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Learning & Development

Enabling development, Impacting growth…

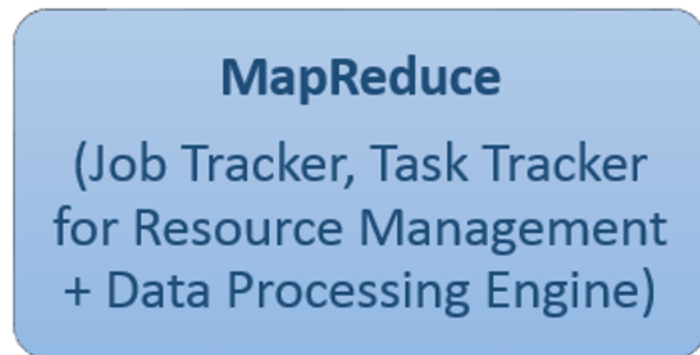**BIG-04**

Hadoop 2.0 & YARN – Module 03

INSIGHTS&DATA

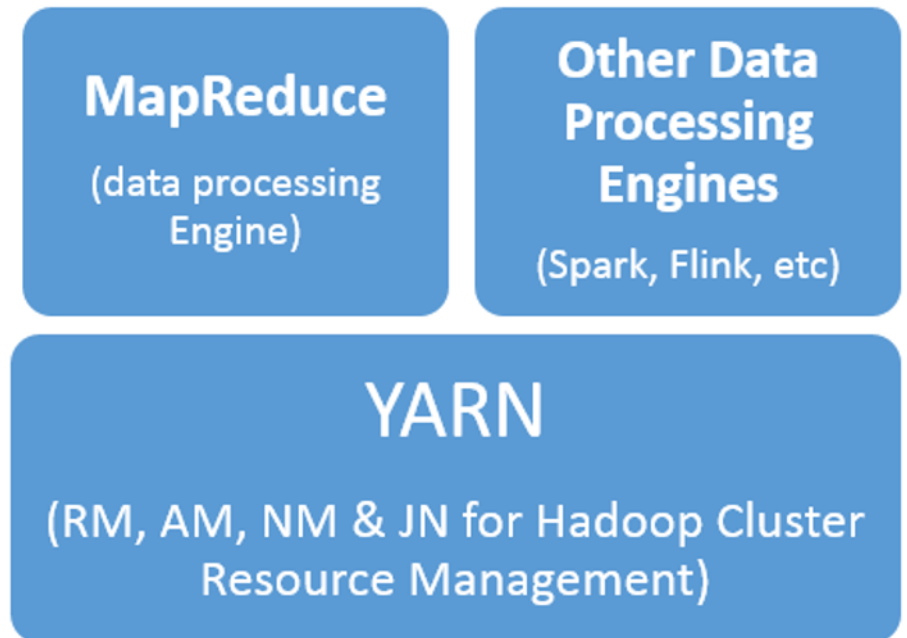# Module outline(continued)

- Difference between Hadoop 1.0 and 2.0

- New Components in Hadoop 2.x

- YARN/MRv2

- Configuration Files in Hadoop 2.x

- Major Hadoop Distributors/Vendors

- Cluster Management & Monitoring

- Hadoop Downloads

- Q & A

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Difference between Hadoop 1.0 and 2.0

Hadoop v1.0 (MRv1)

MapReduce

(Job Tracker, Task Tracker for Resource Management + Data Processing Engine)

Hadoop v2.0 (MRv2)

MapReduce

(data processing Engine)

Other Data Processing Engines

(Spark, Flink, etc)

YARN

(RM, AM, NM & JN for Hadoop Cluster Resource Management)

Difference between Hadoop 1.0 and 2.0(continued)

Hadoop 1	Hadoop 2
Supports MapReduce (MR) processing model only. Does not support non MR tools	Allows to work in MR as well as other distributed computing models like Spark, Hama, Giraph, Message Passing Interface) MPI & HBase coprocessors.
MR does both processing and cluster-resource management.	YARN (Yet Another Resource Negotiator) does cluster resource management and processing is done using different processing models.
Has limited scaling of nodes. Limited to 4000 nodes per cluster	Has better scalability. Scalable up to 10000 nodes per cluster
Works on concepts of slots − slots can run either a Map task or a Reduce task only.	Works on concepts of containers. Using containers can run generic tasks.
A single Namenode to manage the entire namespace.	Multiple Namenode servers manage multiple namespace.
Has Single-Point-of-Failure (SPOF) − because of single Namenode- and in case of Namenode failure, needs manual intervention to overcome.	Has feature to overcome SPOF with a standby Namenode and in case of Namenode failure, it is configured for automatic recovery.
MR API is compatible with Hadoop 1x. A program written in Hadoop1 executes in Hadoop1x without any additional files.	MR API requires additional files for a program written in Hadoop1x to execute in Hadoop2x.

