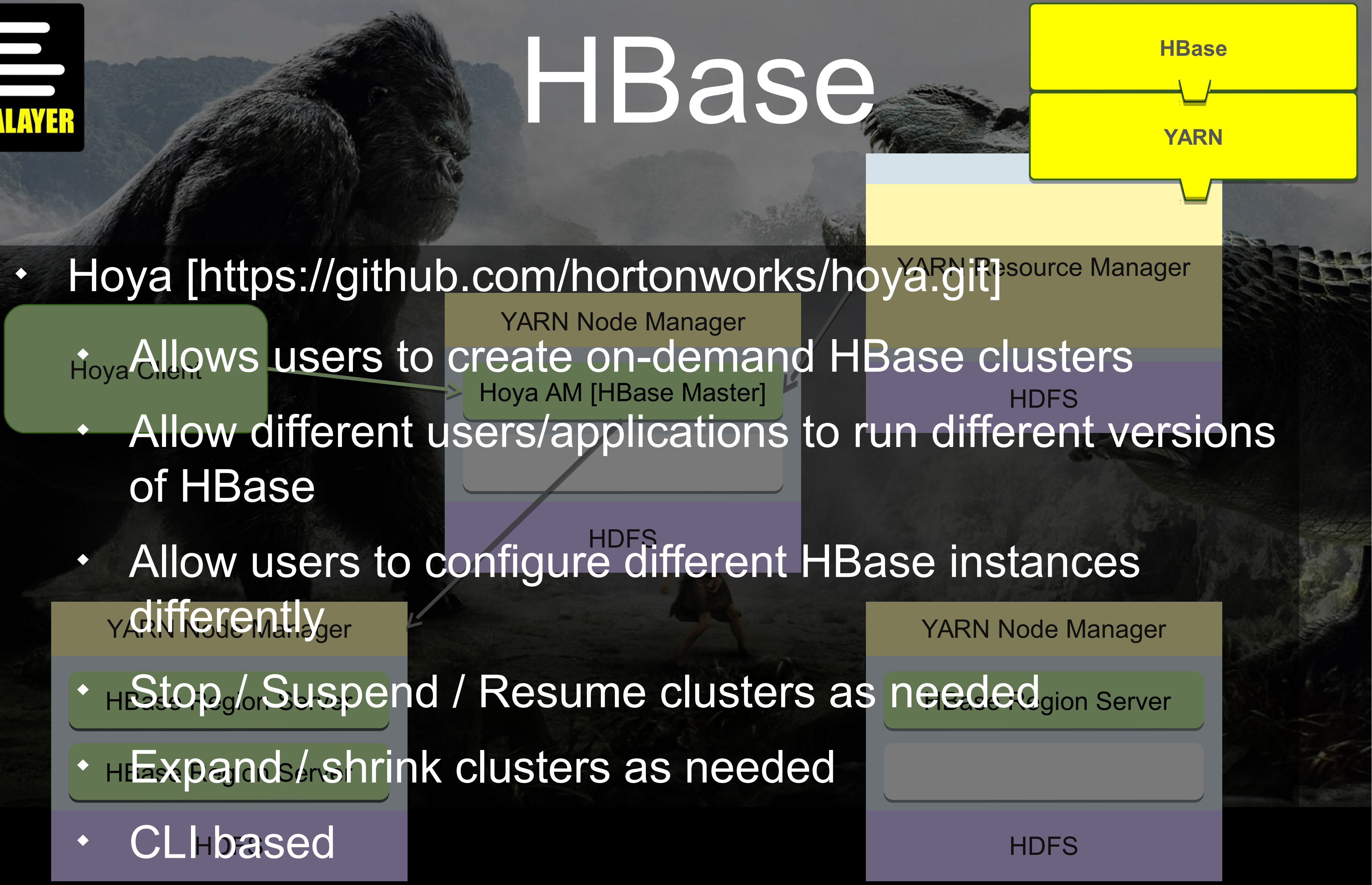
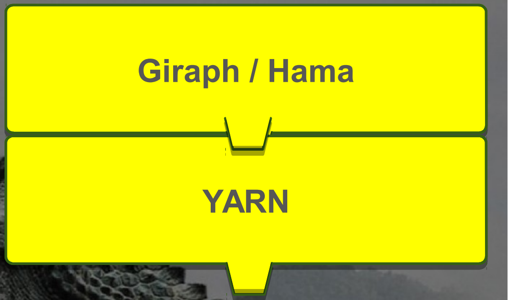
HBase

