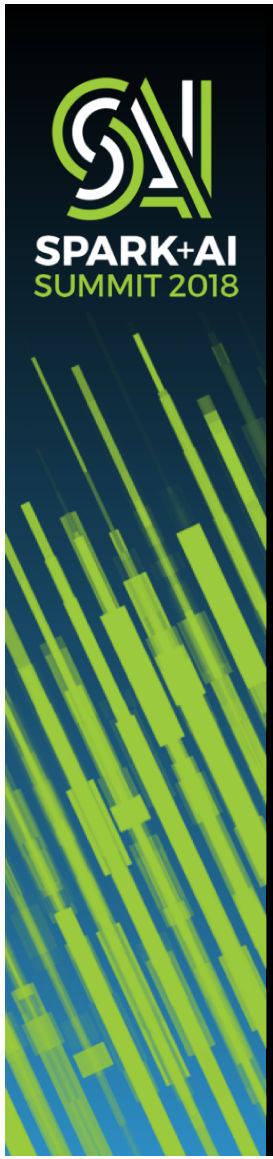


Virtualizing Spark

Justin Murray,
VMware

Agenda

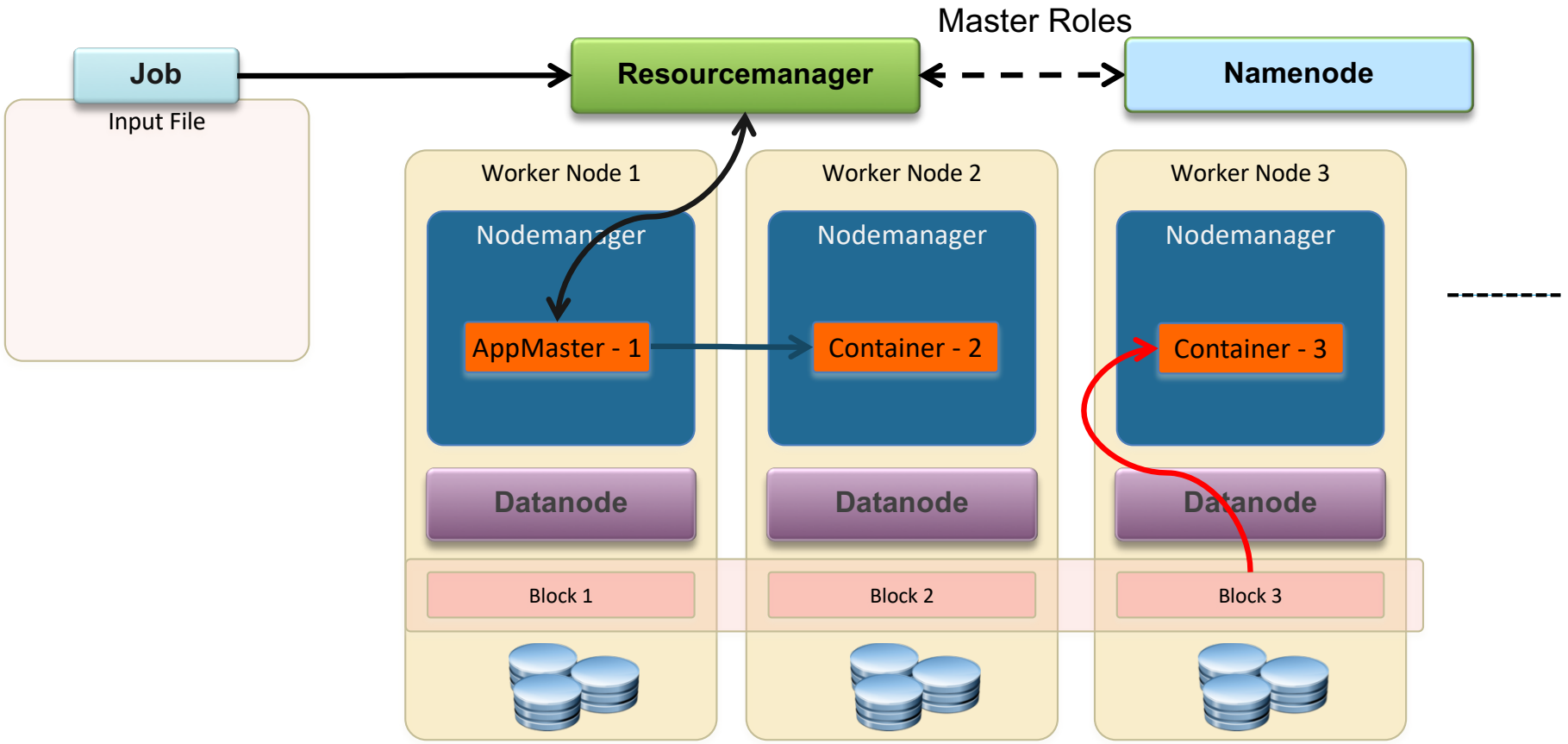
- Why Virtualize Spark?
- A Review of the Architectures
- What does Virtualized Spark look like?
- Virtualizing Spark in the Private Cloud and Public Cloud – using the same infrastructure
- VMware Cloud on AWS – a platform for Spark in the public cloud
- Performance
- A Key Best Practice
- Conclusions

Why Virtualize Spark?

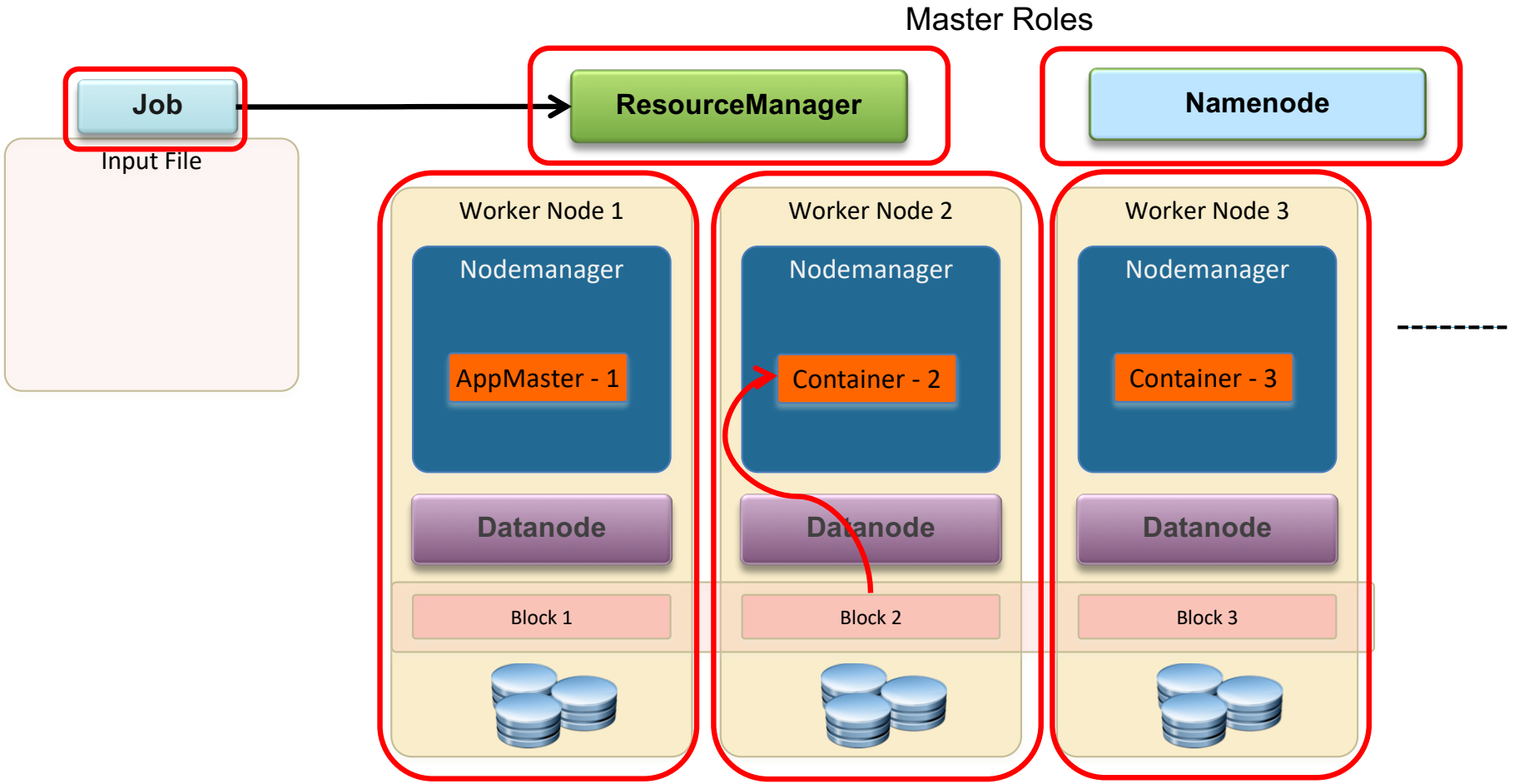
Use Cases : Virtualization of Big Data

- Enterprises have development, test, pre-prod staging and production clusters that are required to be separated from each other and provisioned independently
- Organizations need different versions of Spark to be available to different teams - with possibly different services available
- Enterprises do not wish to dedicate a specific set of hardware to each different requirement above, and want to reduce overall costs

