Effectively Deploying Hadoop to the Cloud

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CLAIRVOYANT

Agenda

- Hadoop - 101
- Understanding the needs
- Amazon Web Services - 101
- Compute and Storage Types
- HA and DR options
- Run your own cluster ?
- Questions

Clairvoyant

BACKGROUND

- One of the fastest growing big data companies
- Founded by highly experienced technologists passionate about designing and building scalable platforms
- Multiple years of combined complete product development, enterprise product launch and product success experience
- Extensive experience in providing strategic and architectural consulting on Big Data platforms and implementations
- Successfully pioneered & engineered a predictive analytics product for the higher education domain from inception to a acquisition candidate
- Global delivery experience across multiple locations in US, Asia and Latin America
- Working with over 50 global customers on big data consulting and development projects

HIGHLIGHTS

- Exponential growth over last 4 years, over 50% CAGR
- 100+ big data experts worldwide - US, Latin America and Asia
- Engineered and created a leading Predictive Analytics product
- Developed and deployed a Financial data Entity Resolution & Rating Product

AWARDS & RECOGNITION

Arizona Technology Council — a place to connect and grow
2014 Start up of the Year

CIO Review 50 Most Promising IT Services Companies 2015

CIO Review 20 Most Promising Cloud Solution Providers 2015

PARTNERS

cloudera

amazon web services

ZOOMDATA

TRIFACTA

StreamSets

Clairvoyant Services

MANAGED SERVICES

We host and manage your Hadoop cluster(s) and provide SLA based support, ongoing maintenance, and administration.

CONSULTING SERVICES

Our services include big data strategy and roadmap, bootstrapping a solution, building POC's, and application development.

DATA SCIENCE

We work with your team and provide the data science expertise to help implement your data-driven applications.

Hadoop - Key Concepts to understand

- Unlike CPU, RAM improvements the disk speed has not changed much in the last 10 years
- Hardware fails! Redundancy
- Data locality
- Commodity hardware: Hadoop prefers more average nodes than few supernodes
- Hadoop is a giant I/O platform: To counter disk slowness > more spindles per node for parallelism > more network traffic > more data per node > longer re-replication times

Understanding your needs

Technical Use Case	Hive (MR2 or Spark)	Spark	Hbase	Impala
Data Processing	**o**	**x**		**x**
Machine Learning	**x**	**o**		
Operational Database (Fast read write lookups)			**o**	
Analytic Database (Ad-hoc queries)	**x**	**x**		**o**
Most Common: o	**Common: x**			

Understanding your needs

Processing Frameworks	CPU	Memory	IO-Throughput	IO-Latency
Hive / MR2	Heavy	Light/Medium	Most important but tends to be cpu bound	
Spark	Medium	Heavy	ML - Low, ETL - High	Streaming use cases
HBase	Low	Medium	Medium	Most important factor
Impala	Medium (concurrency will need more cores)	Medium	Full scans	Throughput matters over latency for almost all use cases

Common Architectural Patterns

- Long-Running Clusters Vs Transient Clusters
- Patterns based on Storage Types
  - S3
  - EBS
  - Ephemeral

Transient and Long-Running Clusters

	Long-running Clusters	Transient Clusters
Source Data	Often local disk or persistent disk (object storage possible)	Object Storage
Operational Maintenance	• Cluster Upgrades • Maintenance, e.g. , OS upgrade, (node migration) • License Management	None: Start a new cluster
Features:	• Master node HA • Disaster recovery • Security • Policy-base scaling	• HA and DR not as critical, source of truth data in object storage • Security and policy-based scaling may be needed based on user scenarios
Features:	• Often local or persistent volume storage • Fast provisioning not as critical • Per cluster metadata	• Object store support • Fast cluster provisioning • Persistent, multi-cluster metadata
Pricing	Node-based	Usage-based, per-node, per-hour

AWS 101

- AWS Compute Services
  - EC2
- AWS Storage Services
  - EBS, S3, EFS
  - Instance/Ephemeral Storage
- AWS Relational Database services
- AWS Networking
  - VPC , DirectConnect

