Building 1000 node Spark cluster on EMR

Manjeet Chayel

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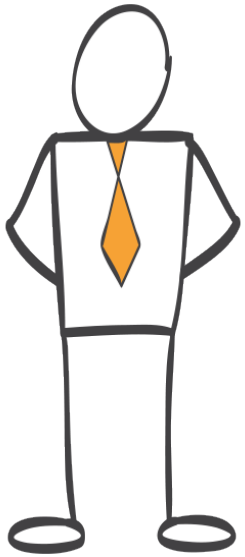
What is EMR?

Amazon Elastic MapReduce



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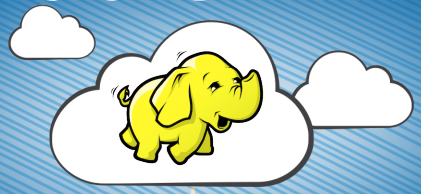
What is EMR?

Hadoop-as-a-service

Map-Reduce engine

Integrated with tools



Massively parallel

Integrated to AWS services

Cost effective AWS wrapper

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Integration

Integration

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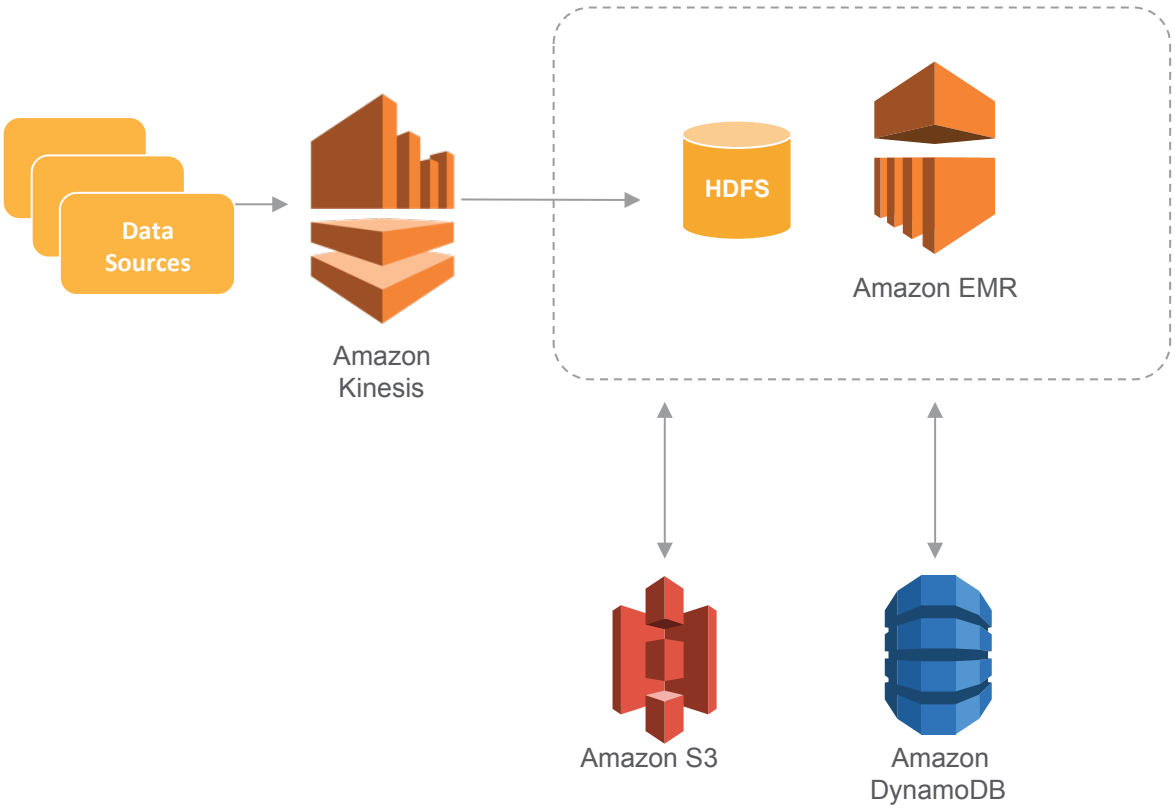
Integration



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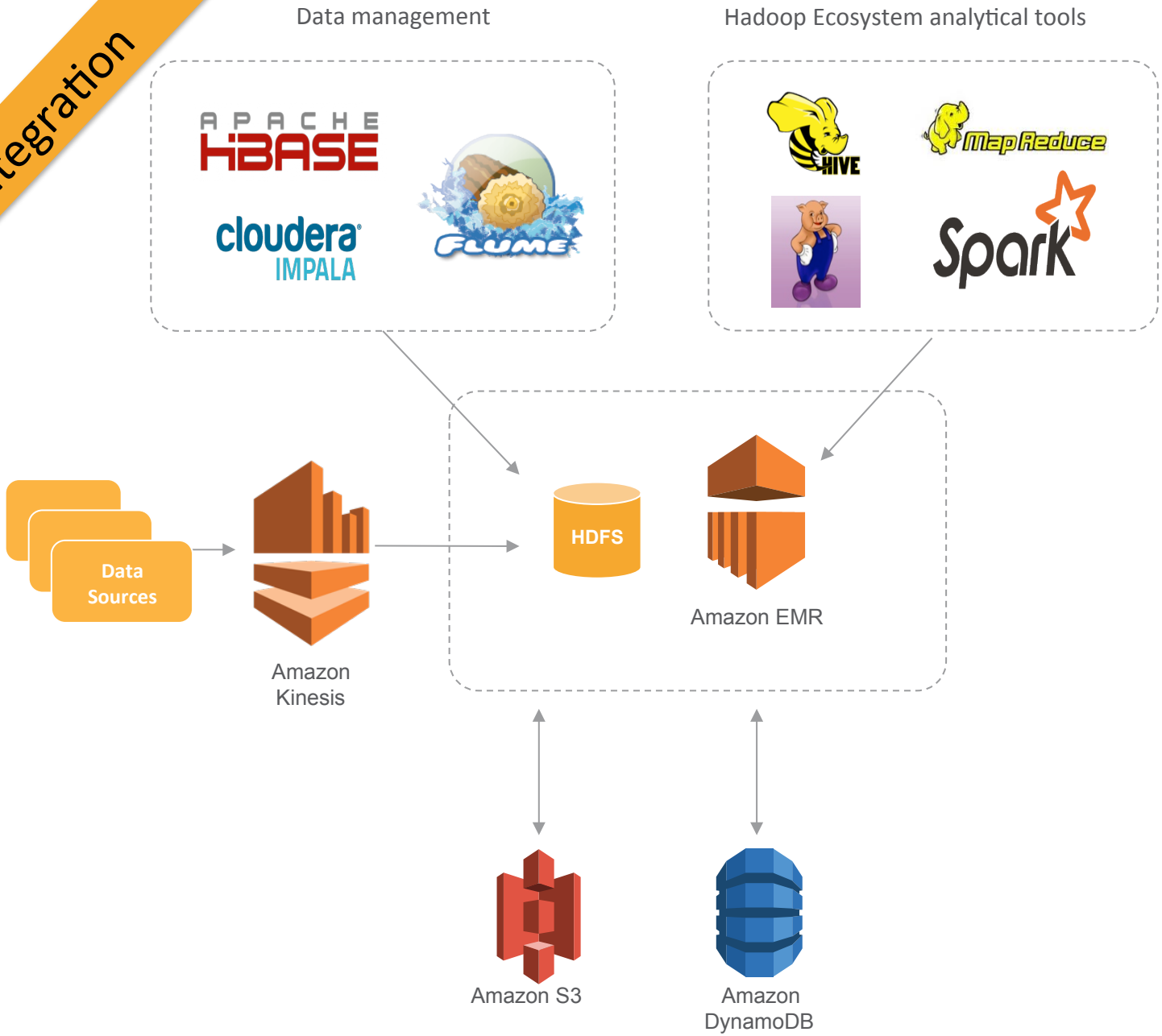
Integration