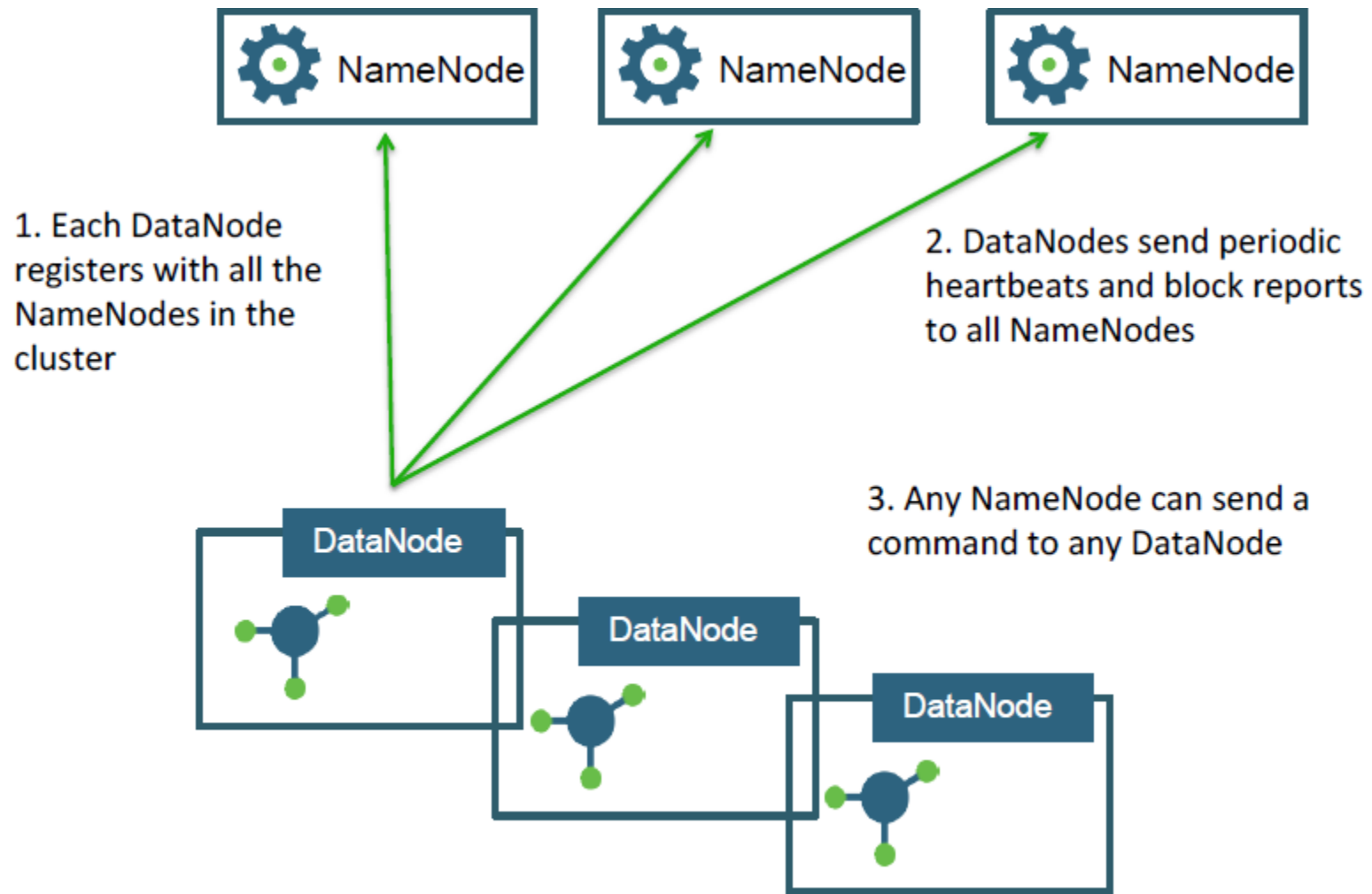Capgemini
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New Components in Hadoop 2.x

- HDFS Federation

- Multiple Federated Name Nodes

- Multiple Namespaces

- HDFS High Availability(HA)

- Automatic Failover

- YARN (Yet Another Resource Negotiator)

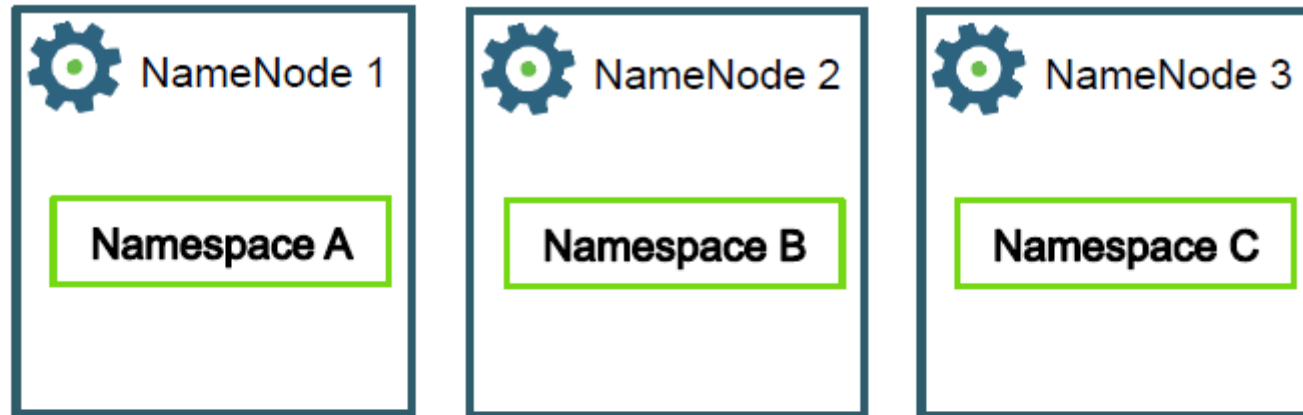# New Components in Hadoop 2.x- **HDFS Federation**