Storage Types - AWS, Azure, GCP

	Object Storage	Instance Storage	Persistent Storage
Use Case Type	Transient, MR2, Hive/MR2, Spark, Impala (R/W)	Lift & Shift Hive,Impala,Spark,MR2, HBase	Lift & Shift Hive,Impala,Spark,MR2, HBase
Why	• Cheap • Scalable • Resilient	• Cheap • Performant	• More instance type selection
AWS	S3 + HDFS for intermediate storage	D2, I2	EBS Volumes - SC1 and ST1 Instance types – C4 and M4
Azure	ADLS + HDFS for intermediate storage		DS13,DS14 with Premium Storage VHDS
GCP	GS +HDFS for intermediate storage		Standard persistent disks

Cloud Storage: Cost vs Latency vs Throughput

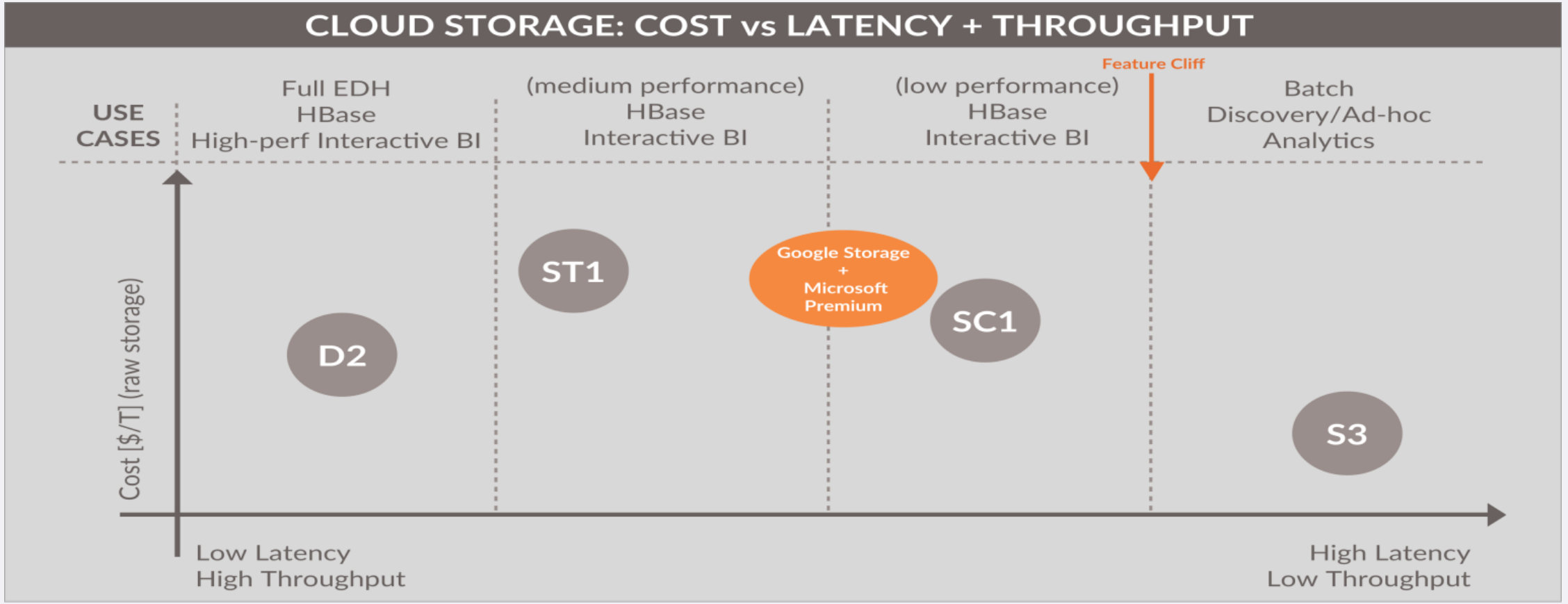


Image: Courtesy Cloudera

Hadoop Clusters on AWS - Storage - Instance Storage

- Instance Storage / Ephemeral Storage
  - Temporary Storage added to certain EC2 instances (d2,i2..)
  - Storage physically attached to the host computer
  - Attached at instance launch time
  - Data is reset when instance is halted, stopped, terminated
  - Faster than EBS Volumes (IOPS and throughput)
  - No specific storage cost
- Best suited for fault-tolerant architectures like Hadoop (Long running / transient clusters - with S3 backed)