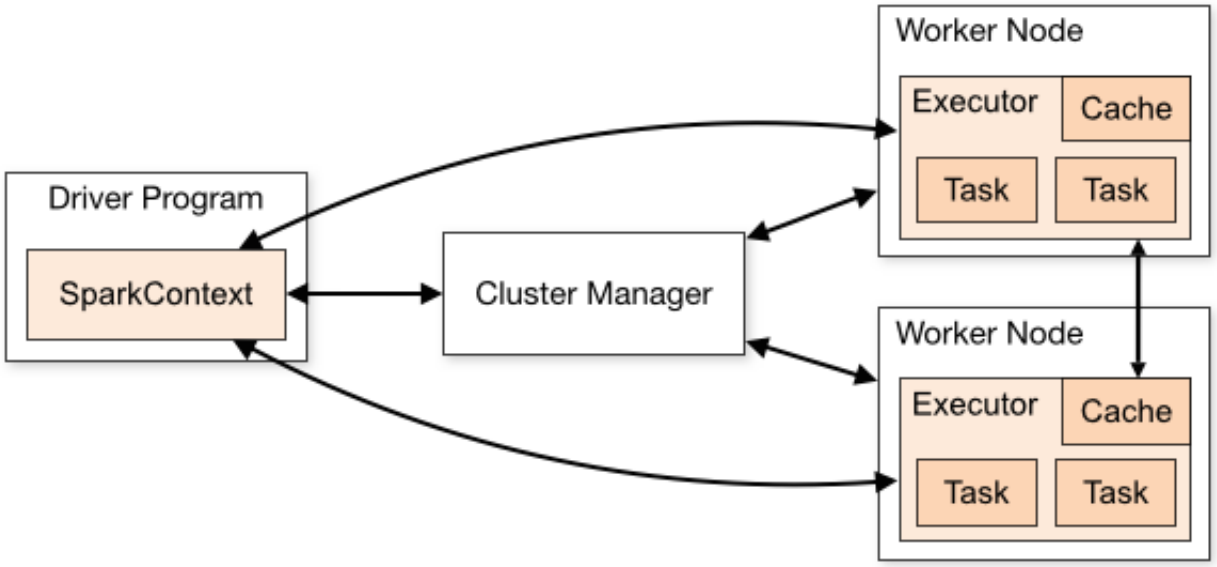
Traditional Hadoop YARN Architecture



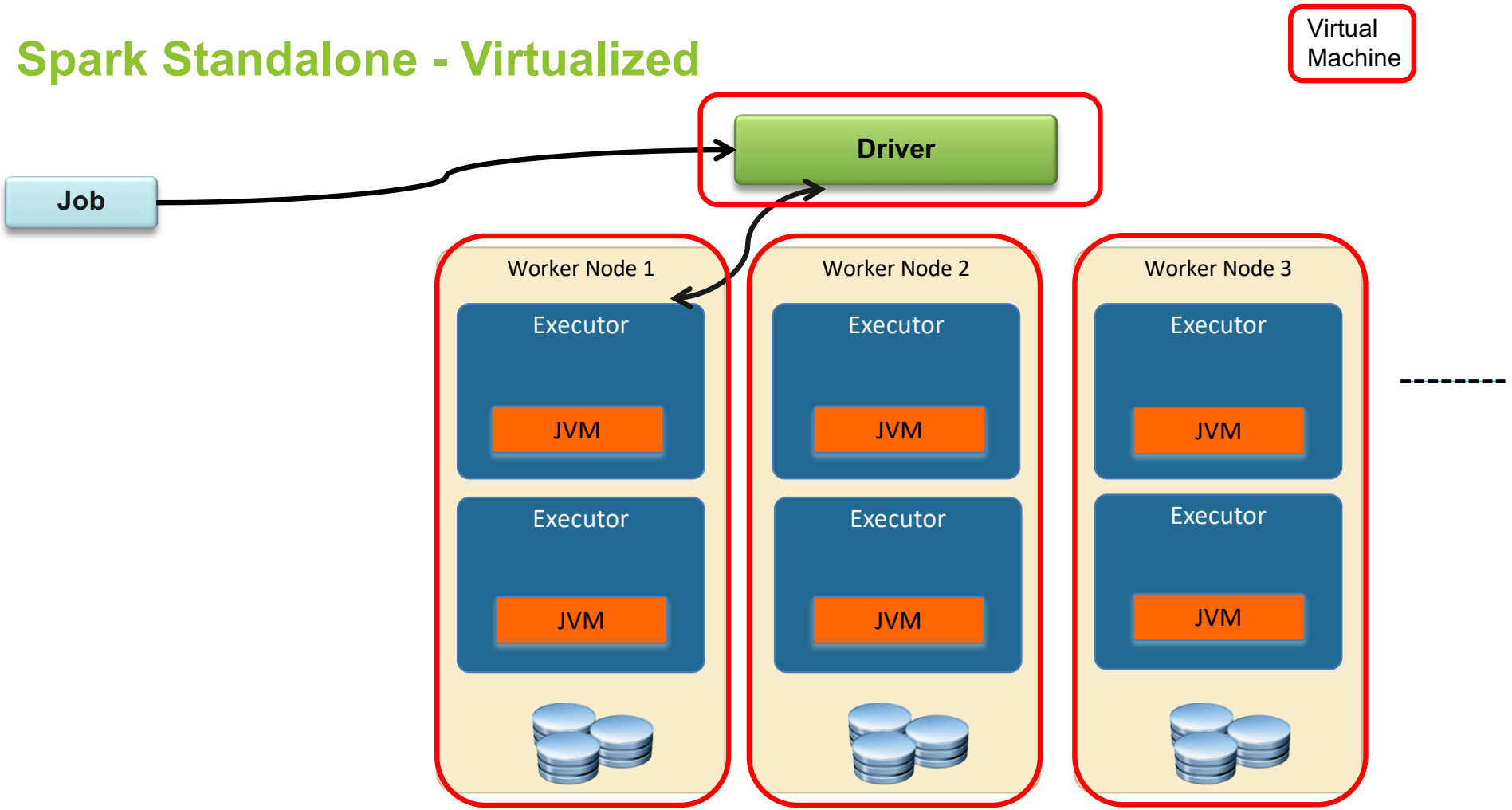
Hadoop/YARN – in Virtual Machines



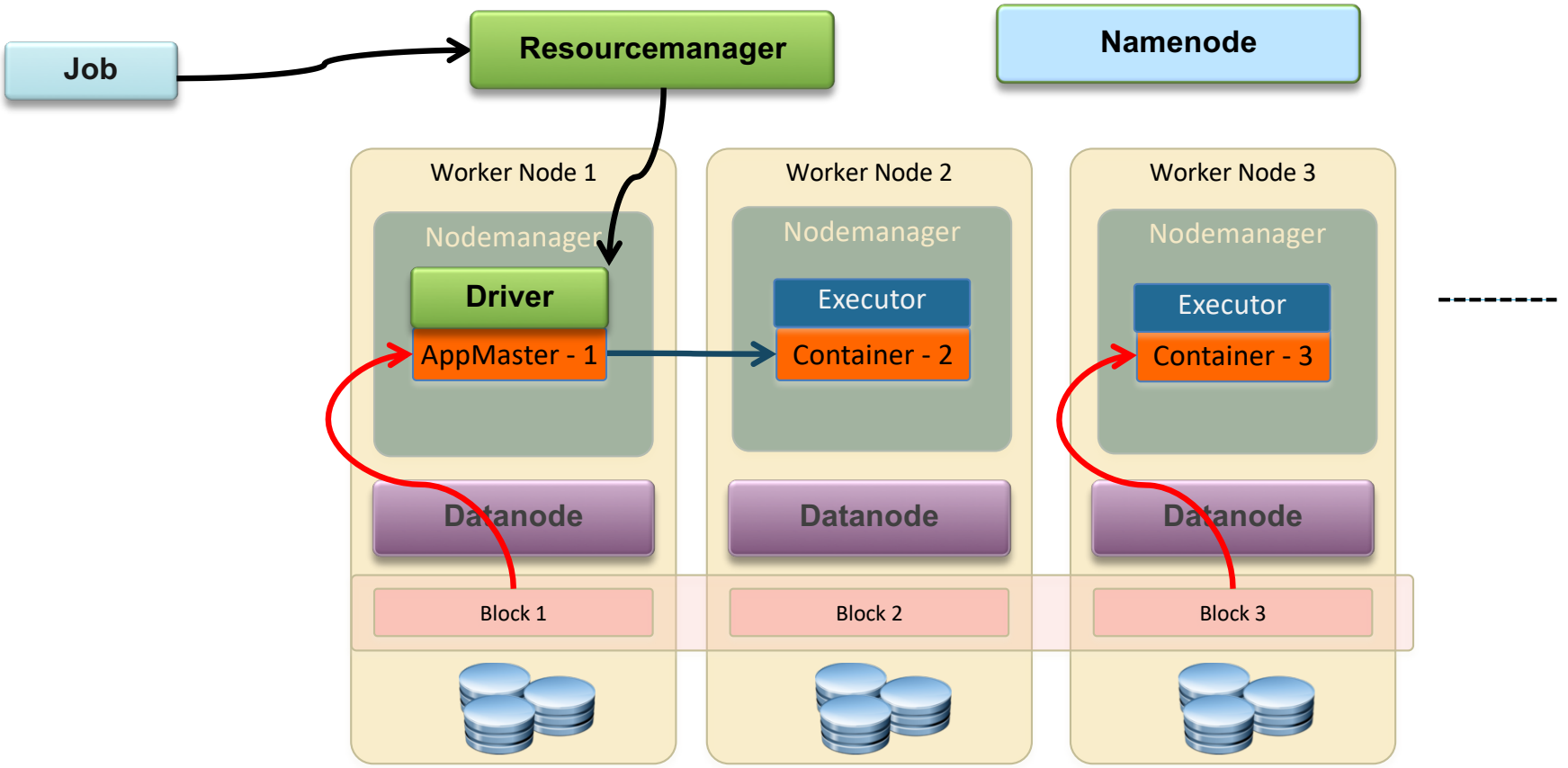
High Level View of Spark



Spark Standalone - Virtualized



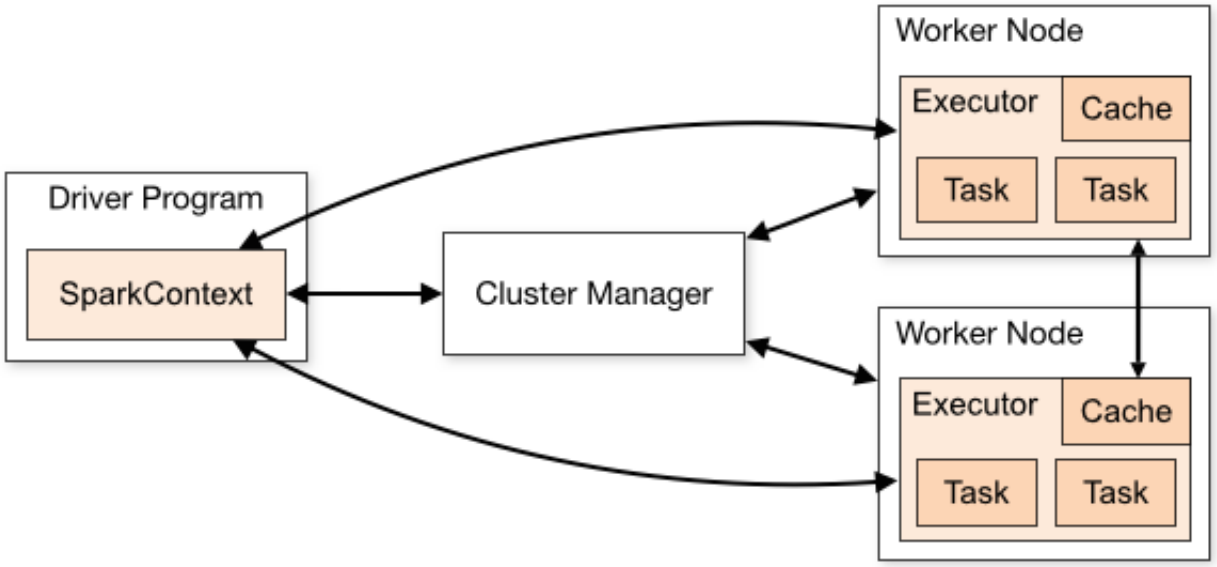
The Spark Architecture (on YARN)