- According to Webster's: a **federation** is an organization or group within smaller divisions have some degree of internal autonomy

- HDFS Federation refers to the ability of Name Nodes to work independent of each other.

- Federation allows
  - a cluster to scale by adding name nodes, each of which manages a portion of file system namespace.
  - Example: One name node manages files under /user and second may manage files under /share directory

New Components in Hadoop 2.x- **Multiple Federated Name Node**

1. Each DataNode registers with all the NameNodes in the cluster

2. DataNodes send periodic heartbeats and block reports to all NameNodes

3. Any NameNode can send a command to any DataNode

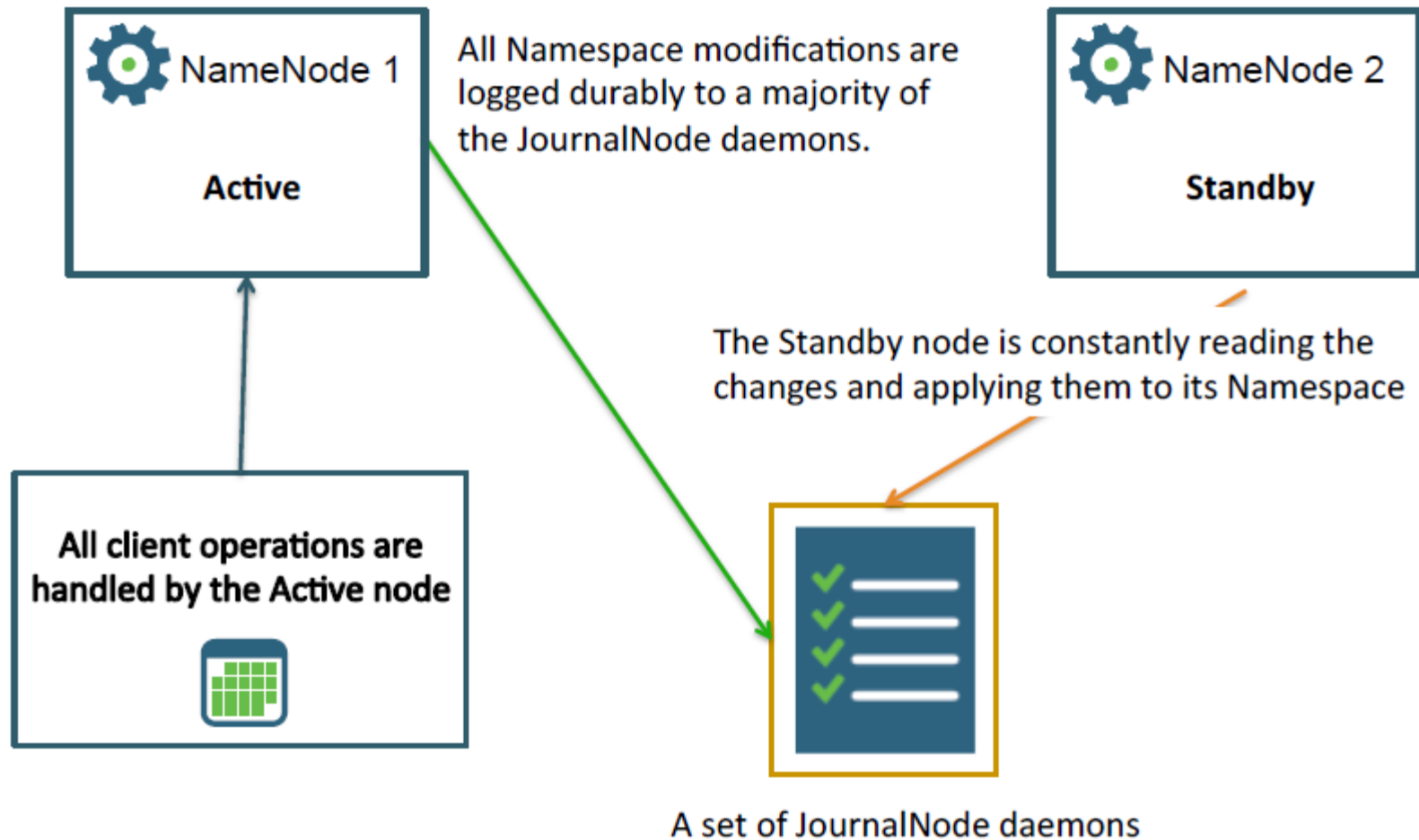# New Components in Hadoop 2.x- **Multiple Namespaces**