Hadoop Clusters on AWS - Storage - EBS Volumes

- Elastic Block Storage
  - Storage persists independently from the life of EC2 instance
  - Network attached disks
  - Multiple types (IOPs are dependent upon size of the disk)
    - General Purpose SSD (gp2)
    - Provisioned IOPS SSD (io1)
    - Throughput Optimized (st1)
    - Cold HDD (sc1)
    - Magnetic (standard)
  - Support for snapshots.
  - Encrypted to protect the data in-transit and at-rest

Hadoop Clusters on AWS - Storage - EBS Volumes

- EBS- Optimized instances
  - Dedicated bandwidth to EBS
- Minimum dedicated EBS Bandwidth - 1000 Mbps (125 MB / s)
  - 1 TB st1 / 3.2 TB sc1 : 40 MB/s
  - 4 - 1 TB st1 volumes for instance ?
- No more than 25 EBS volumes per instance
- Increase read-ahead for high throughput (sudo blockdev --settra 2048 /dev/<device>)
- EBS Volumes Baseline , Burst performance and Burst Credit bucket

Hadoop Clusters on AWS - Instance Types

- Attach Ephemeral disks if they are available for the instances
- Pick instance types with enhanced networking like C4,C3,R3,R4,M4 instances
  - M4: general instance type: Mixed
    S3 - Data Processing
    EBS - Data Processing + Lineage, Audit, HDFS Encryption, etc
  - C4(S3/EBS): Compute optimized but low memory: Hive/MR
    S3 - Data Processing
    EBS - Data Processing + Lineage, Audit, HDFS Encryption, etc
  - R3 (S3/EBS): Spark, Impala
    S3 - Machine Learning, Discovery Analytics
    EBS - Interactive BI, Machine Learning + Data Processing + Lineage, Audit, HDFS Encryption, etc
  - D2 (Ephemeral): All, HBase for low latency, Impala high concurrent workloads, deep storage
- CPU
  - 2 vCPU for OS ,1 vCPU for each master service
- Placement groups
- Support for different types of instances for worker nodes ?

Sizing the cluster

- Sizing the cluster based on IOPs
  - data to be scanned at a time for the workloads
- Sizing the cluster based on CPU Usage
  - Executors/Mappers/reducers/parallelism required for the processing
- Sizing based on data
  - compression ratio (Snappy, LZOP, etc)
  - Replication factor
  - Initial size of data
  - Intermediate data factor, for temporary storage
  - Rate of data increase
- Sizing based on Memory

Hadoop Clusters on AWS - Recommendations

- Master
  - Use gp2 volumes for master nodes
  - 100 GB volume for each HDFS metadata , Zookeeper
  - 1 vCPU for each master service
- Worker
  - 1 vCPU for each worker service
  - Use st1 volumes for data storage
- Recommended to use HVM AMIs over PV (paravirtualization)
- Cloud Watch Monitoring for disk usage
  - burst balance, volume read/write bytes, volume read/write ops, volume queue length