Virtualizing Spark in the Private Cloud and Public Cloud

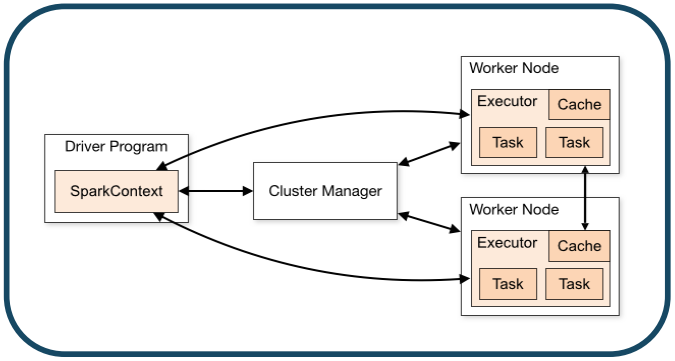
Using the Same Infrastructure

High Level View of Spark



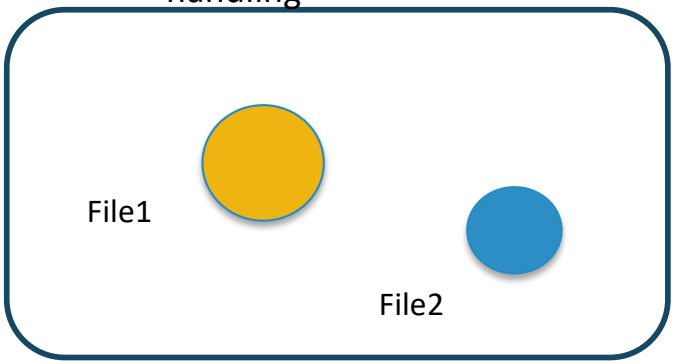
Deploying Spark in the Private Cloud

Compute Tier- Spark



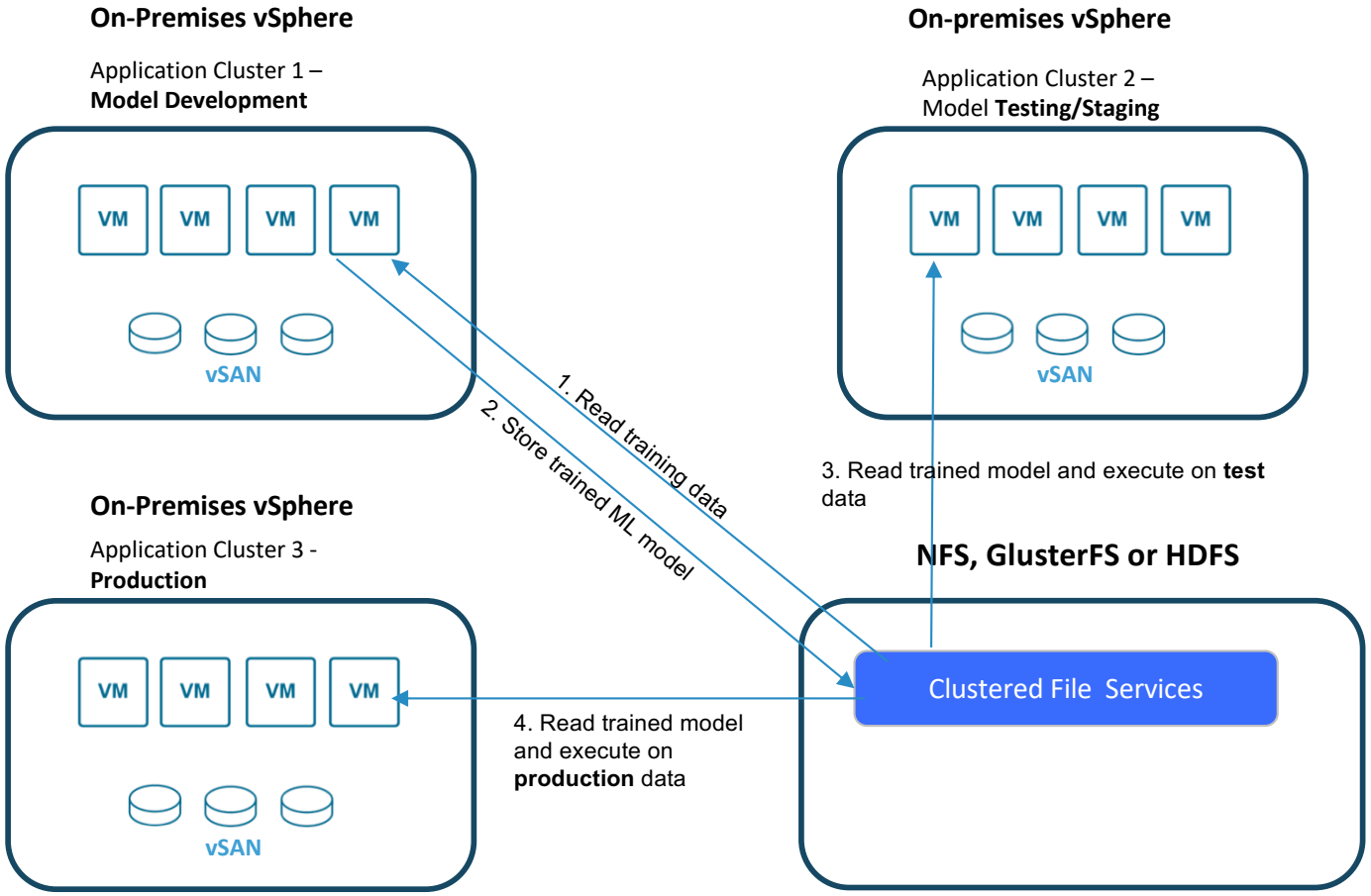
Virtual Machine

Storage Tier-
choice of NFS or HDFS or others for data handling

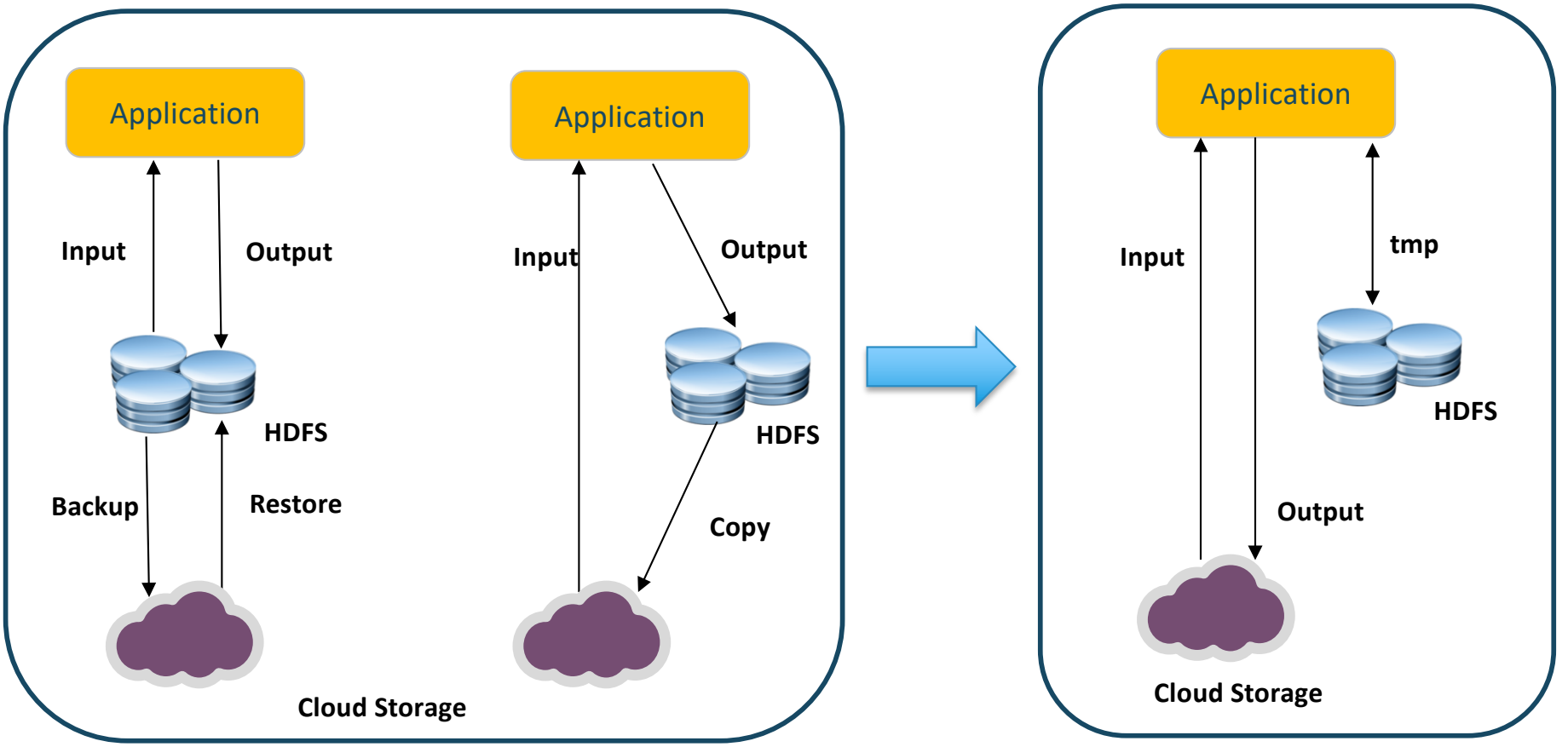


Enterprise Storage System

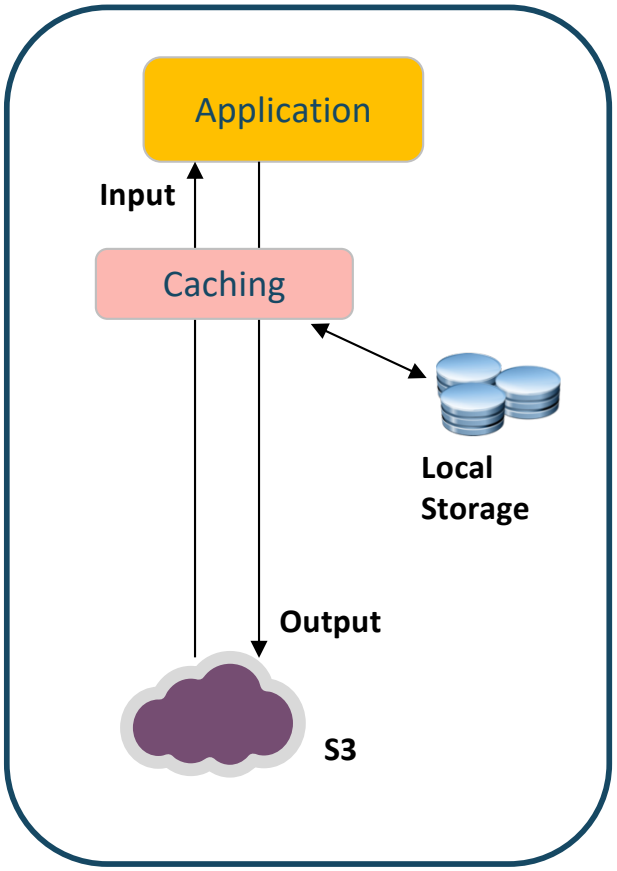
Sharing ML Models and Data using Shared Storage



Big Data - Storage Evolution



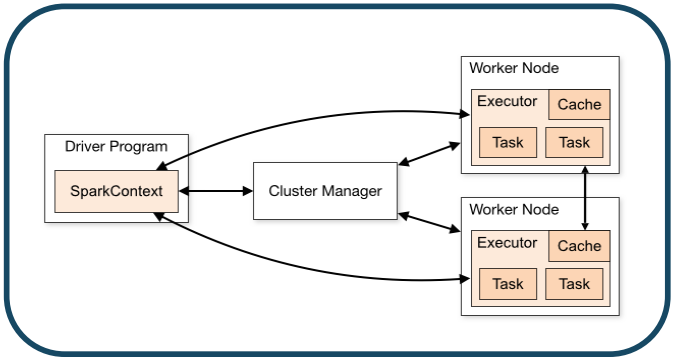
Evolving Cloud Storage for Big Data



- **S3 for Big Data**
  - S3 is an Object storage system rather than a file system
  - Moving existing HDFS data to S3 requires care (file-> object mapping)
  - S3 is **eventually consistent**
  - Guard mechanisms like S3Guard to ensure file consistency
  - Caching locally to improve performance of storage access