- Hoya [https://github.com/hortonworks/hoya.git]
  - Allows users to create on-demand HBase clusters
  - Allow different users/applications to run different versions of HBase
  - Allow users to configure different HBase instances differently
  - Stop / Suspend / Resume clusters as needed
  - Expand / shrink clusters as needed
  - CLI based



Graph



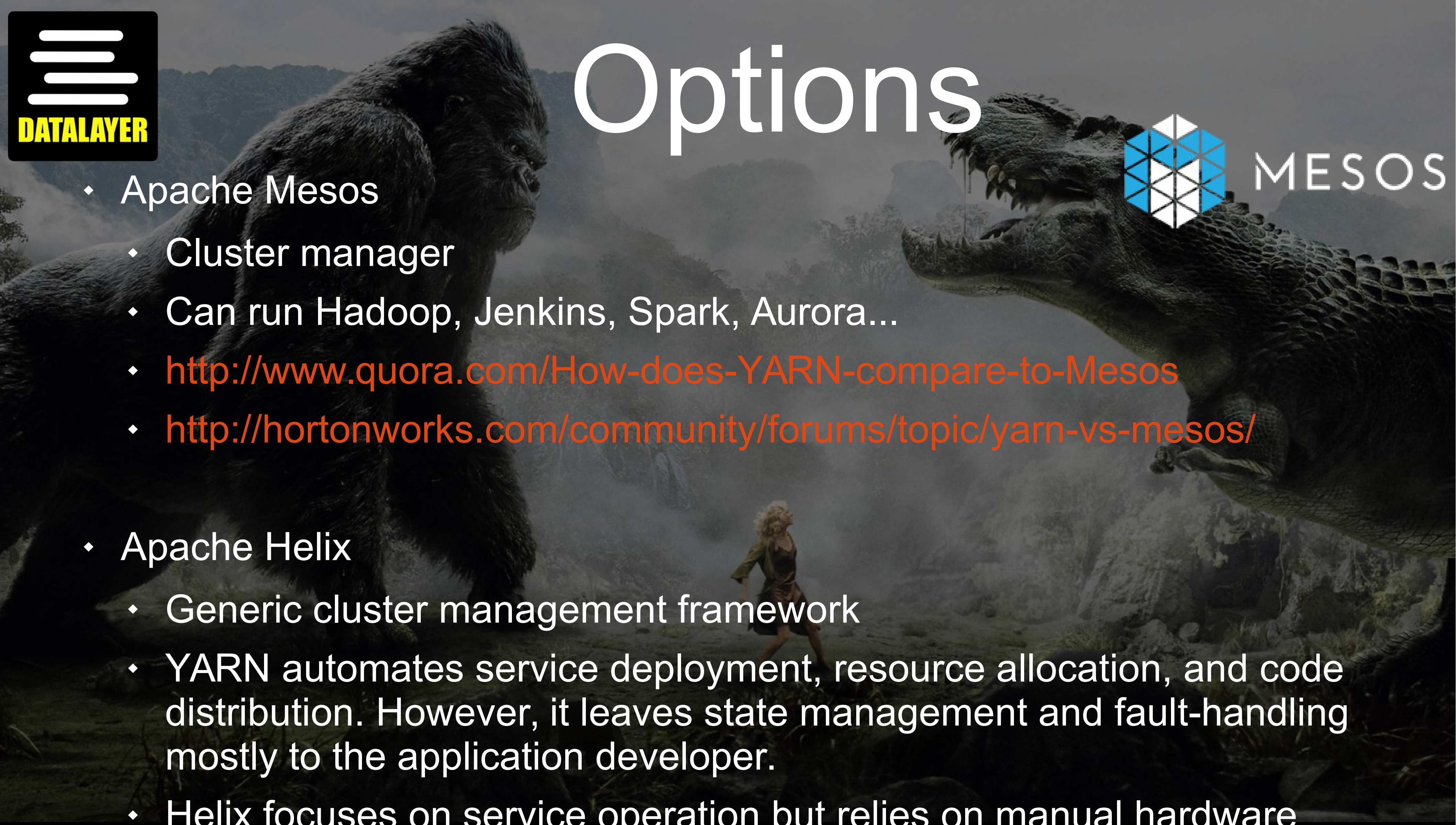
Giraph / Hama

YARN

- Giraph
  - Offline batch processing of semi-structured graph data on a massive scale
    - Compatible with Hadoop 2.x
    - "Pure YARN" build profile
  - Manages Failure Scenarios
    - Worker/container failure during a job?
    - What happens if our App Master fails during a job?
  - Application Master allows natural bootstrapping of Giraph jobs
  - Next Steps
    - Zookeeper in AM
    - Own Management WEB UI
    - ...
  - Abstracting the Giraph framework logic away from MapReduce has made porting Giraph to other platforms like Mesos possible

    (from “Giraph on YARN - Qcon SF”)

Options



- Apache Mesos
  - Cluster manager
  - Can run Hadoop, Jenkins, Spark, Aurora...
  - http://www.quora.com/How-does-YARN-compare-to-Mesos
  - http://hortonworks.com/community/forums/topic/yarn-vs-mesos/

- Apache Helix
  - Generic cluster management framework