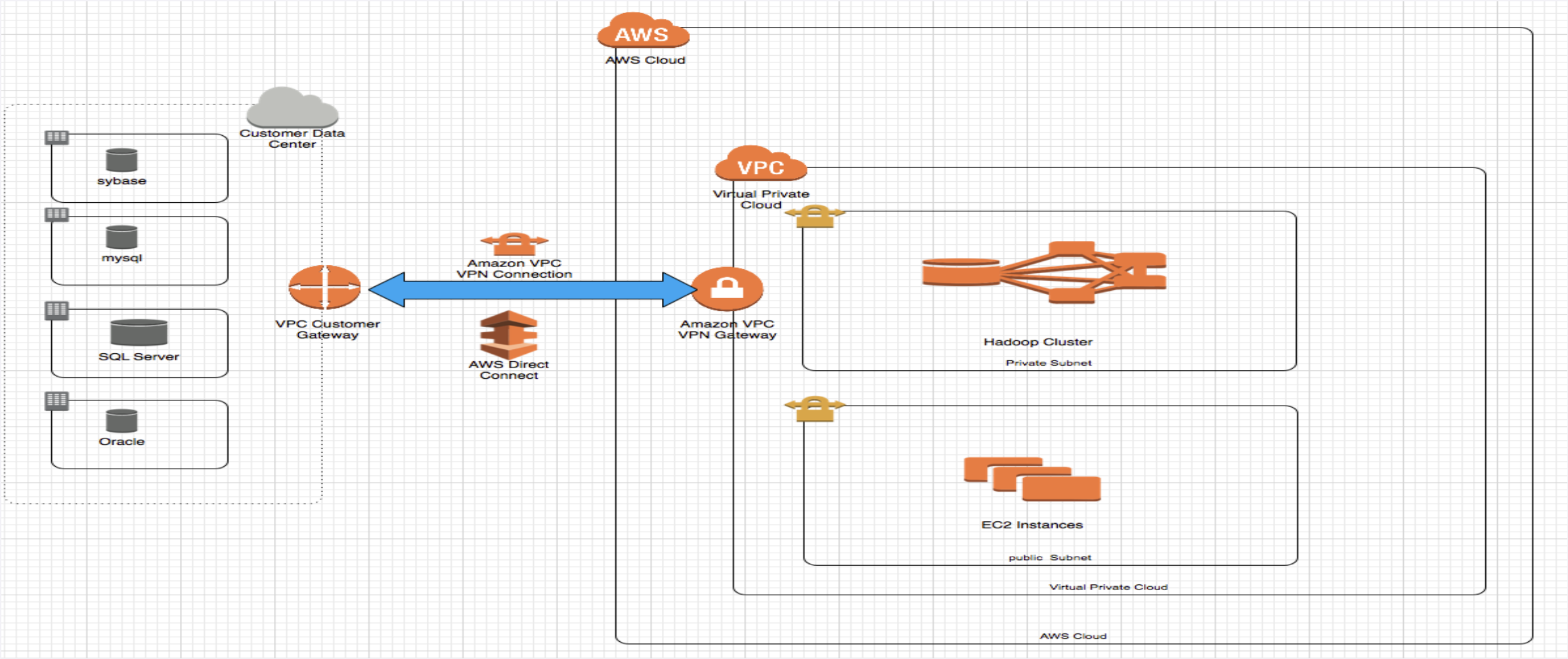
Hadoop Clusters on AWS - HA , DR

- HA
  - HDFS HA, YARN HA, HBase HA, Hive HA
- AWS Regions
  - Hadoop nodes across Regions ?
- AWS Availability Zones
  - Hadoop nodes across Availability zones ?
- Recovery Point Objective and Recovery Time Objective
  - Backup data / metadata to S3
  - Separate DR cluster
    - Parallel Ingest
    - Parallel Compute
    - Distcp/ Cloudera BDR

Hadoop Clusters on AWS - Security

- Hadoop Security
  - Kerberos
  - Sentry / Ranger / Navigator / Atlas
- S3
  - IAM Roles
  - Server side encryption
- EBS volume encryption
- HDFS transparent encryption
  - encryption zones
  - navigator encrypt

Typical Deployment Layout on AWS



Tiny / Small / Medium / Large?

Tiny: 1-9 Small: 10-99 Medium: 100-999 Large: 1000+

MINIMAL HA CLUSTER					
Cloudera Manager - (1)	**Master Nodes A - (2)**	**Master Node B - (1)**	**Worker Nodes - (4)**	**Security Node A - (1)**	**Security Node B - (1)**
Alert Publisher Event Server Host Monitor Navigator Audit Server Navigator Metadata Server Reports Manager Service Monitor CM Database	ZooKeeper HDFS JournalNode HDFS Failover Controller HDFS NameNode YARN Resource Manager Hive Metastore HiveServer2 Hue Oozie HBase Master HDFS Gateway YARN Gateway Spark Gateway Hive Gateway Sqoop Gateway	ZooKeeper HDFS JournalNode HDFS Balancer Impala Catalog Server Impala StateStore YARN History Server Spark History Server HBase/SOLR Key Value Indexer Sentry Key Trustee KMS HDFS Gateway YARN Gateway Spark Gateway Hive Gateway Sqoop Gateway	HDFS DataNode YARN NodeManager Impala Impalad HBase RegionServer SOLR Server Kafka Broker Flume Agent	KDC LDAP Private Certificate Authority Active Key Trustee Server Key Trustee Server Active Database	KDC LDAP Passive Key Trustee Server Key Trustee Server Passive Database

Cloudera licensed services / Orange is for Client Gateway roles / Blue is for Ingest services /Purple is for RDBMS database.