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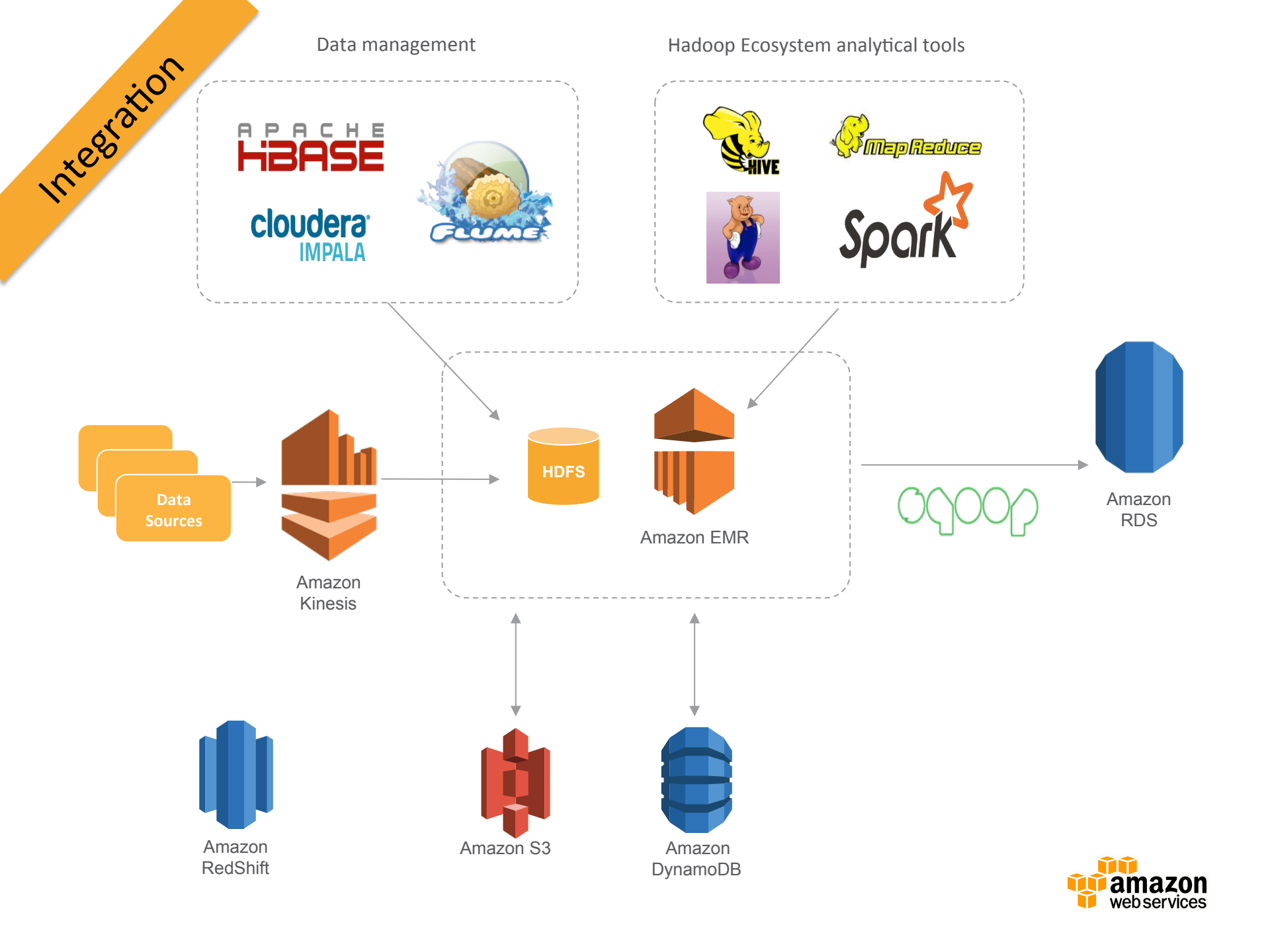
Integration
Data management
Hadoop Ecosystem analytical tools
APACHE HBASE
cloudera IMPALA
FLUME
HIVE
MapReduce
Spark
Data Sources
Amazon Kinesis
HDFS
Amazon EMR
Amazon RDS
Amazon RedShift
Amazon S3
Amazon DynamoDB
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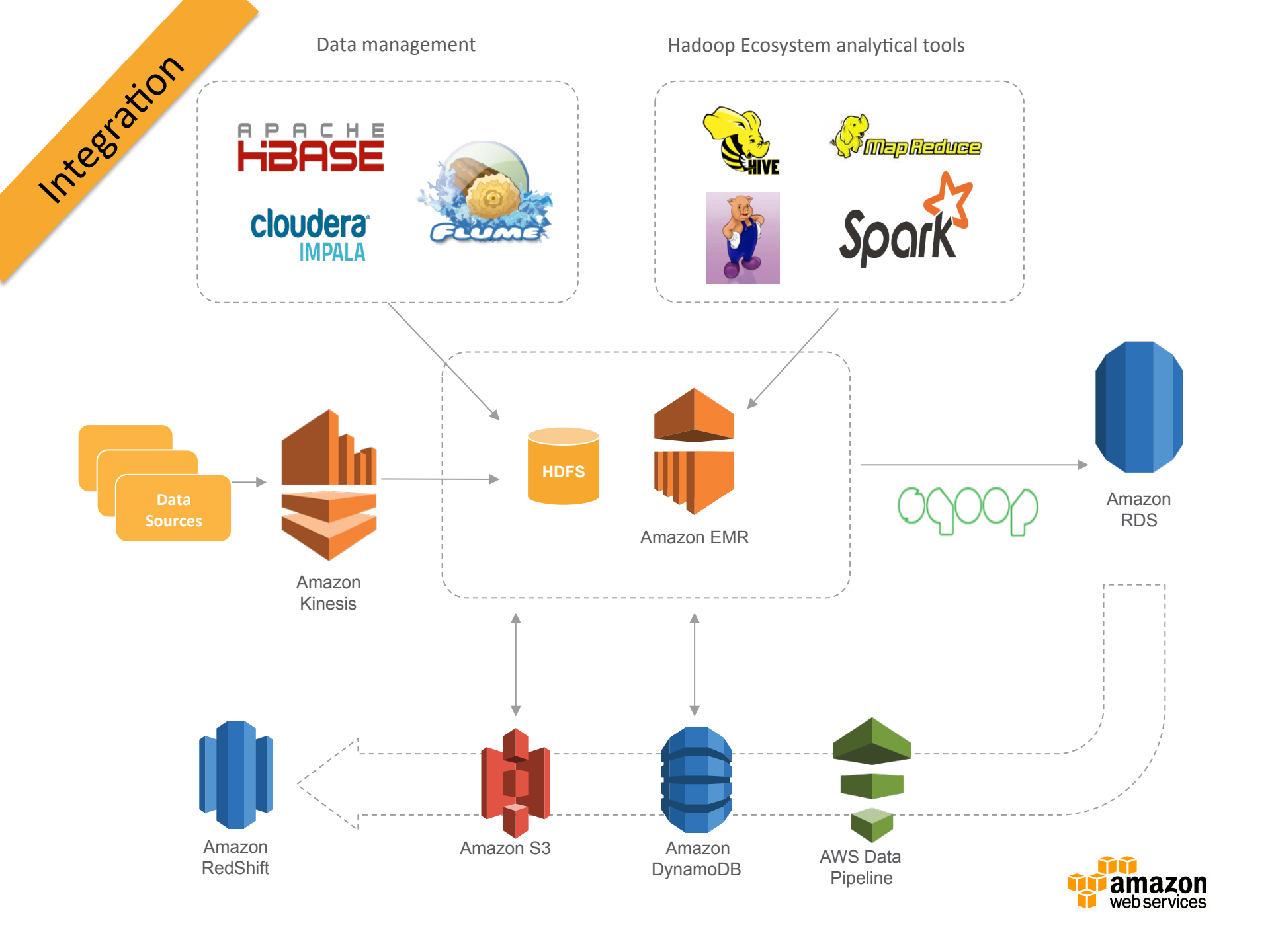
Integration
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Amazon RDS
Amazon RedShift
Amazon S3
Amazon DynamoDB
AWS Data Pipeline
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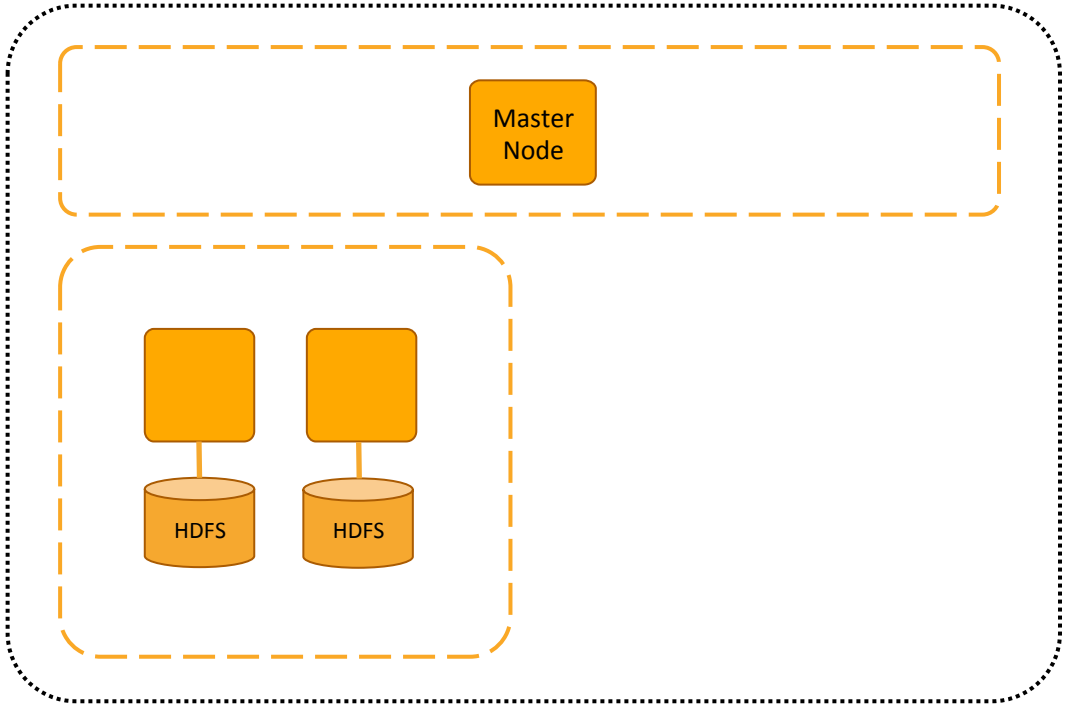
Amazon EMR Concepts

- Master Node
- Core Nodes
- Task Nodes

Core Nodes

DataNode (HDFS)



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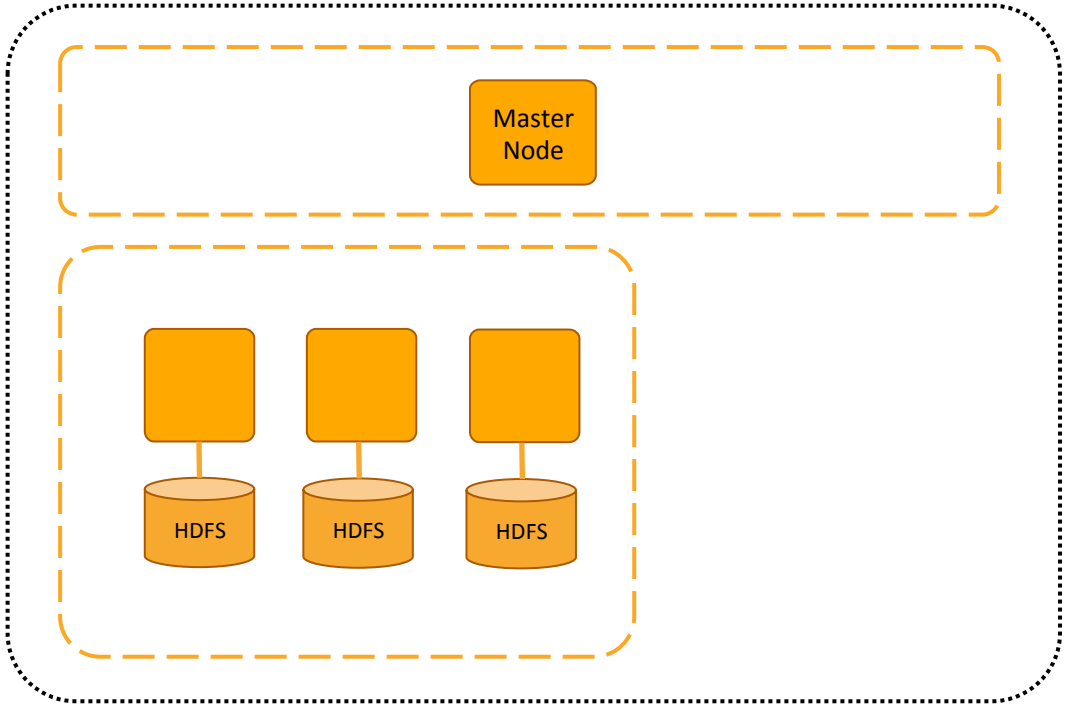
Core Nodes