- Files and directories belong to a Namespace
- Prior versions of Hadoop only had a single Namespace
- Hadoop 2.x allows for multiple Namespaces
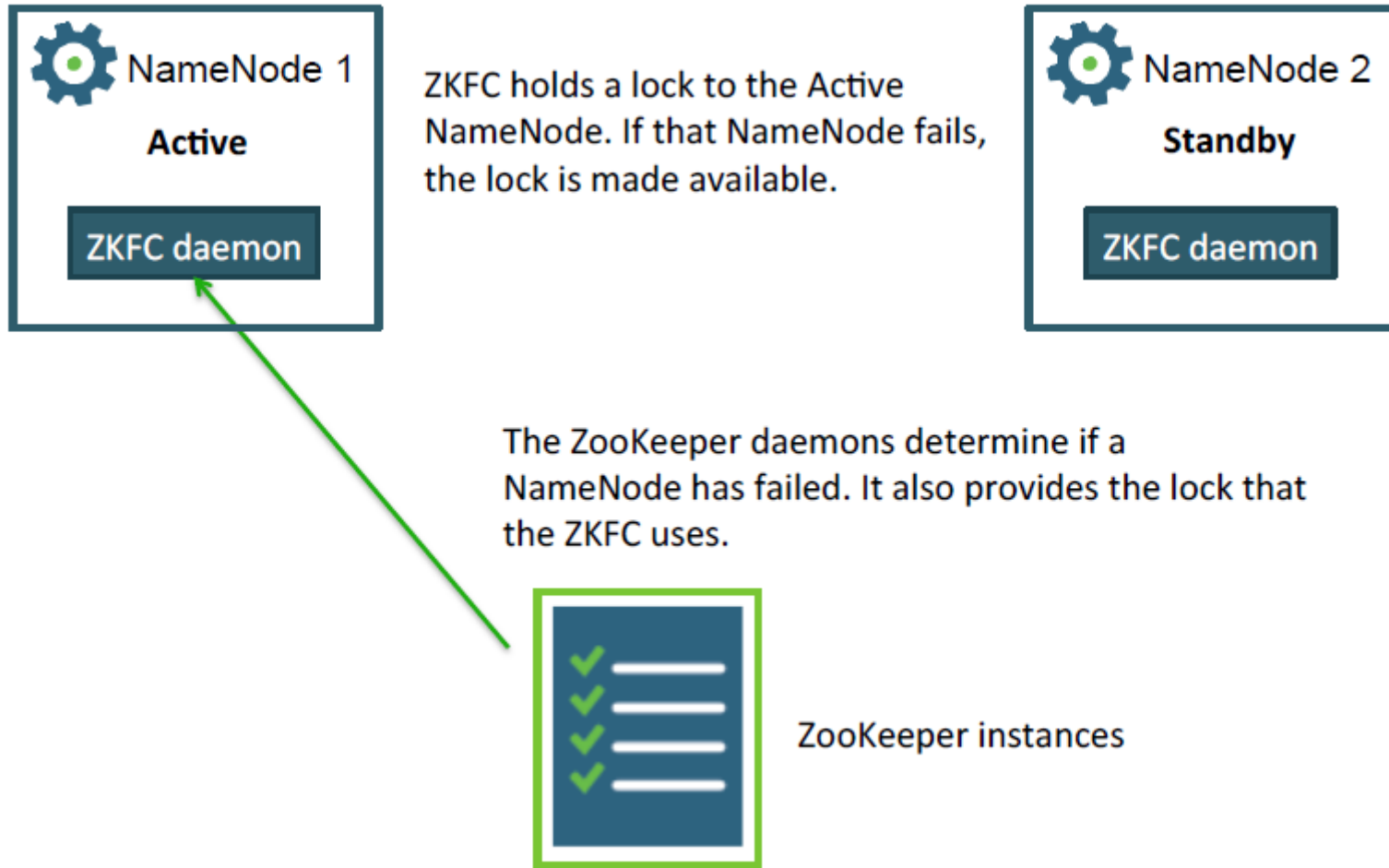- A NameNode manages a single Namespace Volume

New Components in Hadoop 2.x- **HDFS High Availability(HA)**

- In prior versions of Hadoop, the Name Node was a single point of failure that required additional tools to achieve High Availability

- In Hadoop 2.0, Name Node HA is now achieved using the built-in Quorum Journal Manager Framework

# HDFS High Availability(continued)... **Quorum Journal Manager**

NameNode 1

Active

All Namespace modifications are logged durably to a majority of the JournalNode daemons.

NameNode 2

Standby

The Standby node is constantly reading the changes and applying them to its Namespace

All client operations are handled by the Active node

A set of JournalNode daemons

New Components in Hadoop 2.x- **Automatic Failover**

NameNode 1

Active

ZKFC daemon

ZKFC holds a lock to the Active NameNode. If that NameNode fails, the lock is made available.

NameNode 2

Standby

ZKFC daemon

The ZooKeeper daemons determine if a NameNode has failed. It also provides the lock that the ZKFC uses.