Hadoop Cluster

Security Cluster

Pricing

	Transient cluster (on-demand) (S3 + HDFS for intermediate storage)	Transient cluster –EBS (shutdown when not in use)	Long-running cluster - EBS	Long-running cluster – Instance Storage
AWS Provisioning • 15 TB • 11 EC2 instances – 4 CPU, 16 GB	• VPC • S3 • 8 hours / day • M4.xlarge	• VPC • 8 hours / day • EBS- ST1 • M4.xlarge • RDS	• VPC • EBS- ST1 • M4.xlarge • RDS	• VPC • EBS- ST1,SSD for master • d2.xlarge (4 CPU, 30 GB, 6 TB)
Cluster • 10 Licensed Nodes • No Kerberos / AD	• 1 masters • 9 worker nodes • 1 Cloudera Manager • Data loaded from S3 at cluster launch (or processed directly on S3) • Cluster terminated when not in use (no HA)	• 3 masters • 7 worker nodes • 1 Cloudera Manager • 1 RDS • Data is on EBS volumes • Cluster shutdown when not in use • HA cluster	• 3 masters • 7 worker nodes • 1 Cloudera Manager • 1 RDS • HA cluster	• 3 masters • 7 worker nodes • 1 Cloudera Manager • 1 RDS • HA cluster
AWS Hosting Costs:	$1500 / month	$1900/ month	$3200 / month	$4800 / month
Cost: • Cluster setup • Data pipeline • Solution implementation • Managed services				

Run your own cluster?