Can Add Core Nodes:

More CPU

More Memory

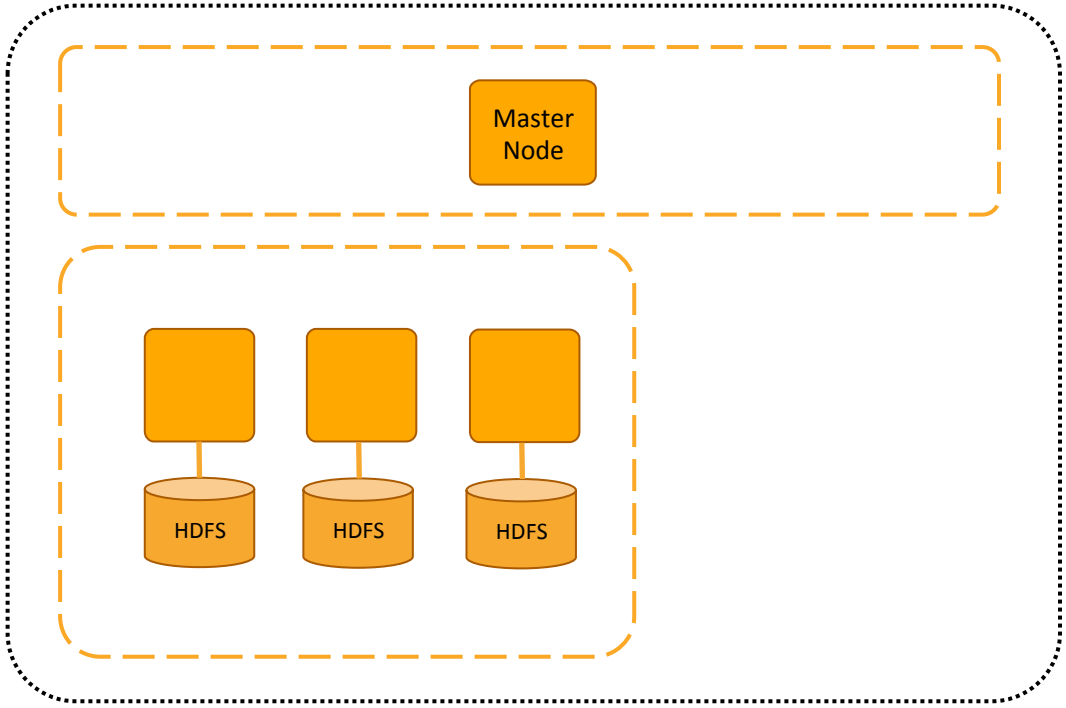
More HDFS Space



Core Nodes

Can’t remove core nodes:

HDFS corruption



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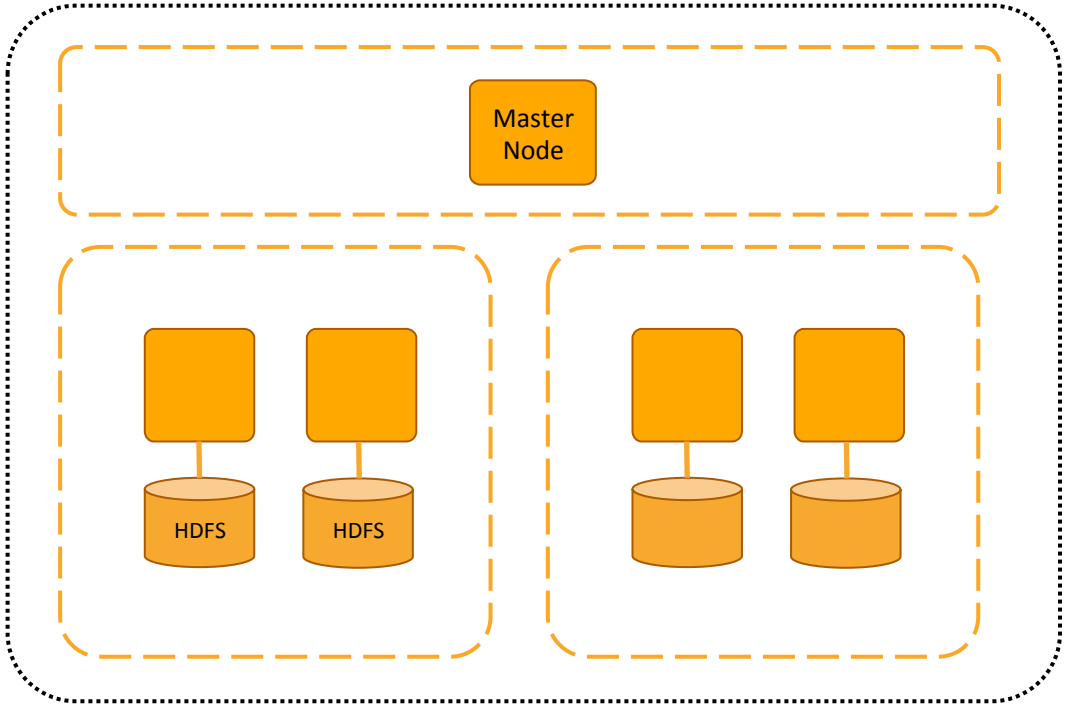
Task Nodes

No HDFS

Provides compute resources:

CPU

Memory



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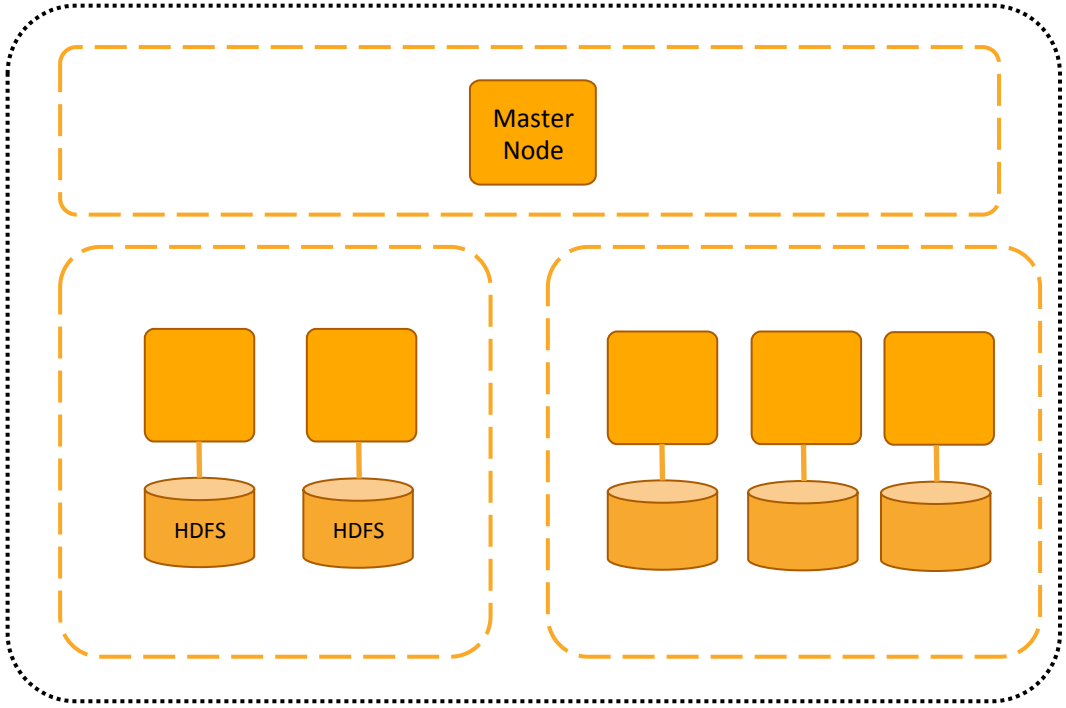
Task Nodes

Can add and remove task nodes



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Spark On Amazon EMR

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Bootstrap Actions

- Ability to run or install additional packages/ software on EMR nodes
- Simple bash script stored on S3
- Script gets executed during node/instance boot time
- Script gets executed on every node that gets added to the cluster

Spark on Amazon EMR

- Bootstrap action installs Spark on EMR nodes
- Currently on Spark 0.8.1 & upgrading to 1.0 very soon

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Why Spark on Amazon EMR?