ZooKeeper instances

YARN/MRv2

- **YARN** = Yet Another Resource Negotiator

- YARN splits up the functionality of Job Tracker in Hadoop 1.x into two separate processes:

  - **Resource Manager**: for allocating resources and scheduling applications

  - **Application Master**: for executing applications and providing failover

YARN/MRv2(continued)
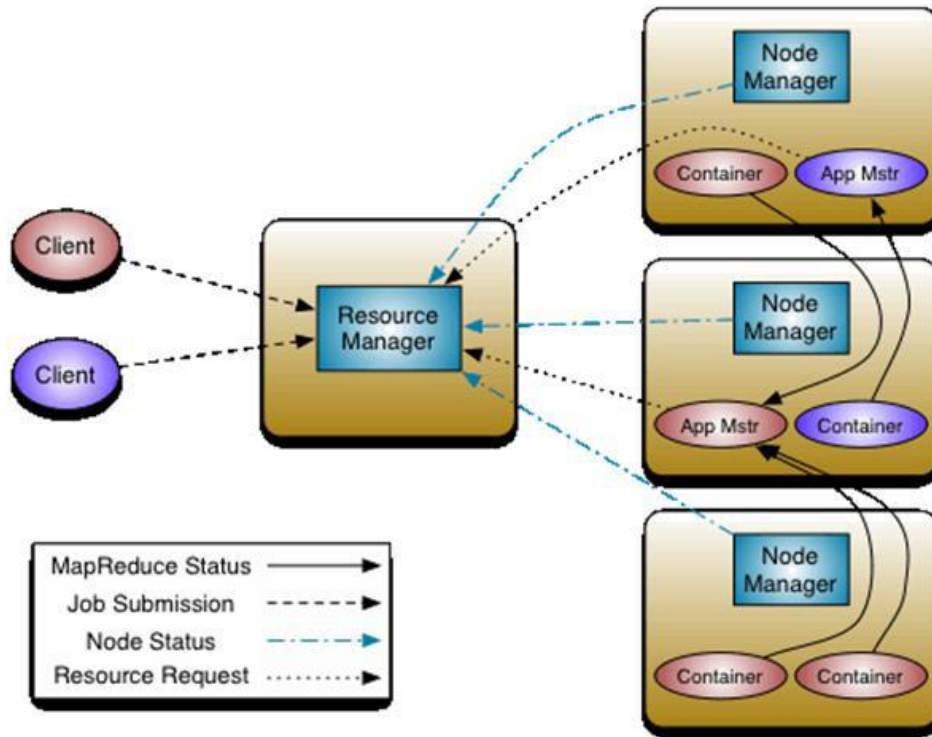
- Resource Management
- Job Scheduling & Monitoring

- Resource Manager
  - Scheduler
  - Applications Manager

- Application Master
- Node Managers

YARN/MRv2 (continued)