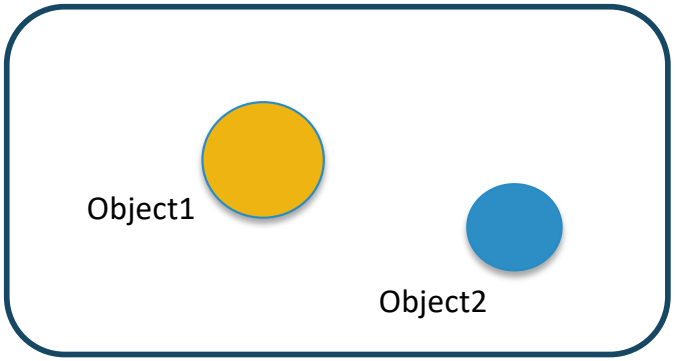
Deploying Spark in the Public Cloud

Compute Tier- Spark



Virtual Machine

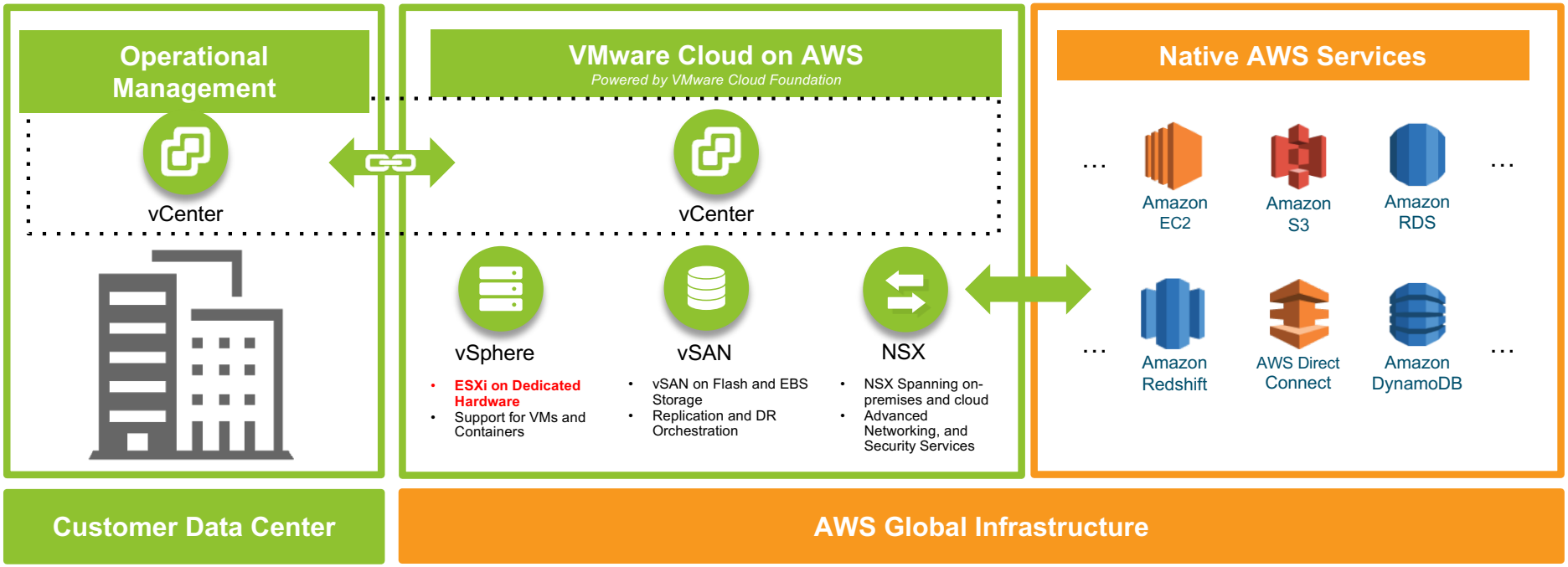
Storage Tier- Cloud Storage



S3 Object Store

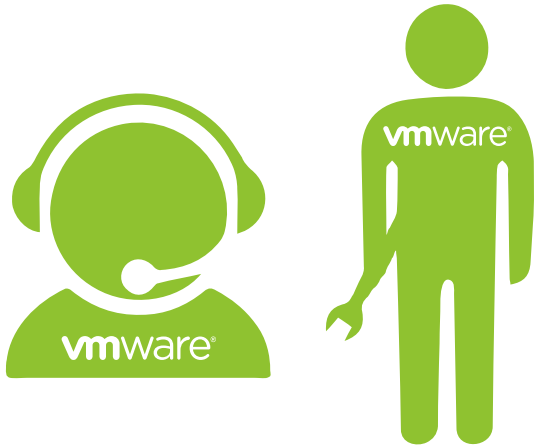
Other AWS Services

VMware Cloud on AWS

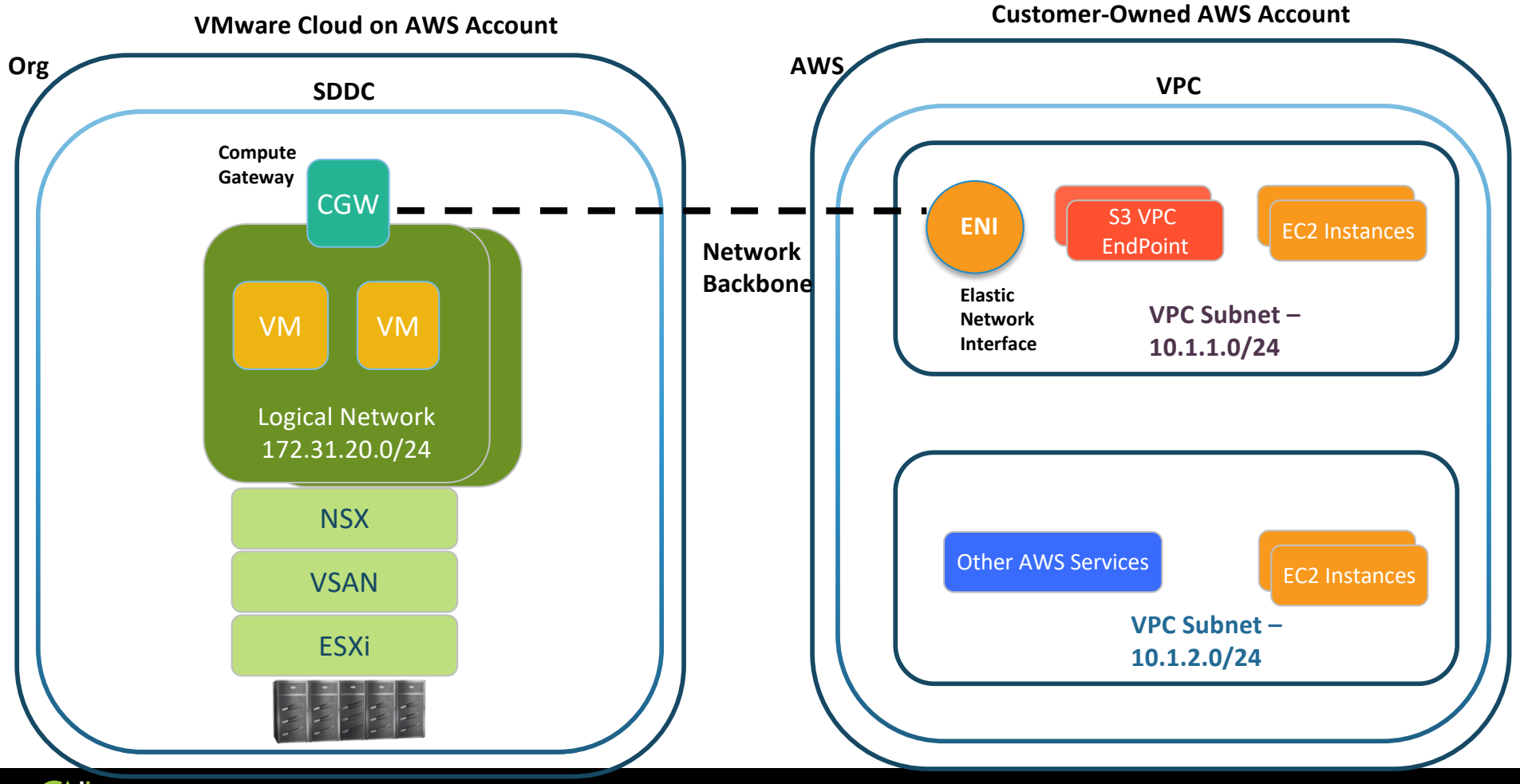


Sold as a Service

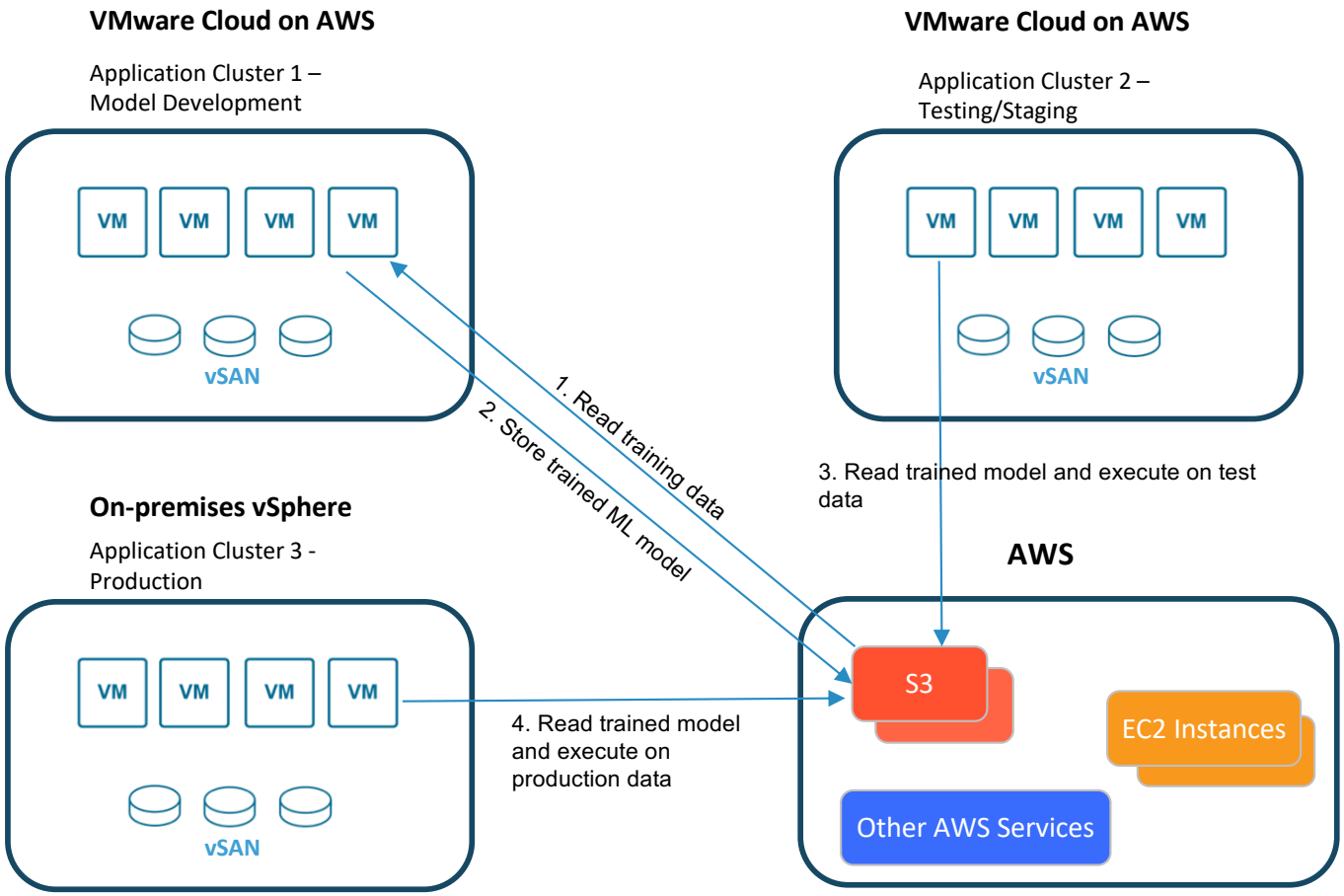
- VMware manages hypervisor and management components
- AWS manages physical resources
- Customer manages VMs
- Customer decides how many VMs to run on vSphere