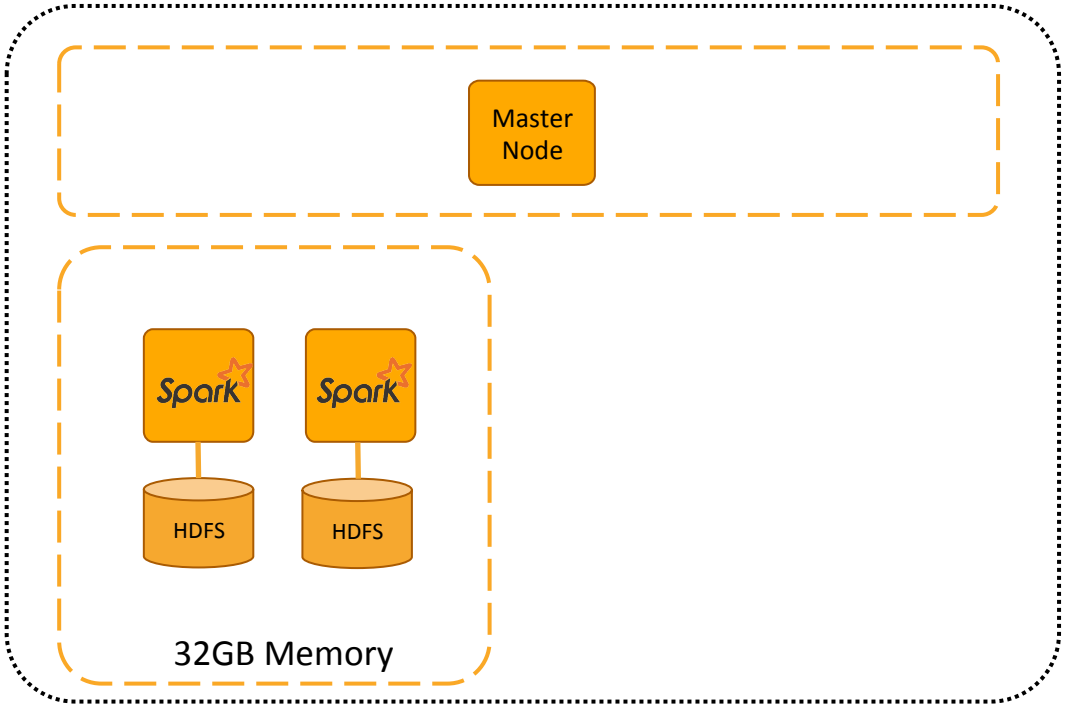
- Deploy small and large Spark clusters in minutes
- EMR manages your cluster, and handles node recover in case of failures
- Integration with EC2 Spot Market, Amazon Redshift, Amazon Data pipeline, Amazon Cloudwatch and etc
- Tight integration with Amazon S3

Why Spark on Amazon EMR?

- Shipping Spark logs to S3 for debugging
  - Define S3 bucket at cluster deploy time

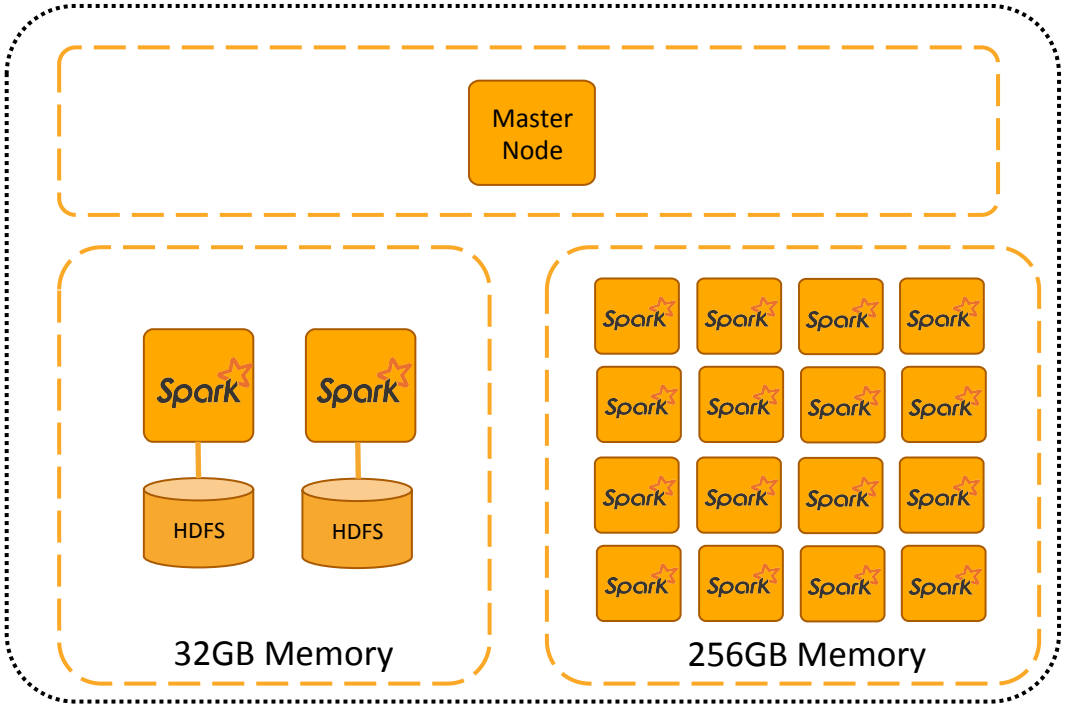
Scaling Spark on EMR

- Launch initial Spark cluster with core nodes
- HDFS to store and checkpoint RDDs



Scaling Spark on EMR

- Add Task nodes in spot market to increase memory capacity



Scaling Spark on EMR

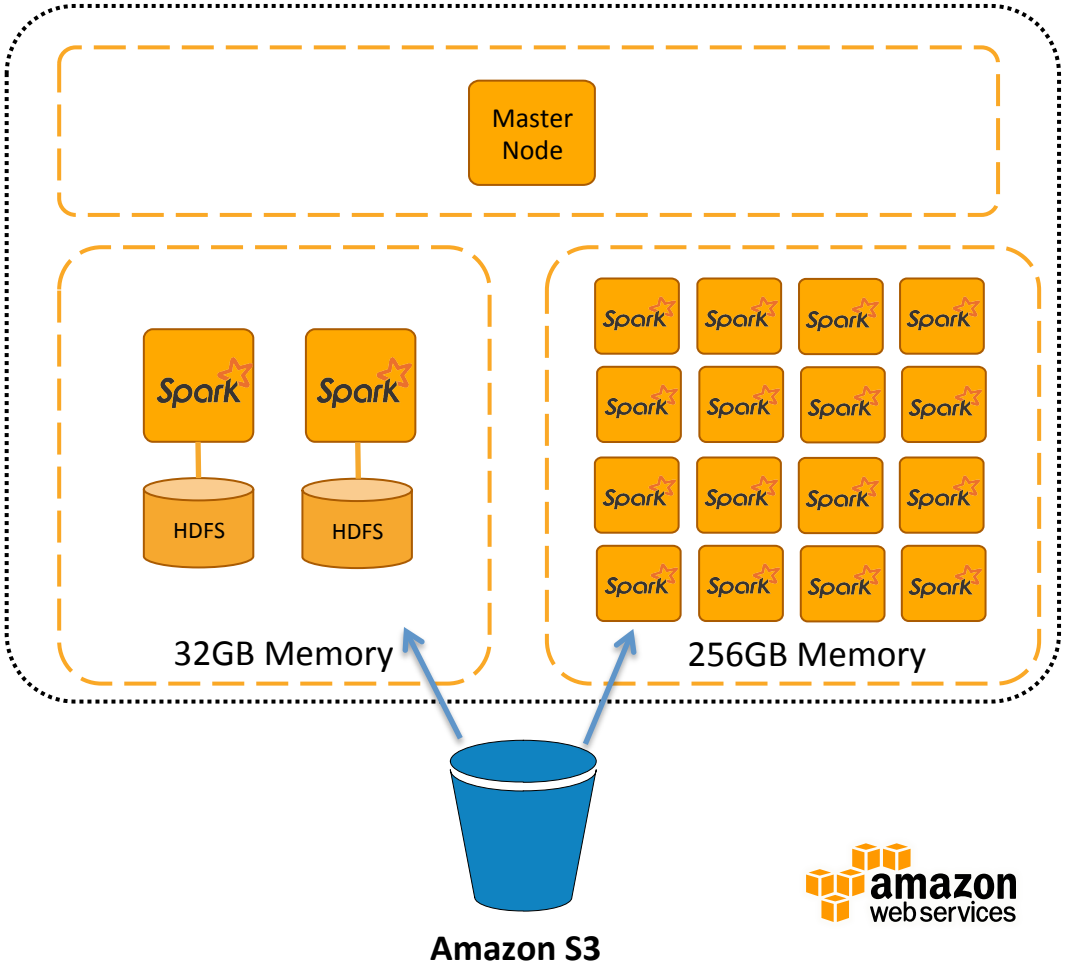
- Create RDDs from HDFS or Amazon S3 with:

  sc.textFile

  OR

  sc.sequenceFile

- Run Computation on RDDs



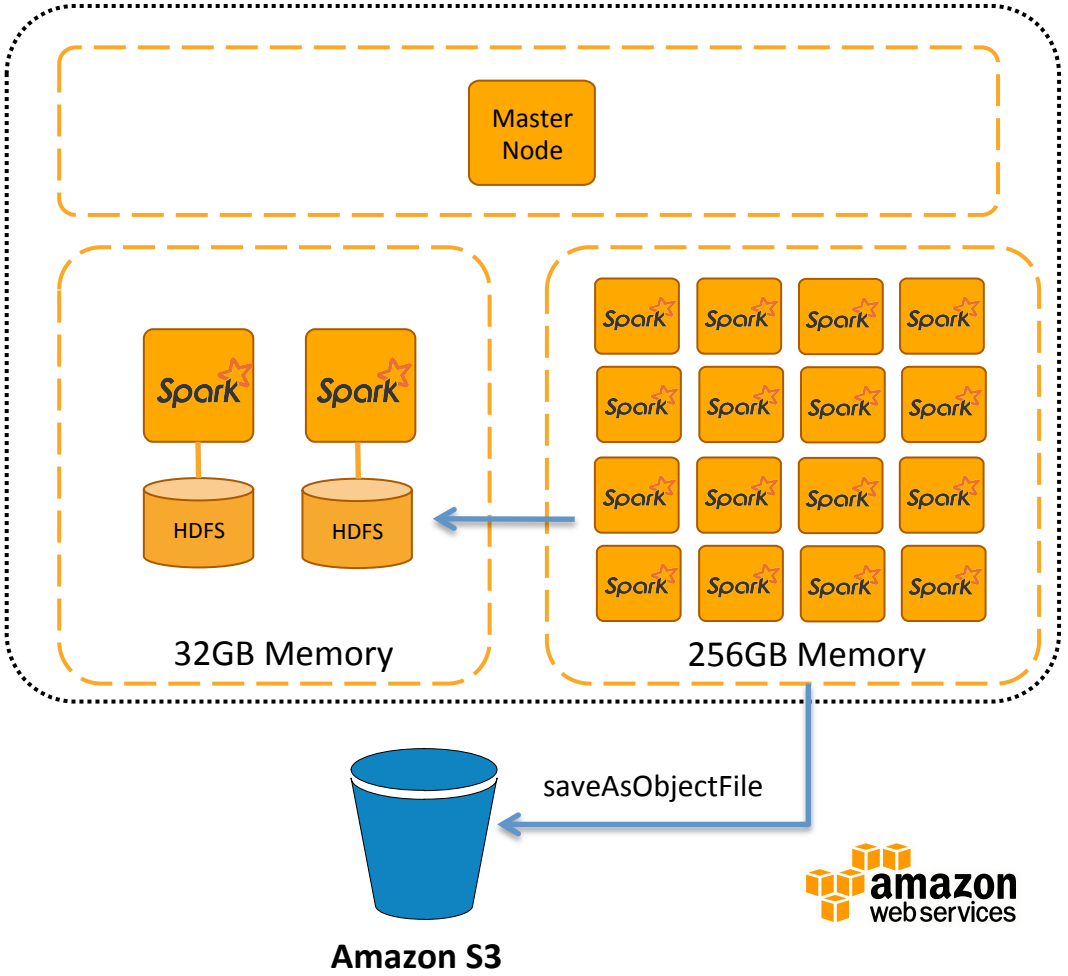
Scaling Spark on EMR

- Save the resulting RDDs to HDFS or S3 with:

  rdd.saveAsSequenceFile

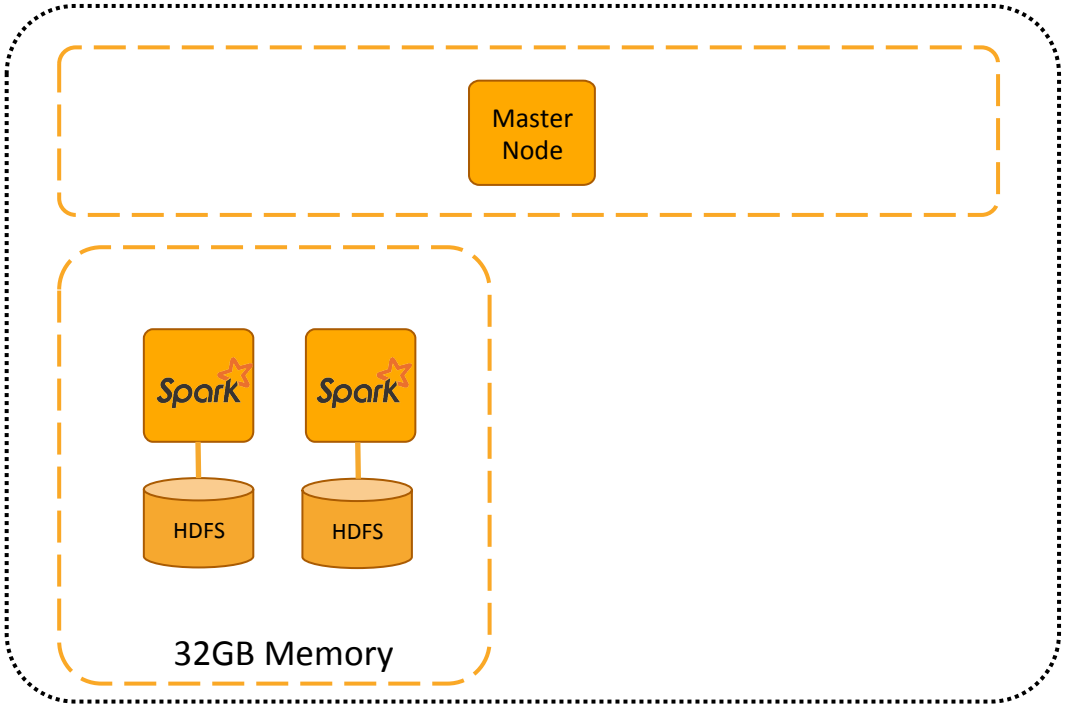
  OR

  rdd.saveAsObjectFile

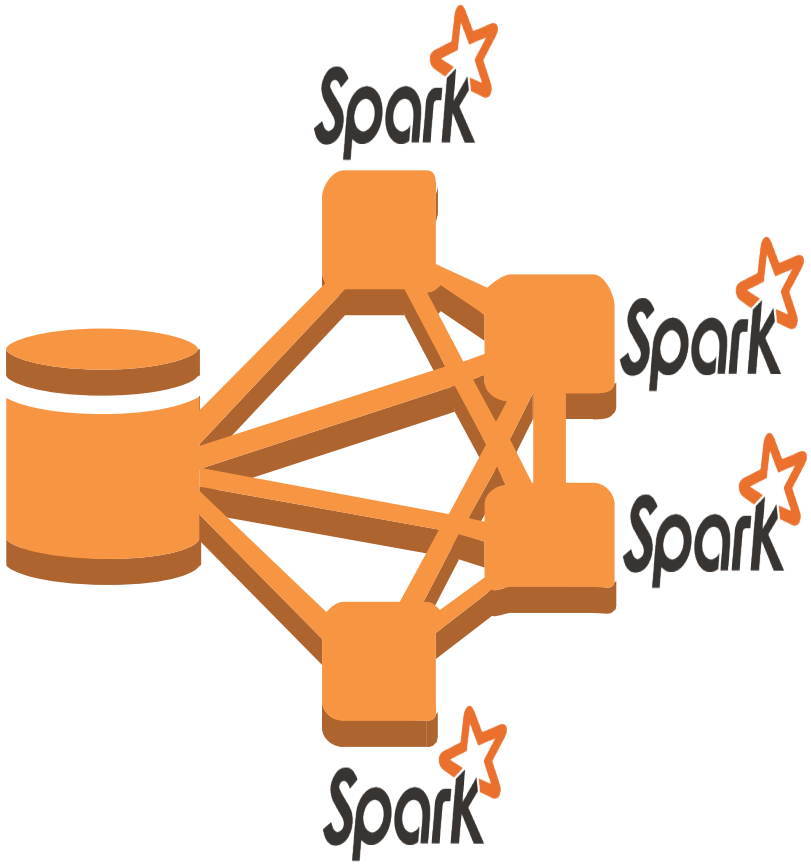


Scaling Spark on EMR

- Shutdown TaskNodes when your job is done



Elastic Spark With Amazon EMR



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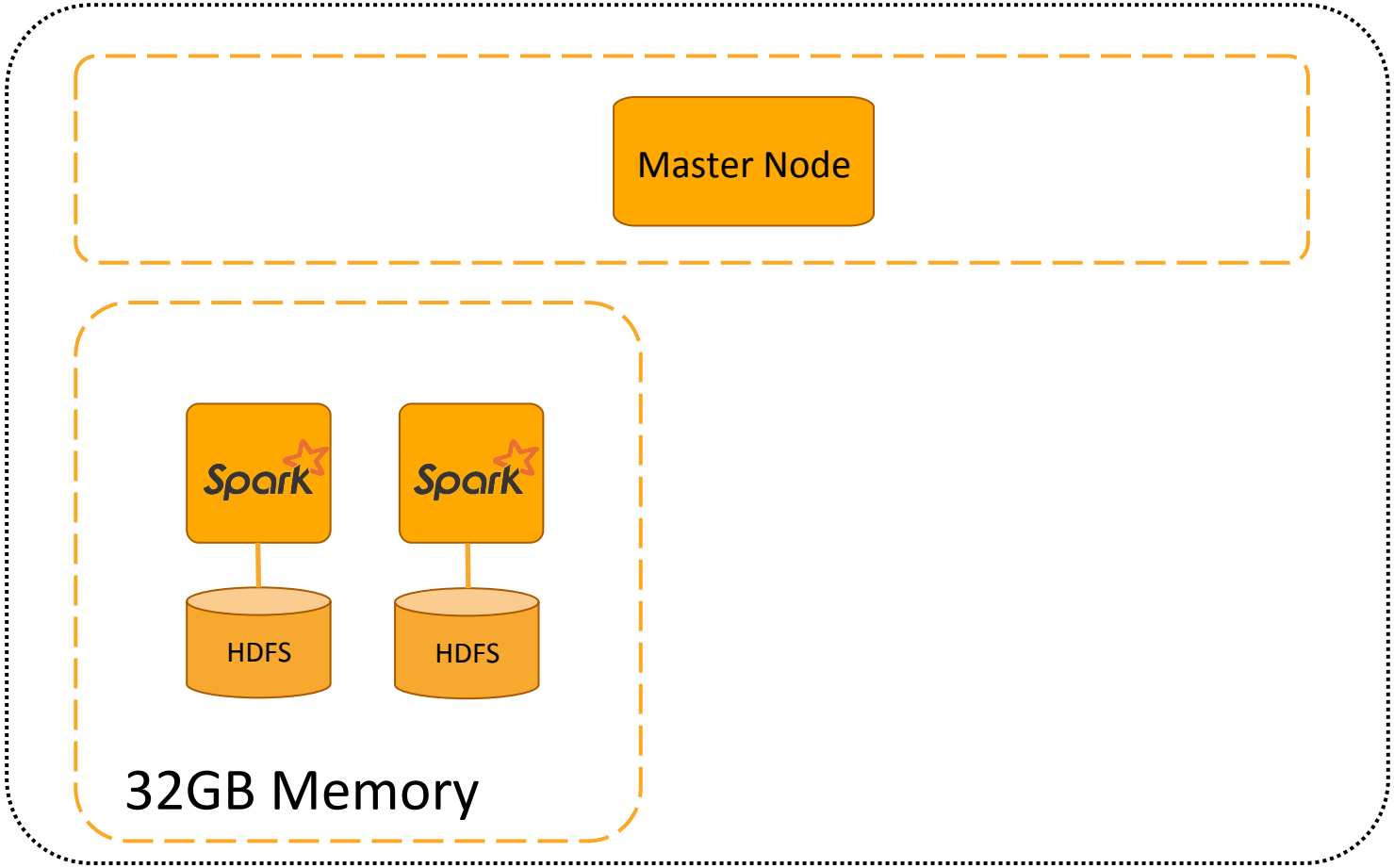
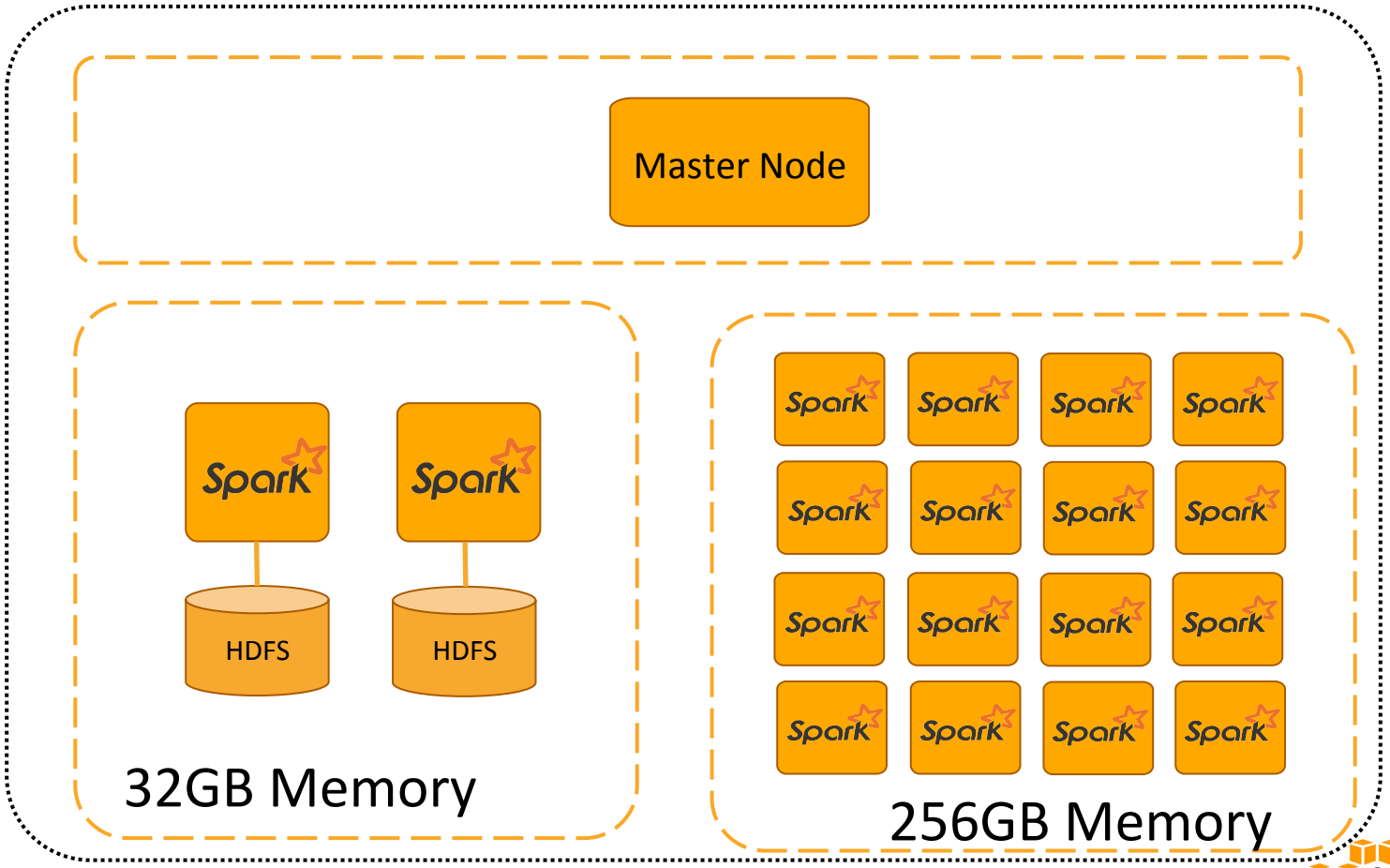
Autoscaling Spark