- Split up the two major functionalities of the Job Tracker, resource management and job scheduling/monitoring, into separate daemons.
  - Resource Manager (*RM) and per-application Application Master (AM).*
- The Resource Manager and per-node slave, the Node Manager (*NM), form the data-computation framework*
- The per-application Application Master is, in effect, a framework specific library and is tasked with negotiating resources from the Resource Manager and working with the Node Manager to execute and monitor the tasks.
- The Yarn Cluster consists of a single Resource manager which has 2 components
  - **Scheduler –** Manages and enforces resource scheduling policy in the cluster, Ex- Capacity scheduler , FIFO scheduler, Fair Scheduler.
  - **Applications Manager –** Manages Applications Master in the cluster, i.e., it is responsible for starting application masters and monitoring and restarting them on different nodes in case of failure
- The cluster also consists of Containers ,Node Managers(NM) & Application Masters(AM).
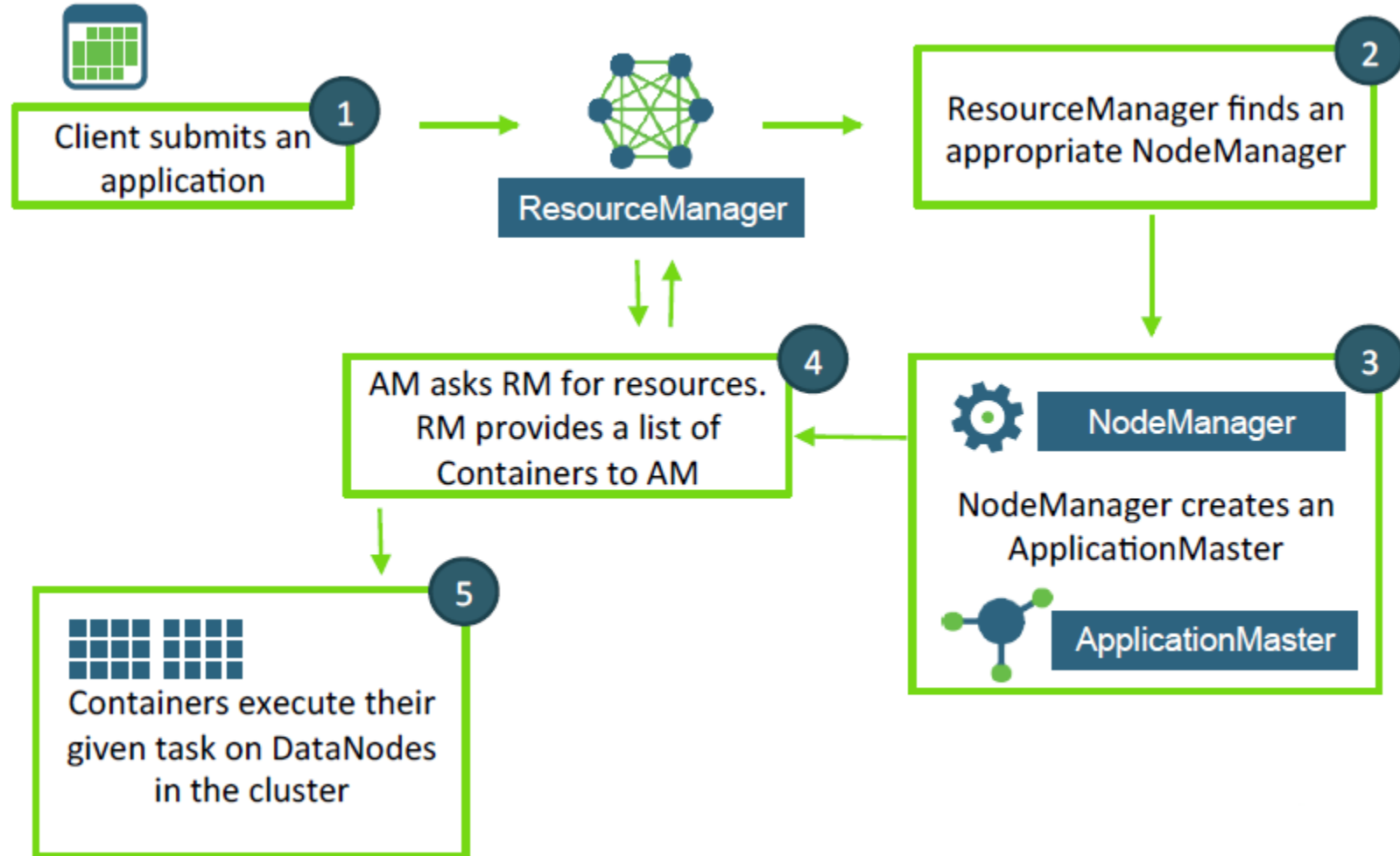- There will be as many Application Masters as the number of jobs running.