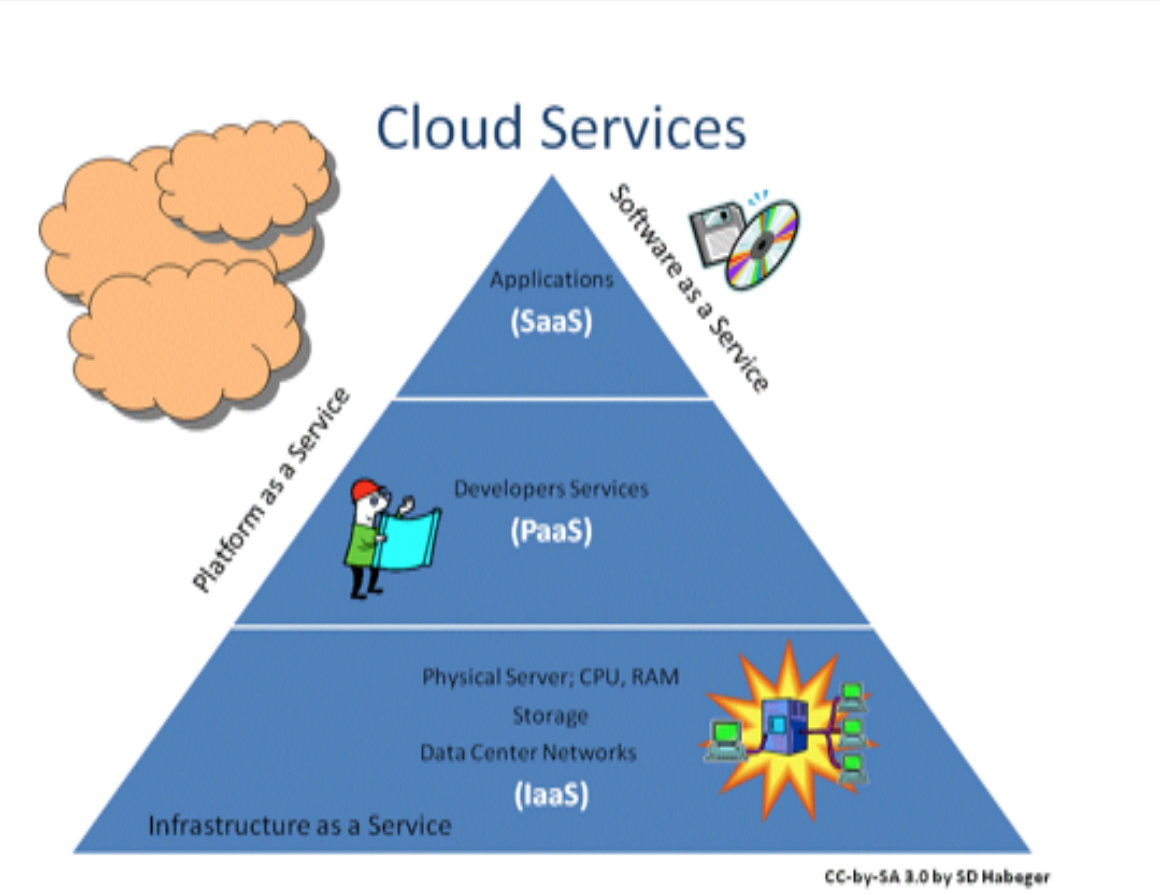


Image: Courtesy Amazon

- Amazon S3, Kinesis, Lambda, Athena, Databricks
- GCP -- Google Data flow
- Azure
- Cloudera Altus
- Databricks