Autoscaling Spark



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Elastic Spark

- When to Scale?
  - Depends on your job
- CPU bounded or Memory intensive?
  - Probably both for Spark jobs
- Use CPU/Memory util. metrics to decide when to scale

Spark Autoscaling Based Memory

- Spark needs memory
  - Lots of it!!
- How to scale based on the memory usage?

Launching a 1000 node Cluster

Amazon EMR

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Launching a 1000 node Cluster

- What do I need to launch a cluster?
  - AWS Account
  - Amazon EMR CLI

Launching a 1000 node Cluster

- Easy to launch – 1 command

```
./elastic-mapreduce --create –alive
    --name "Spark/Shark Cluster"   \
    --bootstrap-action s3://elasticmapreduce/samples/spark/0.8.1/install-spark-shark.sh
    --bootstrap-name "Spark/Shark"
    --instance-type m1.xlarge
    --instance-count 1000
```

- Comes up in 15-20mins

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Launching a 1000 node Cluster

- Adding Task nodes

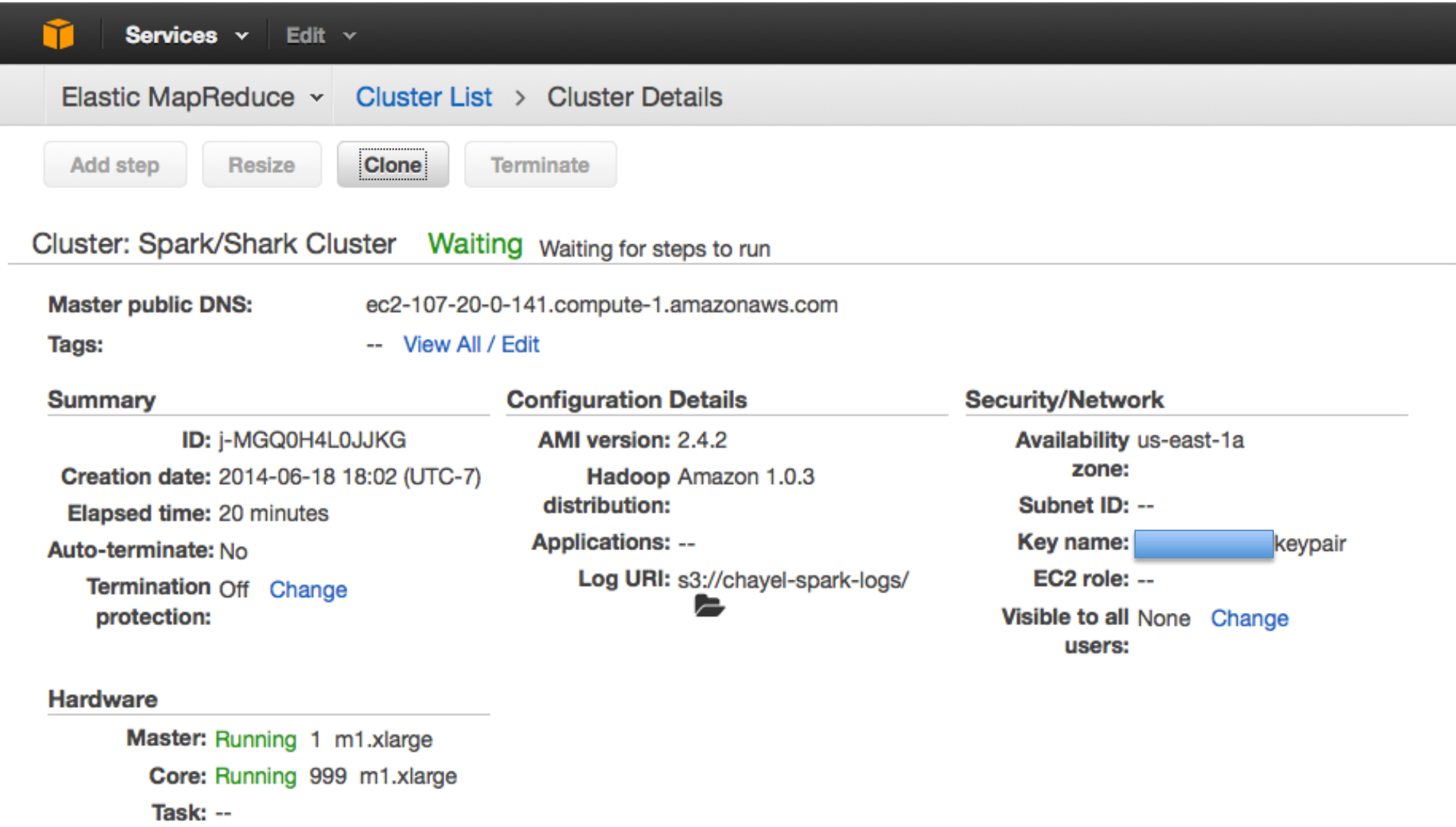
--add-instance-group *TASK*

--instance-count *INSTANCE_COUNT*

--instance-type *INSTANCE_TYPE*

Is cluster ready?