14

YARN/MRv2- **Components of YARN**

- The **ResourceManager** communicates with the **NodeManagers**, **ApplicationMasters**, and **Client** applications
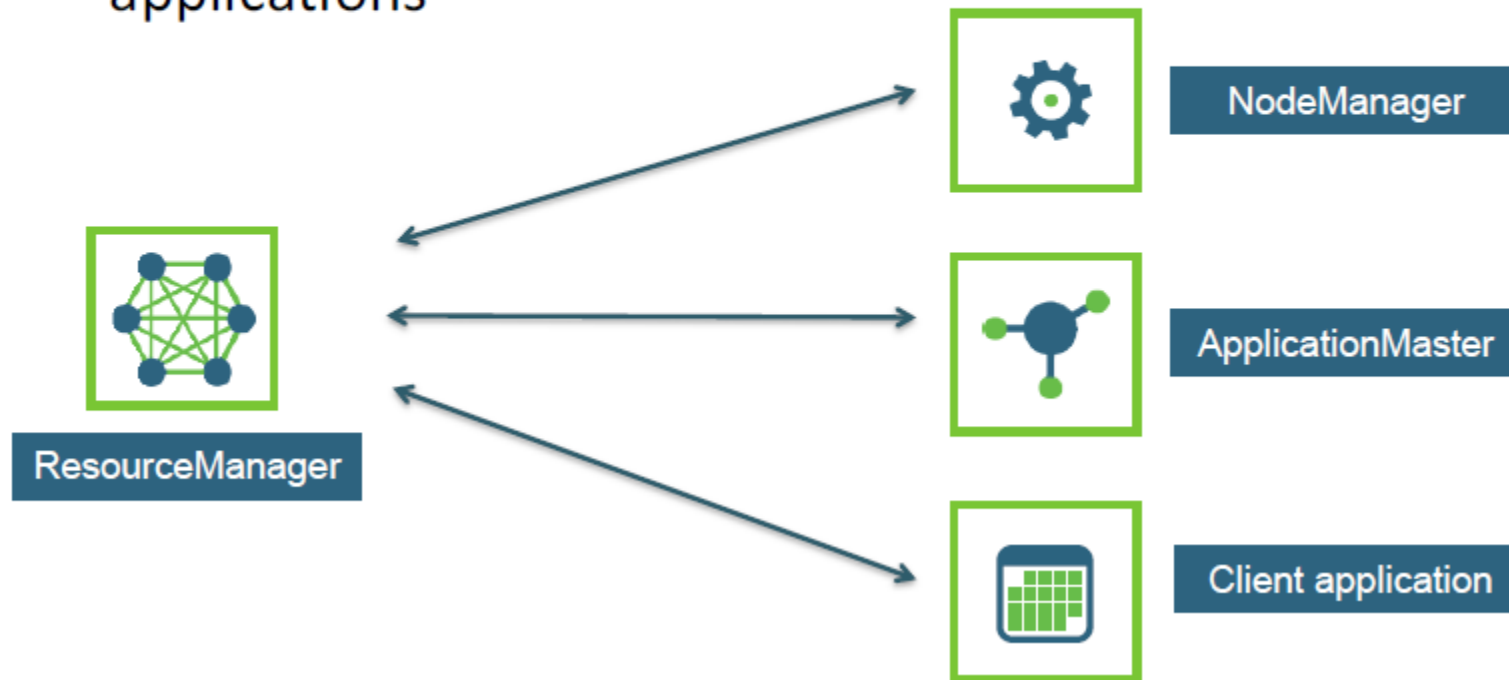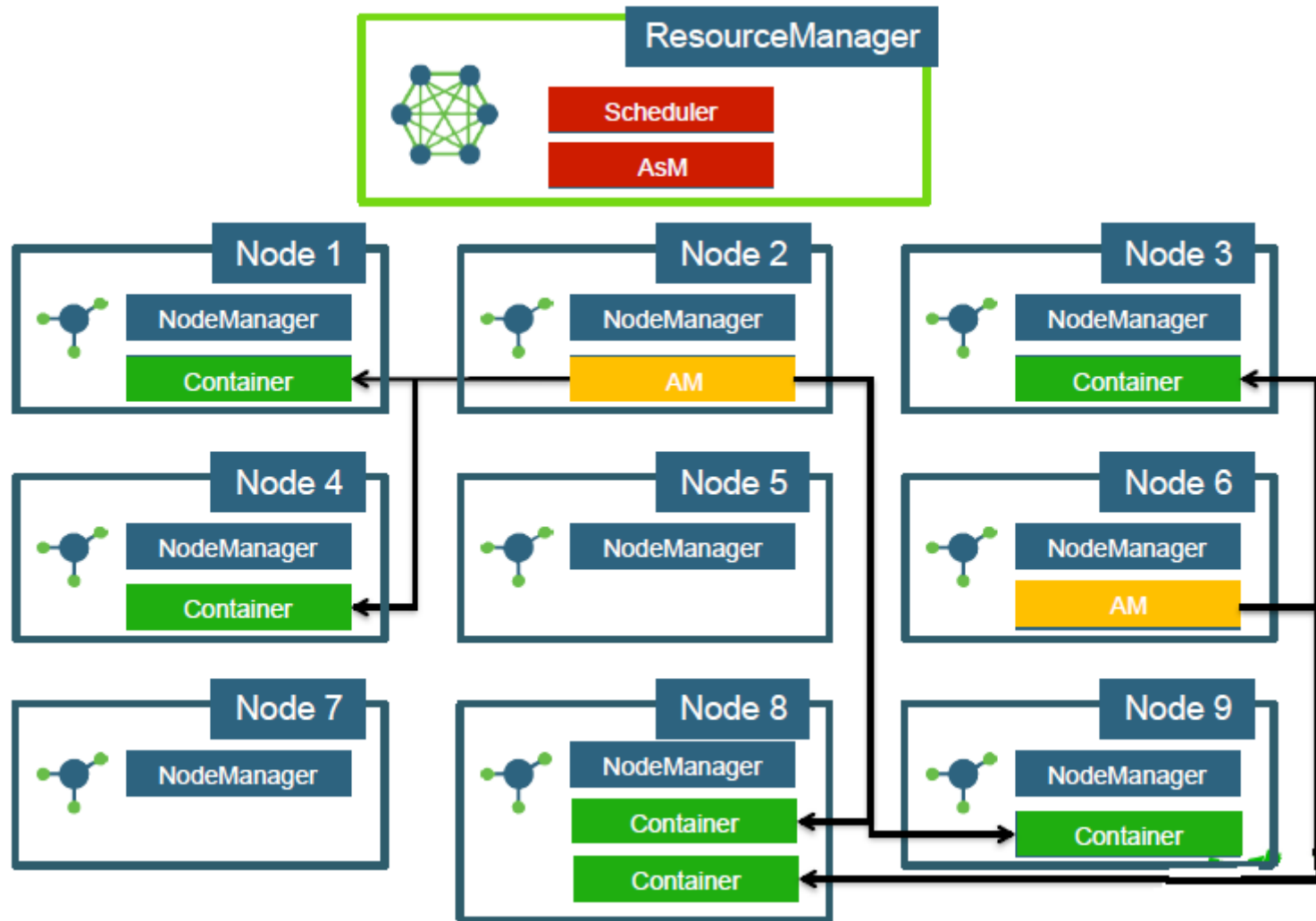
YARN/MRv2- **Life cycle of a YARN Application**

YARN/MRv2- **A cluster view example**

Quiz

- 1. True or False: A Name Node can contain multiple namespaces in Hadoop 2.x?