AWS Big Data

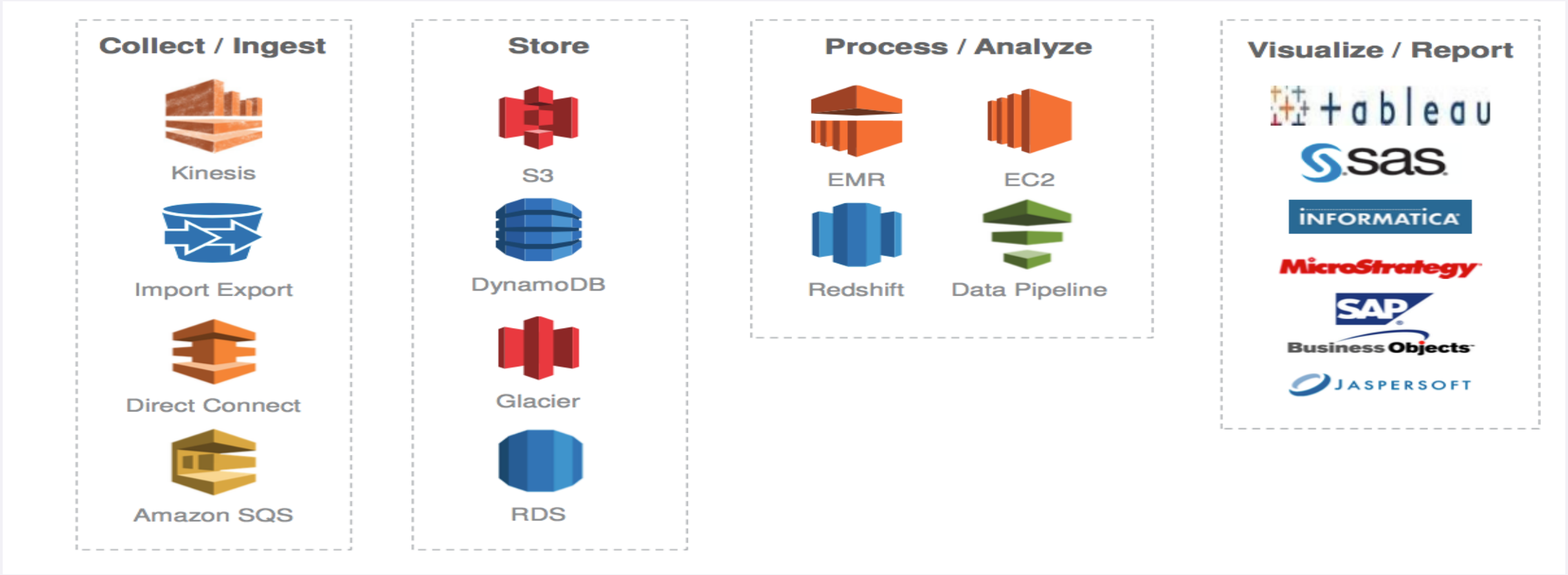


Image: Courtesy Amazon

Azure Big Data

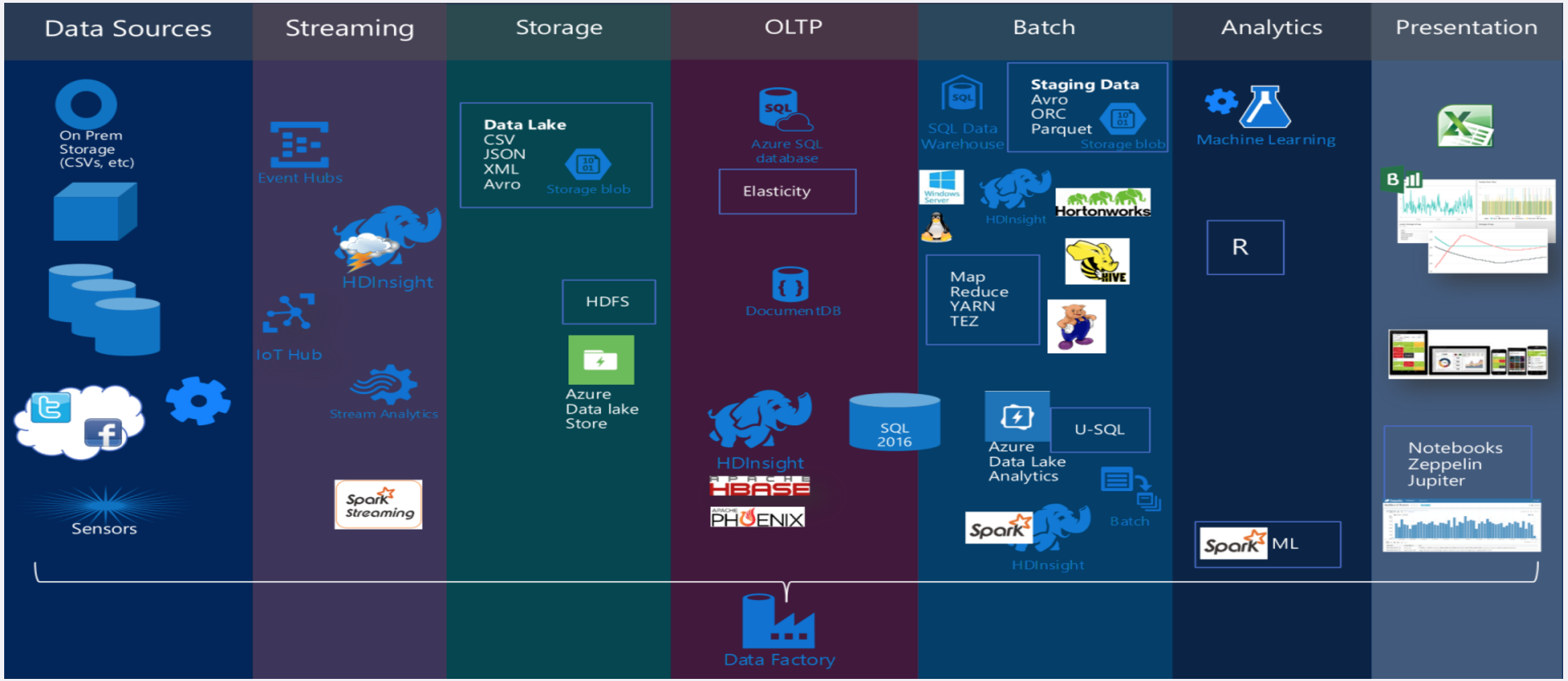


Image: Courtesy Microsoft

Google Big Data

Image: Courtesy Google

It’s a tricky job

Feedback & Questions

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Thank You!

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