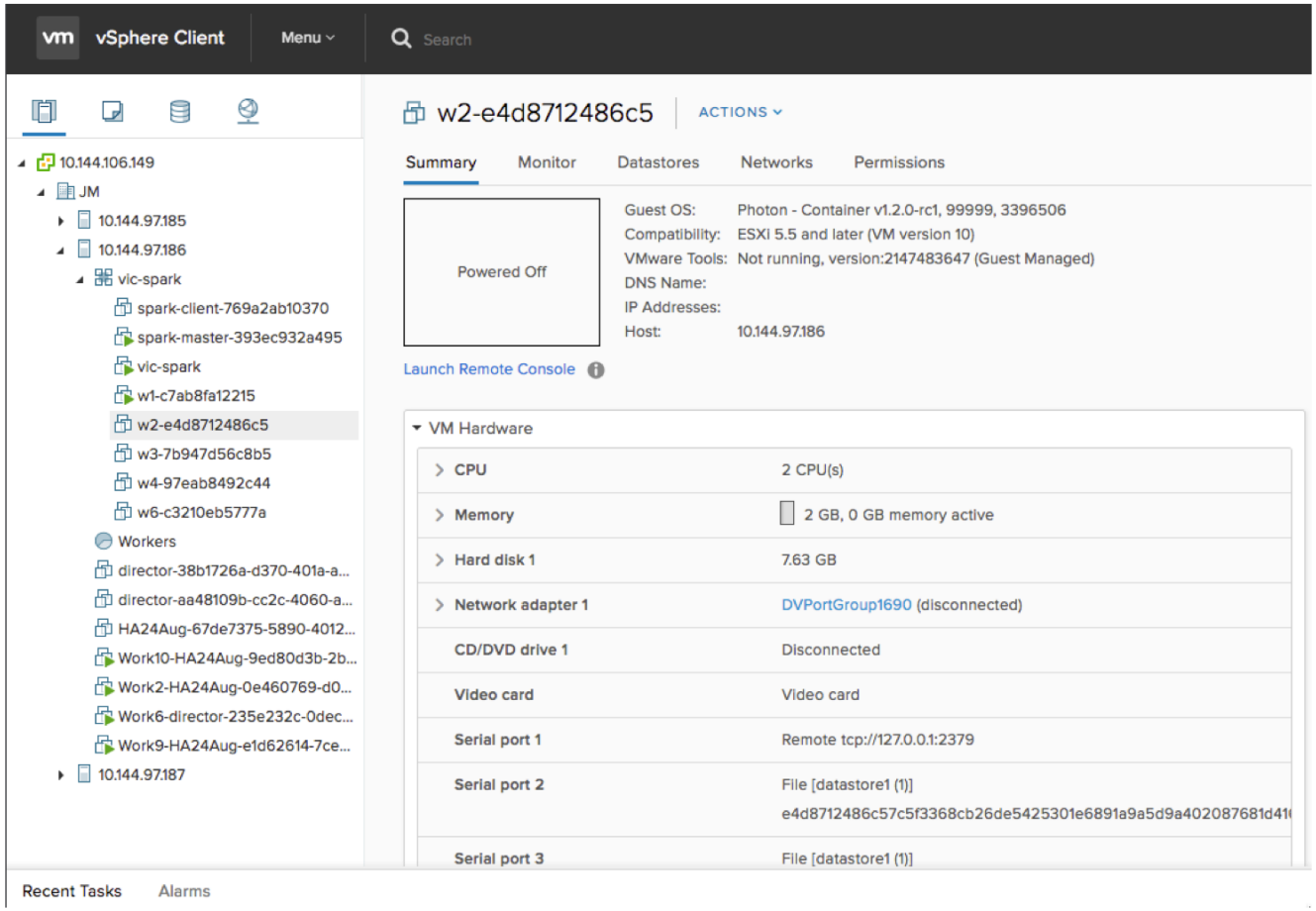
VMware Cloud on AWS : Integration to AWS Services