- 2. What is the key benefit of the new YARN framework?

- 3. What are the three main components of YARN?

Quiz-Answers

- 1. False. A Name Node can represent only a single namespace.

- 2. Hadoop jobs are no longer restricted to Map Reduce. With YARN, any type of computing paradigm can be implemented to run on Hadoop.

- 3. Resource Manager, Node Manager and Application Master

Configuration Files in Hadoop 2.x

Configuration Filenames	Description of Log Files
hadoop-env.sh	Environment variables that are used in the scripts to run Hadoop.
core-site.xml	Configuration settings for Hadoop Core such as I/O settings that are common to HDFS and MapReduce.
hdfs-site.xml	Configuration settings for HDFS daemons, the namenode, the secondary namenode and the data nodes.
mapred-site.xml	Configuration settings for MapReduce Applications.
yarn-site.xml	Configuration settings for ResourceManager and NodeManager.
masters	A list of machines (one per line) that each run a secondary namenode.
slaves	A list of machines (one per line) that each run a Datanode and a NodeManager.

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Major Hadoop Distributors/Vendors

cloudera	Cloudera distributes a platform of open-source projects called Cloudera's Distribution including Apache Hadoop or CDH. These include architectural services and technical support for Hadoop clusters in development or in production.
Hortonworks	Another major player in the Hadoop market, Hortonworks has the largest number of committers and code contributors for the Hadoop ecosystem components.Provider of expert technical support, training and partner-enablement services for both end-user organizations and technology vendors.
MAPR	The MapR Distribution including Apache Hadoop provides you with an enterprise-grade distributed data platform to reliably store and process big data. MapR's Apache Hadoop distribution claims to provide full data protection, no single points of failure, improved performance

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Major Hadoop Distributors/Vendors(continued)

	Hortonworks	Cloudera	MapR
Performance and Scalability			
Data Ingest	Batch	Batch	Batch and streaming writes
Metadata Architecture	Centralized	Centralized	Distributed
HBase Performance	Latency spikes	Latency spikes	Consistent low latency
NoSQL Applications	Mainly batch applications	Mainly batch applications	Batch and online/real-time applications
Dependability			
High Availability	Single failure recovery	Single failure recovery	Self healing across multiple failures
MapReduce HA	Restart jobs	Restart jobs	Continuous without restart
Upgrading	Planned downtime	Rolling upgrades	Rolling upgrades
Replication	Data	Data	Data + metadata
Snapshots	Consistent only for closed files	Consistent only for closed files	Point-in-time consistency for all files and tables
Disaster Recovery	No	File copy scheduling (BDR)	Mirroring
Manageability			
Management Tools	Ambari	Cloudera Manager	MapR Control System
Volume Support	No	No	Yes
Heat map, Alarms, Alerts	Yes	Yes	Yes
Integration with REST API	Yes	Yes	Yes
Data and Job Placement Control	No	No	Yes
Data Access			
File System Access	HDFS, read-only NFS	HDFS, read-only NFS	HDFS, read/write NFS (POSIX)
File I/O	Append only	Append only	Read/write
Security: ACLs	Yes	Yes	Yes
Wire-level Authentication	Kerberos	Kerberos	Kerberos, Native

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Cluster Management & Monitoring

- ## Apache Ambari
  - Open source management platform for provisioning, managing, monitoring and securing Apache Hadoop clusters
  - makes Hadoop management simpler by providing a consistent, secure platform for operational control
  - provides an intuitive Web UI as well as a robust REST API

- ## Cloudera Manager
  - Cloudera Manager is an end-to-end application for managing CDH clusters
  - deploy and centrally operate the complete CDH stack and other managed services
  - gives you a cluster-wide, real-time view of hosts and services running; provides a single, central console to enact configuration changes across your cluster

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Hadoop Downloads

- Hadoop can be downloaded from apache website and can be installed on UNIX machine

- Alternatively cloudera distribution for hadoop(CDH) can be downloaded from cloudera website

- Another option is to download hortonworks from its official website.

Q & A

Thank You

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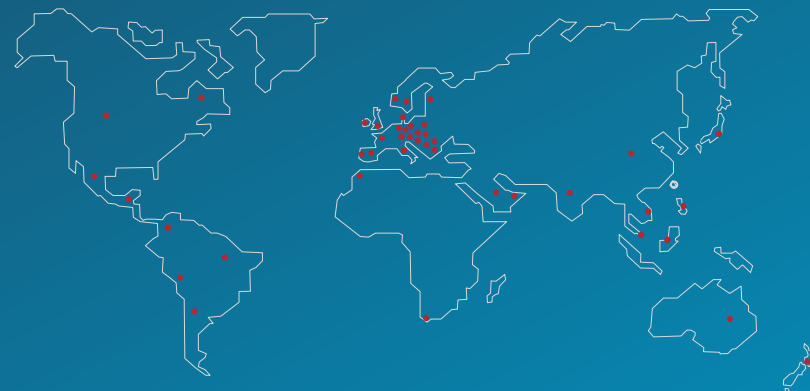CONSULTING.TECHNOLOGY.OUTSOURCING

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