- Cluster will be in Waiting state



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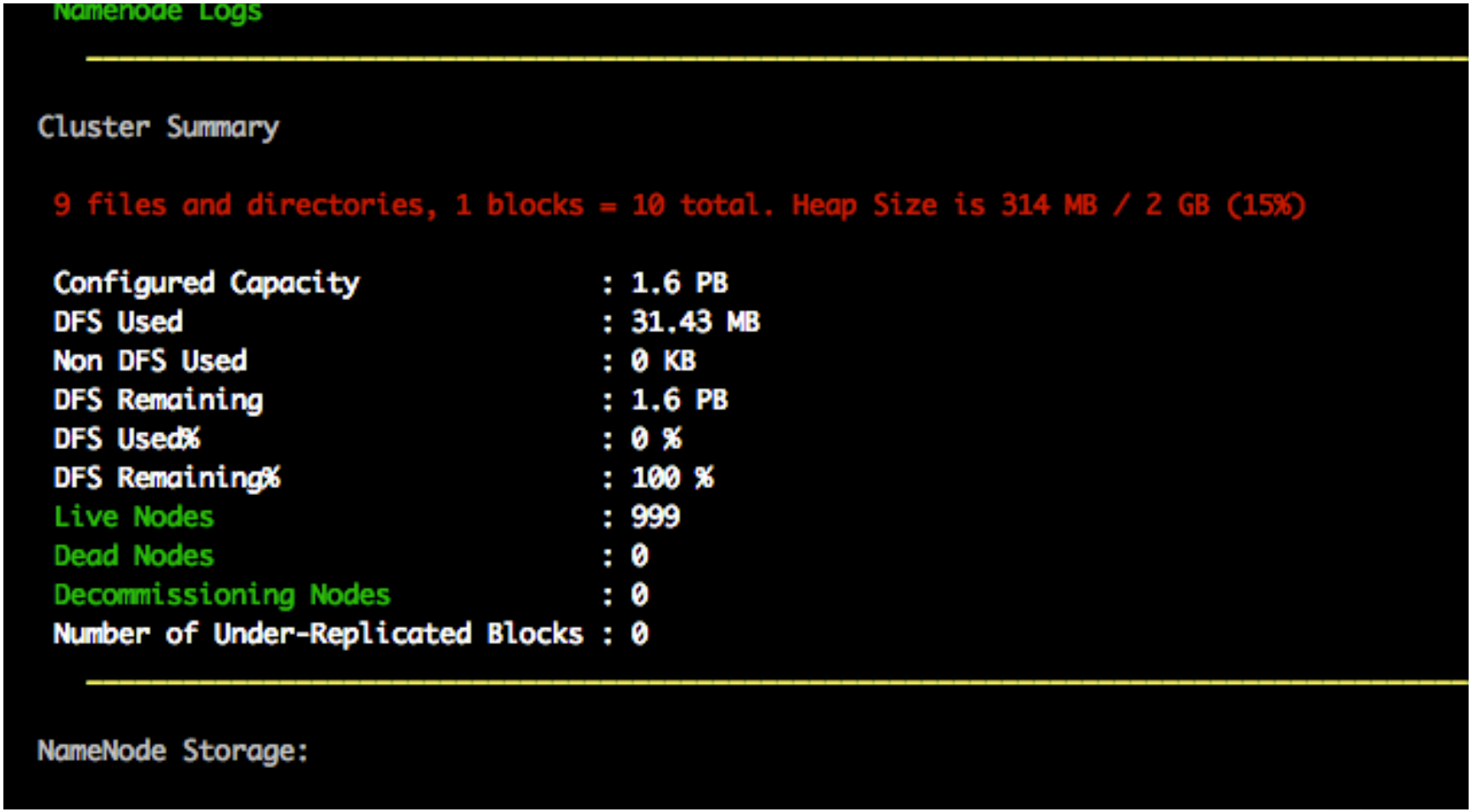
Lynx Interface

lynx http://localhost:9101



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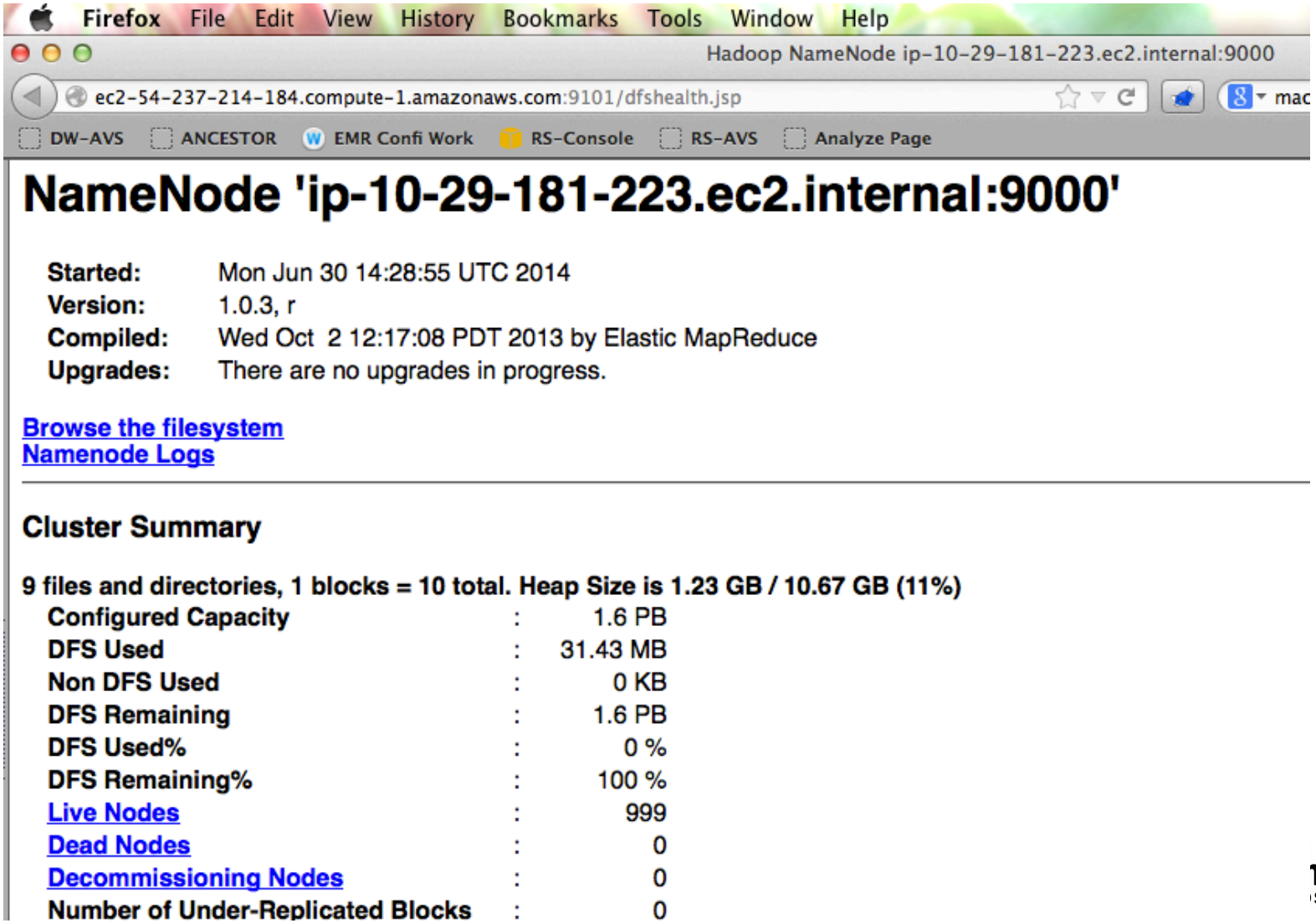
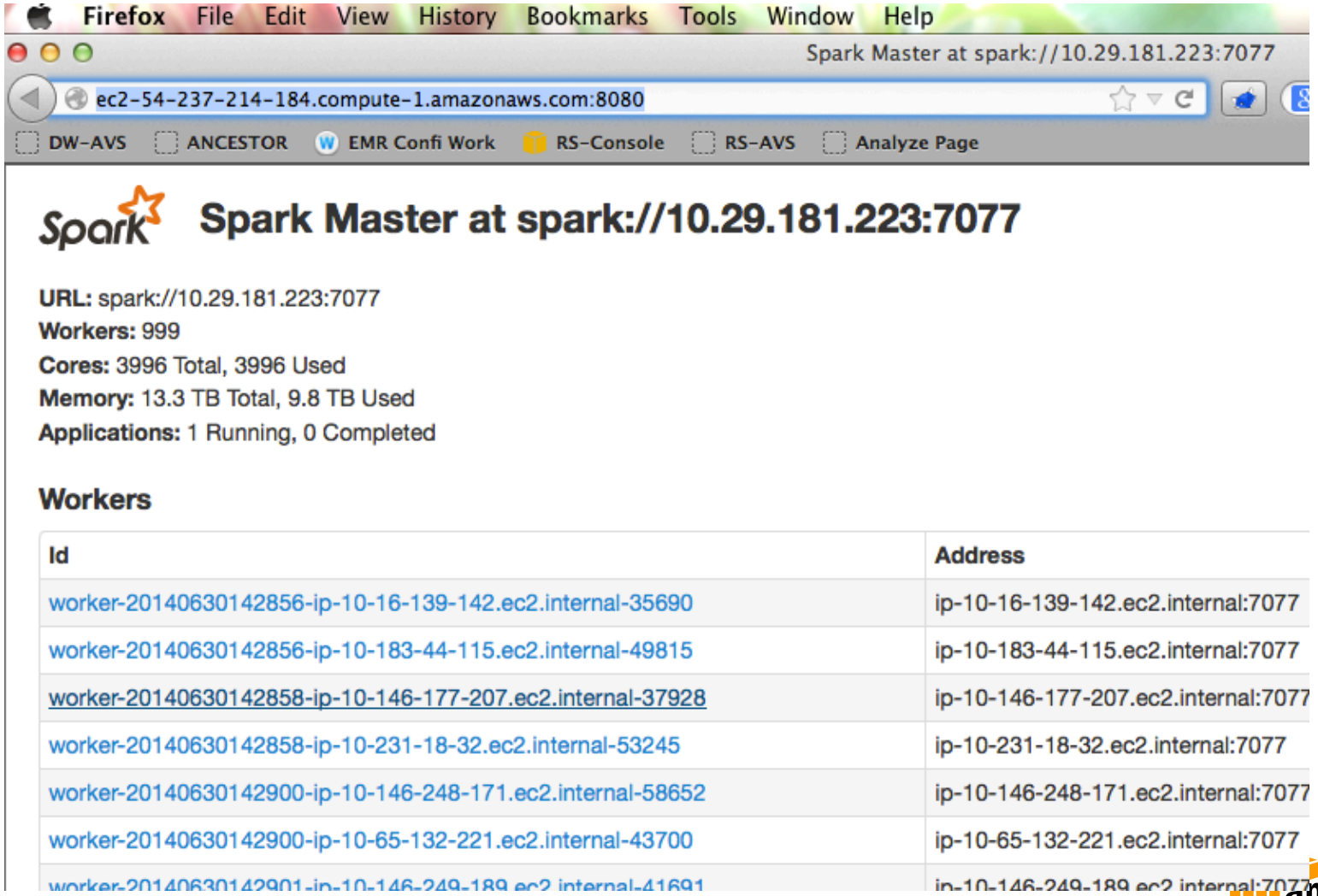
Web Interface