Sharing ML models and Data using Cloud Storage

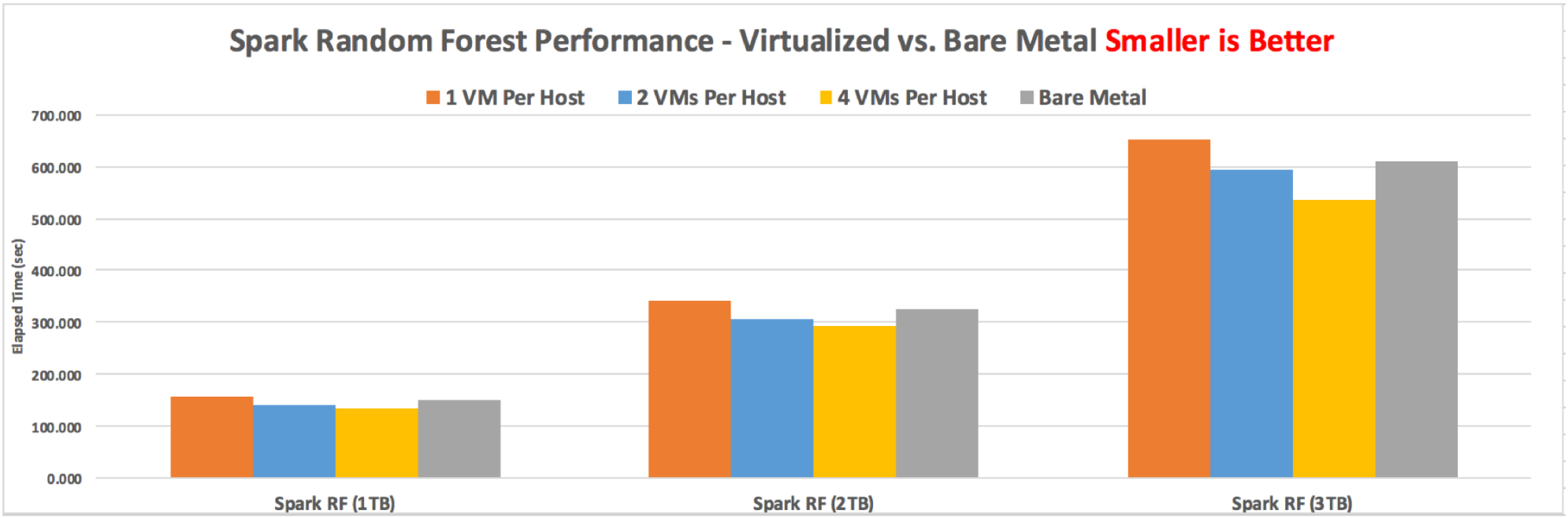


Spark Workers in Docker Containers on vSphere

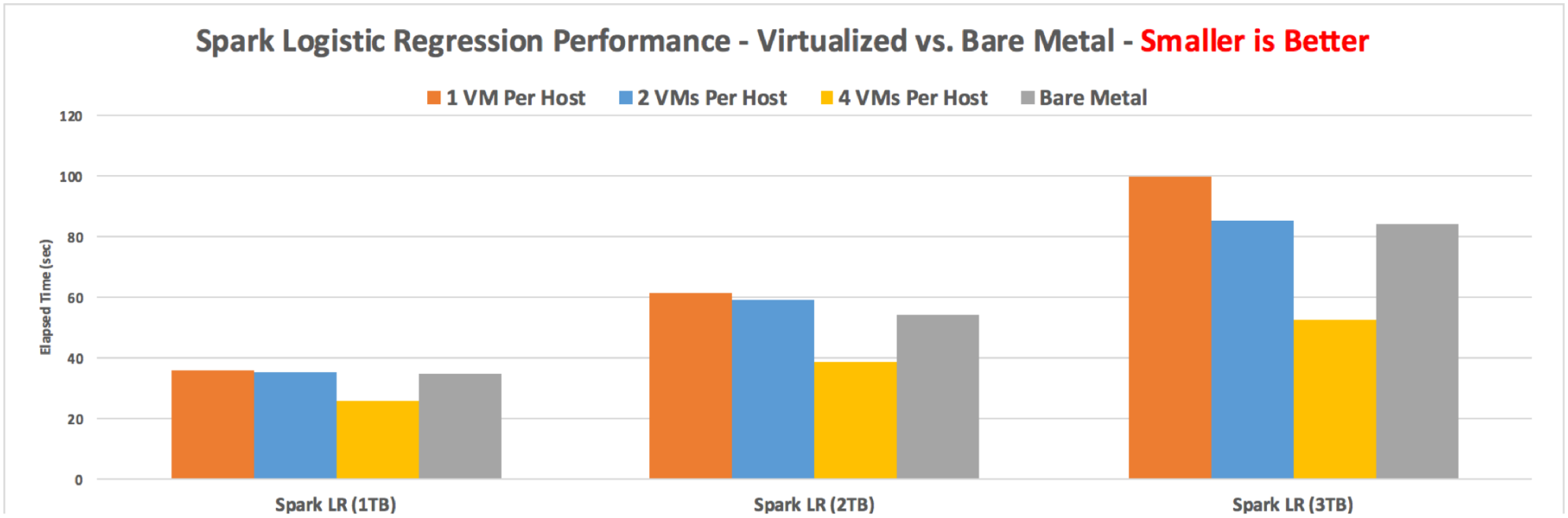


Performance

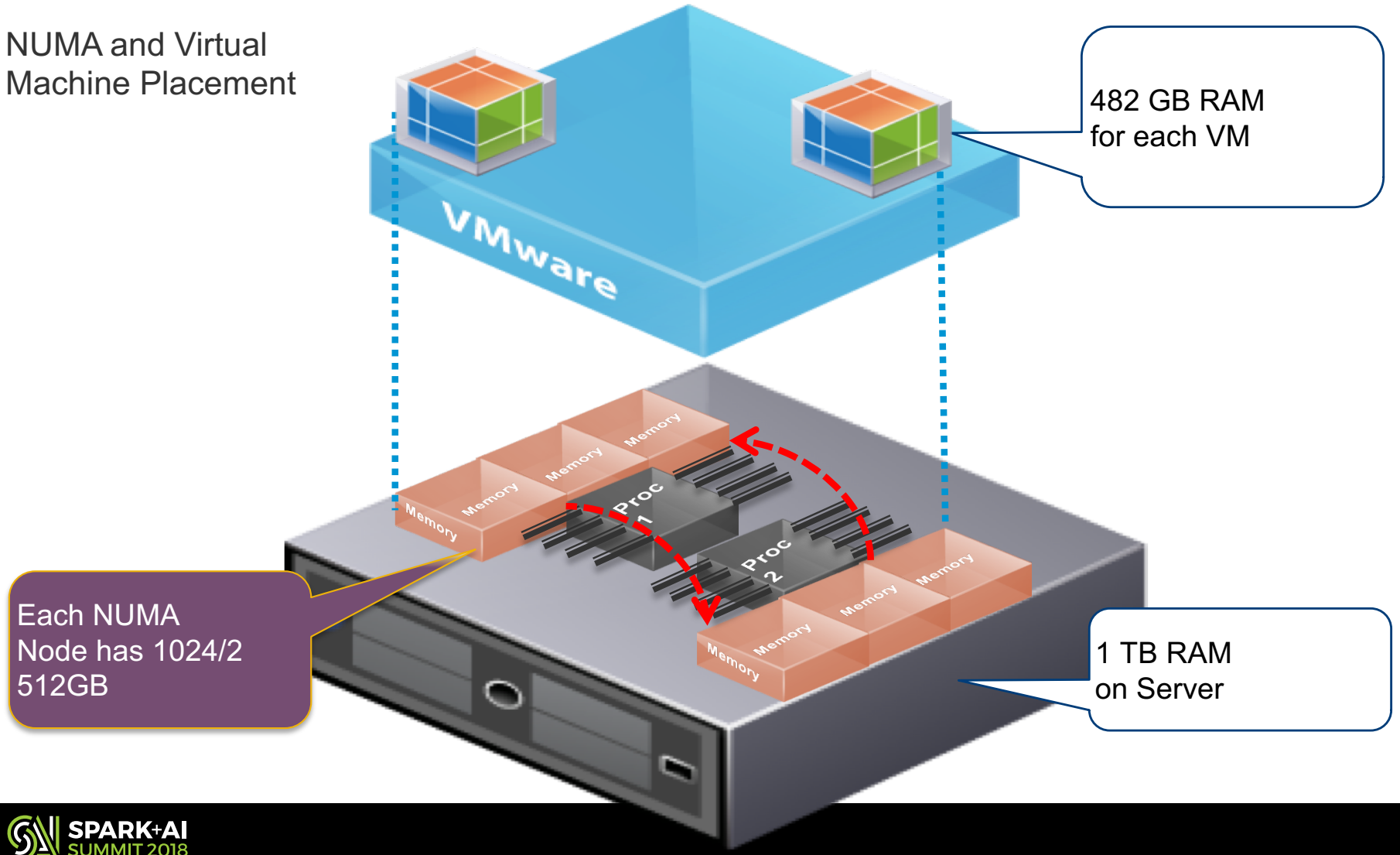
Spark Random Forest Performance



Spark Logistic Regression Performance



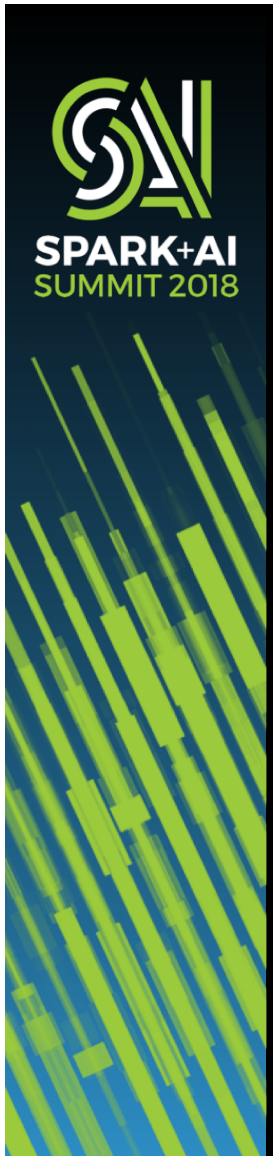
NUMA and Virtual Machine Placement



Virtualizing Spark - conclusions