  - YARN automates service deployment, resource allocation, and code distribution. However, it leaves state management and fault-handling mostly to the application developer.
  - Helix focuses on service operation but relies on manual hardware provisioning and service deployment.

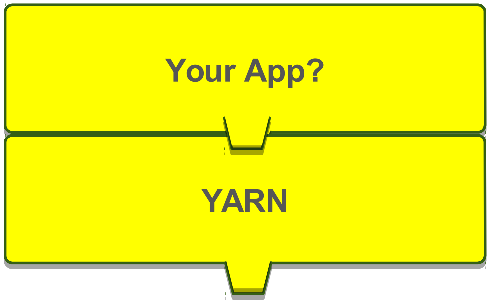
You **Looser!**

- More Devops and IO
- Tuning and Debugging the Application Master and Container is hard
- Both AM and RM based on an asynchronous event framework
  - No flow control
  - Deal with RPC Connection loose - Split Brain, AM Recovery... !!!
  - What happens if a worker/container or a App Master fails?
- New Application Master per MR Job - No JVM Reuse for MR
  - Tez-on-Yarn will fix these
- No Long living Application Master (see YARN-896)
- New application code development difficult
- Resource Manager SPOF (chuch... don't even ask this)
- No mixed V1/V2 Map Reduce (supported by some commercial distribution)

You **Rocker!**

- Sort and Shuffle speed gain for Map Reduce
- Real-time processing with Batch Processing Collocation brings
  - Elasticity to share resource (Memory/CPU/...)
  - Sharing data between realtime and batch - Reduce network transfers and total cost of acquiring the data
- High expectations from #Tez
  - Long Living Sessions
  - Avoid HDFS Read/Write
- High expectations from #Twill
  - Remote Procedure Calls between containers
  - Lifecycle Management
  - Logging