Spark UI



Dataset

- Wikipedia article traffic statistics
  - 4.5 TB
  - 104 Billion records

- Stored in Amazon S3
  - s3://bigdata-spark-demo/wikistats/

Dataset

- File structure (pagecount-DATE-HOUR.gz)
- Period: Dec-2007 to Feb-2014

- Format of File (tsv)
- Feilds

projectcode, pagename, pageviews, and bytes

Sample dataset

Projectcode pagename pageviews bytes

en Barack_Obama 997 123091092

en Barack_Obama%27s_first_100_days 8 850127

en Barack_Obama,_Jr 1 144103

en Barack_Obama,_Sr. 37 938821

en Barack_Obama_%22HOPE%22_poster 4 81005

en Barack_Obama_%22Hope%22_poster 5 102081

Loading data

Analyze options

Table structure

```
create external table wikistats
(
projectcode string,
pagename string,
pageviews int,
pagesize int
)
ROW FORMAT
DELIMITED FIELDS
TERMINATED BY ' '
LOCATION 's3n://bigdata-spark-demo/wikistats/';

ALTER TABLE wikistats add partition(dt='2007-12') location 's3n://bigdata-spark-demo//wikistats/2007/2007-12';
…….
```

Adding partitions for every month till 2014-04

Analyze using Shark

Top 10 Page Views in Jan 2014

```
shark> select pagename, sum(pageviews) c
     > from wikistats_cached
     > where dt='2014-01'
     > group by pagename
     > order by c desc
     > limit 10;
```

Exec time: 26 secs

Scanning 250GB of data

Analyze using Shark

Query 2:

Top 10 Page Views Overall

```
shark> select pagename, sum(pageviews) c
     > from wikistats_cached
     > group by pagename
     > order by c desc
     > limit 10;
```

- Exec time: 45 sec
- Scanning 4.5TB of data

Analyze using Shark

Query 3:

No of pages in each projectcodes

```
shark> select projectcode, count(pagename)
     > from wikistats_cached
     > group by projectcode
     > ;
OK
```

Exec time: 48 secs

Scanning 4.5TB of data / 104 Billion records

Spark Streaming and Amazon Kinesis

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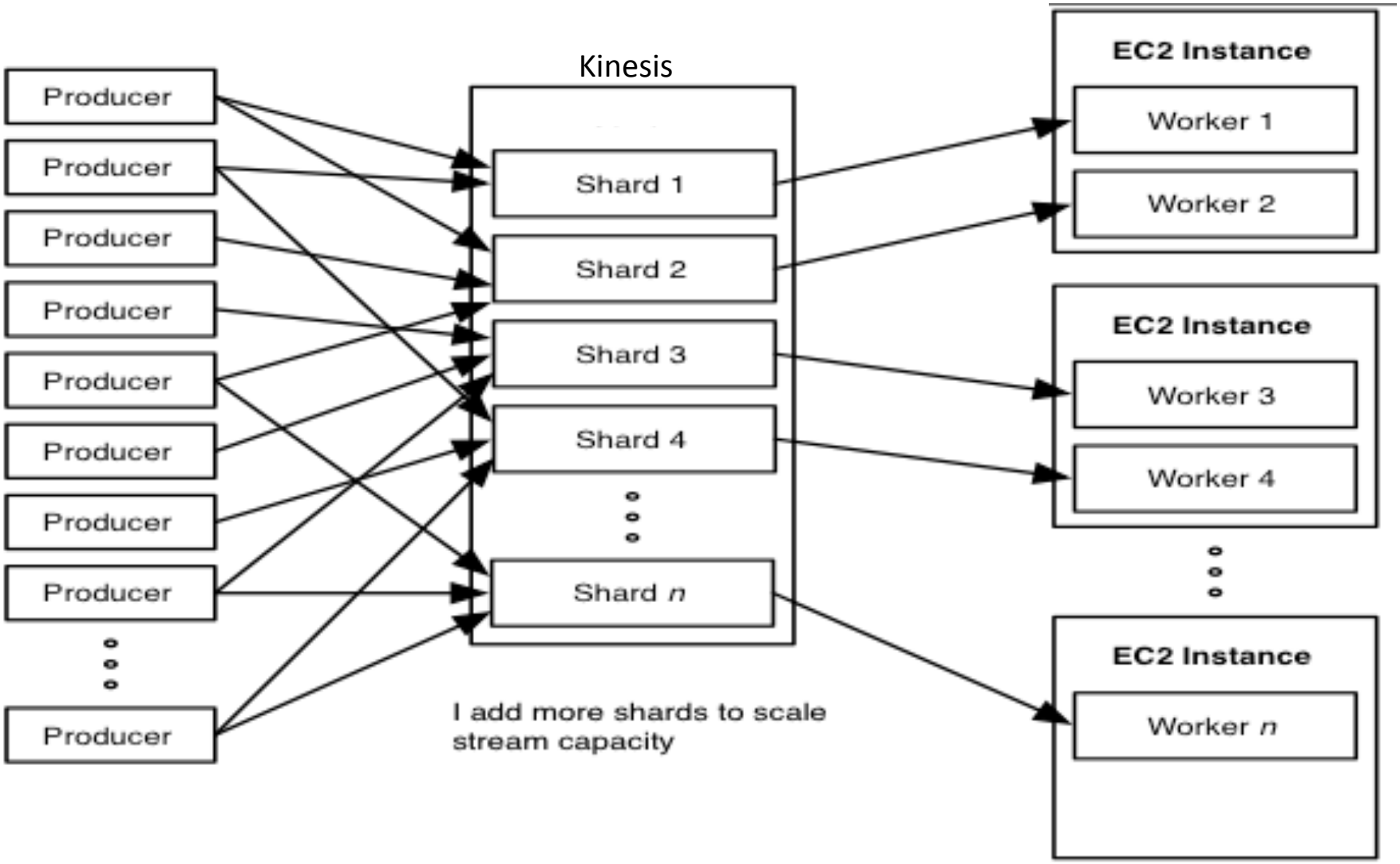
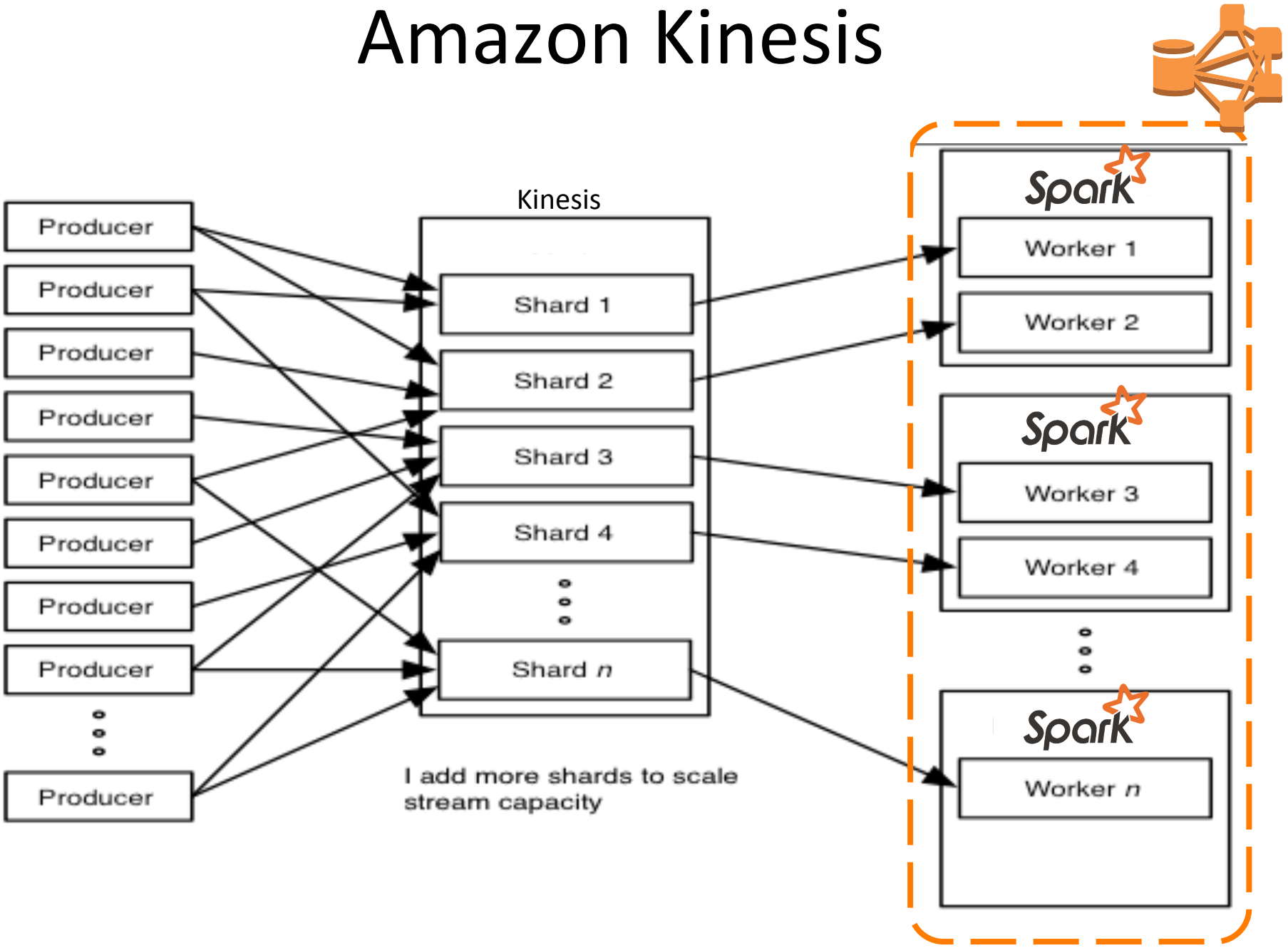
Amazon Kinesis

- **CreateStream**
  - Creates a new Data Stream within the Kinesis Service
- **PutRecord**
  - Adds new records to a Kinesis Stream
- **DescribeStream**
  - Provides metadata about the Stream, including name, status, Shards, etc.
- **GetNextRecord**
  - Fetches next record for processing by user business logic
- **MergeShard / SplitShard**
  - Scales Stream up/ down
- **DeleteStream**
  - Deletes the Stream

Amazon Kinesis



Amazon Kinesis



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