Agility	Simplified Management	Efficiency	Performance
• Infrastructure on demand • Sharing of physical resources – not dedicated clusters	• Centralized data center management • Apply virtualization best practices	• Resource pooling • Server and cluster consolidation	• Equal to, or better performance than native Hadoop • No significant overhead

vSphere and VMware Cloud on AWS

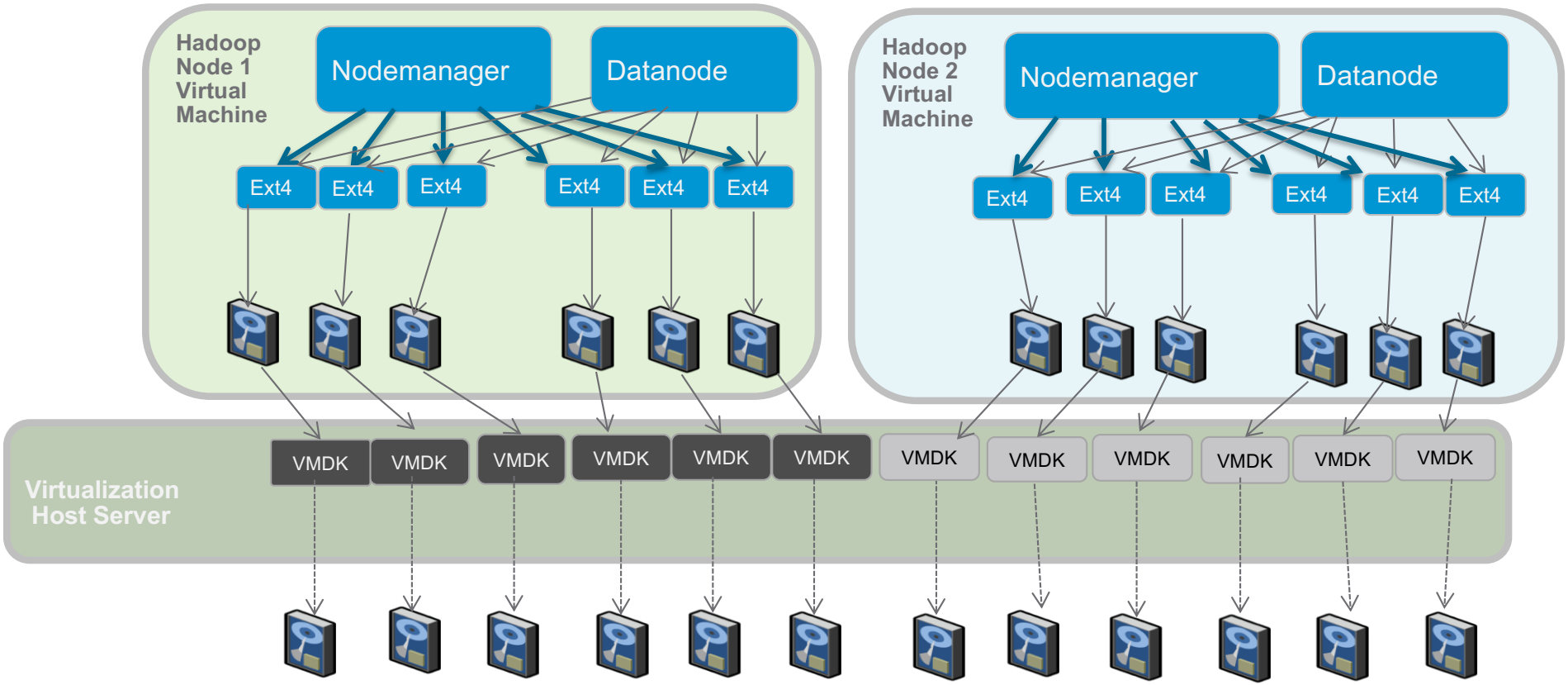


Thank You.