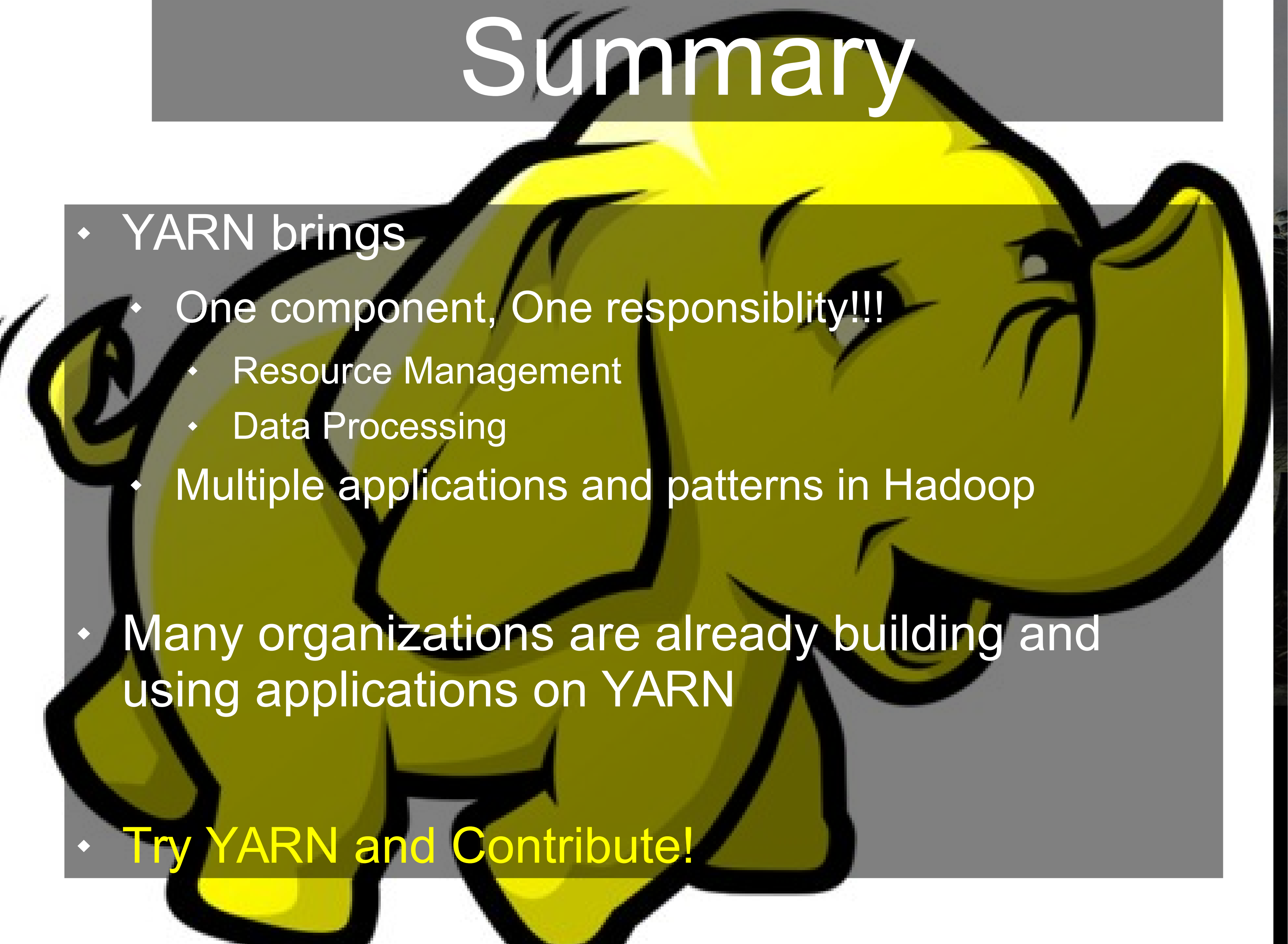
Your App?



WHY porting your App on **YARN**?

- Benefit from existing *-yarn projects
- Reuse unused cluster resource
- Common Monitoring, Management and Security framework
- Avoid HDFS write on reduce (via Tez)
- Abstract and Port to other platforms

Summary



- YARN brings
  - One component, One responsiblity!!!
    - Resource Management
    - Data Processing
  - Multiple applications and patterns in Hadoop
- Many organizations are already building and using applications on YARN
- Try YARN and Contribute!

DATALAYER

Thank You!

(Special Thx to @acmurthy and @steveloughran for helping tweets)

Questions ?

@echarles @datalayerio
http://datalayer.io/hacks
http://datalayer.io/jobs