Contact jmurray@vmware.com or

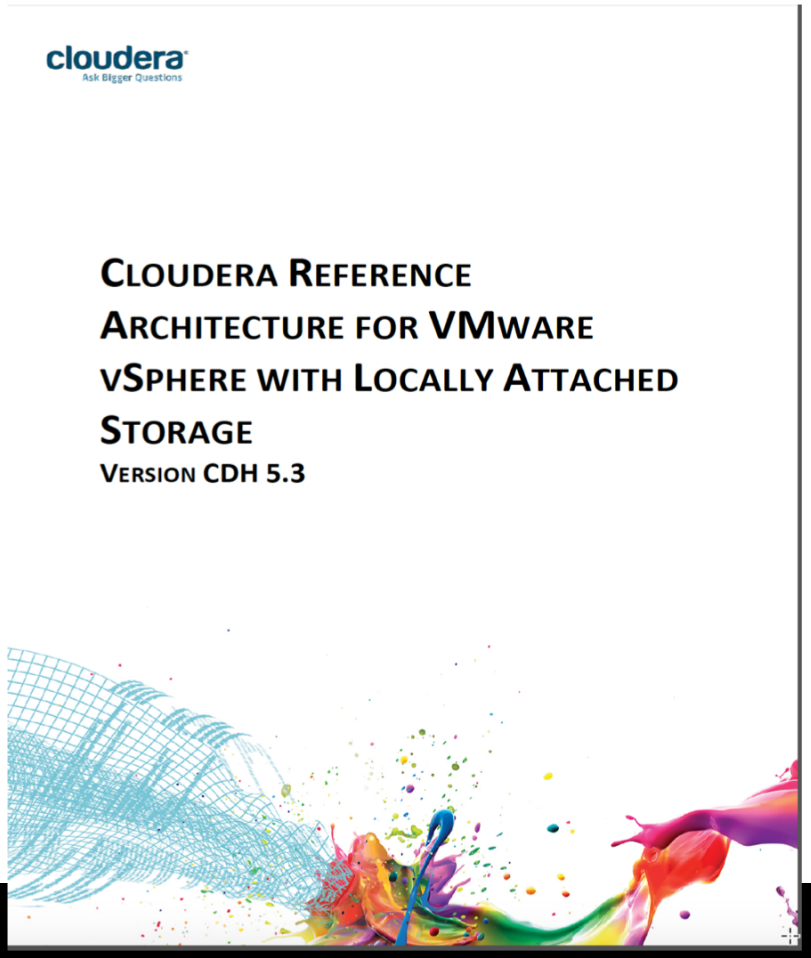
bigdata@vmware.com

Combined Model: Two Virtual Machines on a Host



Six or More Local DAS disks per Virtual Machine

#1 Reference Architecture from Cloudera

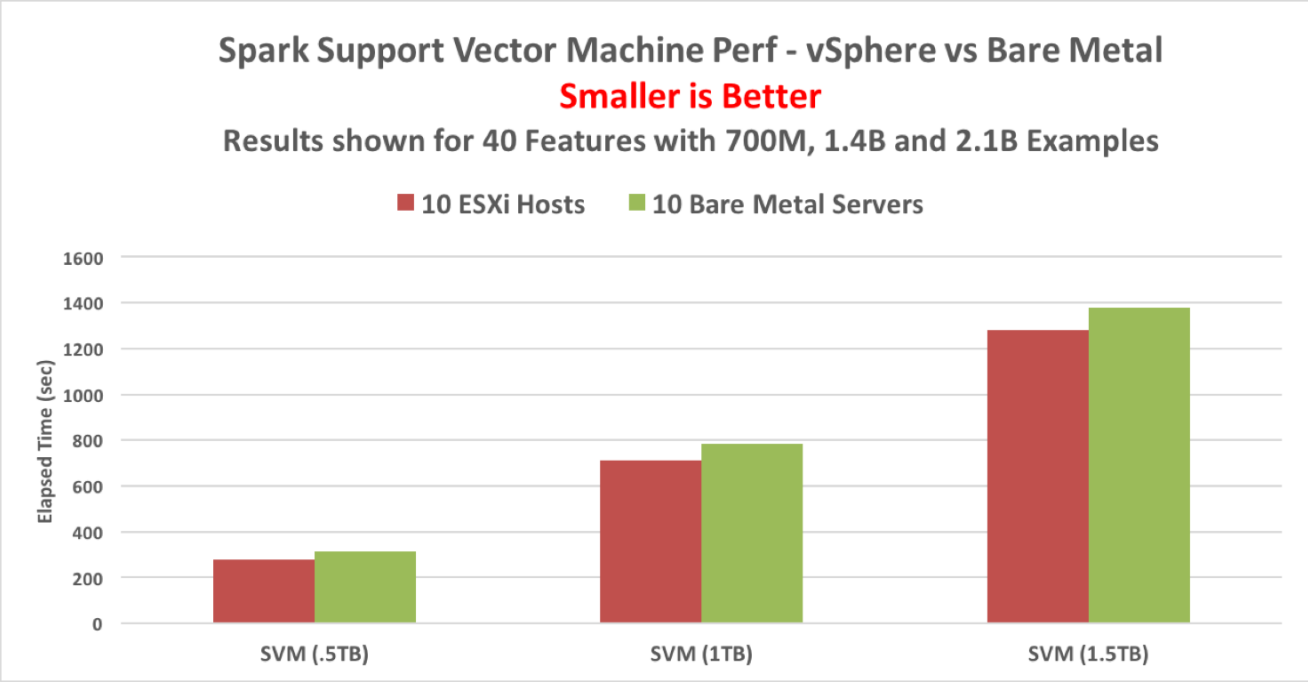


Performance

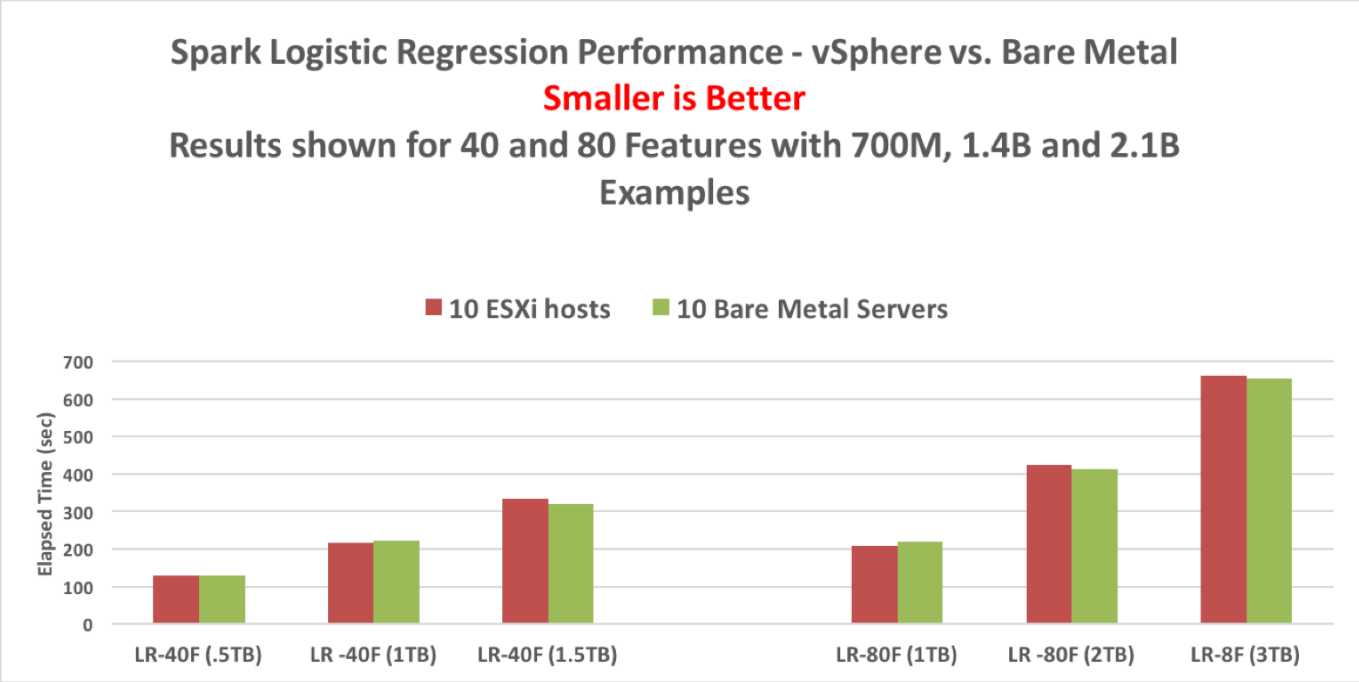
Workloads - Spark

- Two standard analytic programs from the Spark MLLib (Machine Learning Library)
- Driven using SparkBench (https://github.com/SparkTC/spark-bench)
  - Support Vector Machine
  - Logistic Regression

Spark Support Vector Machine Performance



Spark Logistic Regression Performance



Results - Spark

- Support Vector Machines workload, which stayed in memory, ran about 10% faster in virtualized form than on bare metal
- Logistic Regression workload, which was written to disk at the larger dataset sizes, showed a slight advantage to bare metal
    - part of the dataset was cached to disk,
    - larger memory of the bare metal Spark executors may help

- Both workloads showed linear scaling from 5 to 10 hosts and as dataset size increased

Conclusions

- Spark workloads work very well on VMware vSphere
  - Various performance studies have shown that any difference between virtualized performance and native performance is minimal
  - Follow the general best practice guidelines that VMware has published
  - Design patterns such as data-compute separation can be used to provide elasticity of your Spark cluster.

Add Slides as Necessary

- Supporting points go here.