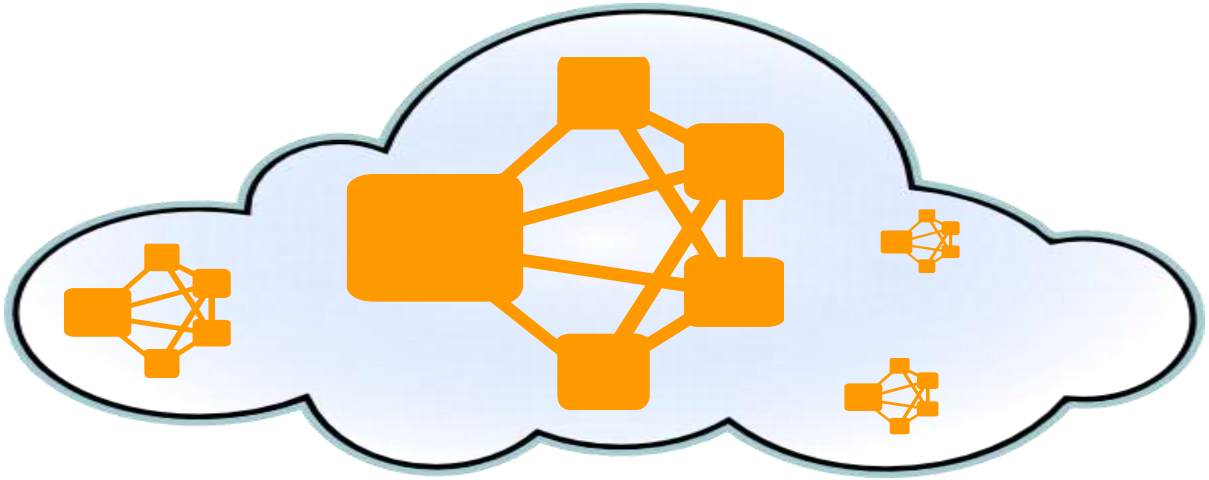

Migrating Big Data Workloads to Amazon EMR

Anthony Nguyen
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June 1st, 2017

amazon web services

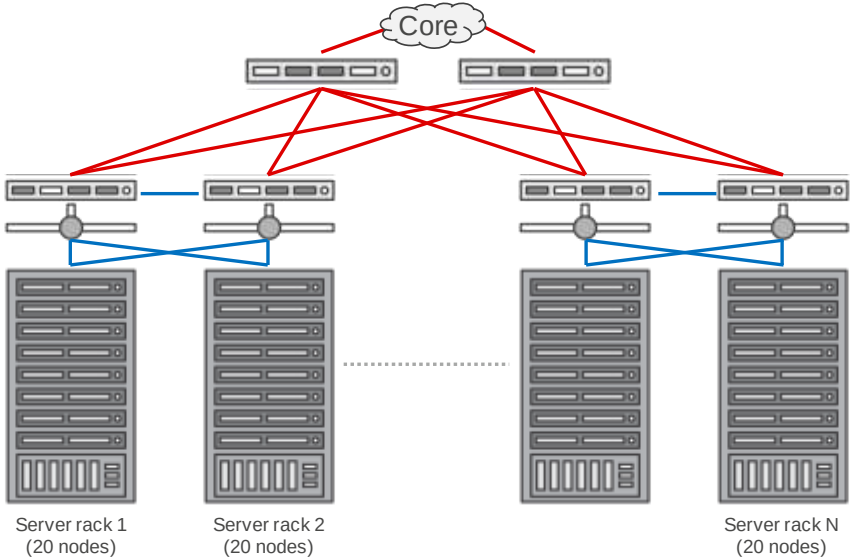
Agenda

- Deconstructing current big data environments
- Identifying challenges with on-premises or unmanaged architectures
- Migrating components to Amazon EMR and AWS analytics services
  - Choosing the right engine for the job
  - Building out an architecture
  - Architecting for cost and scalability
  - Security
- Customer migration stories
- Q+A

Deconstructing current big data environments

On-premises Hadoop clusters

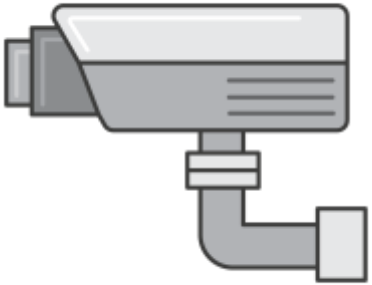
- A cluster of 1U machine
- Typically 12 Cores, 32/64 GB RAM, and 6 - 8 TB of HDD ($3-4K)
- Networking switches and racks
- Open-source distribution of Hadoop or a fixed licensing term by commercial distributions
- Different node roles
- HDFS uses local disk and is sized for 3x data replication



Workload types running on the same cluster

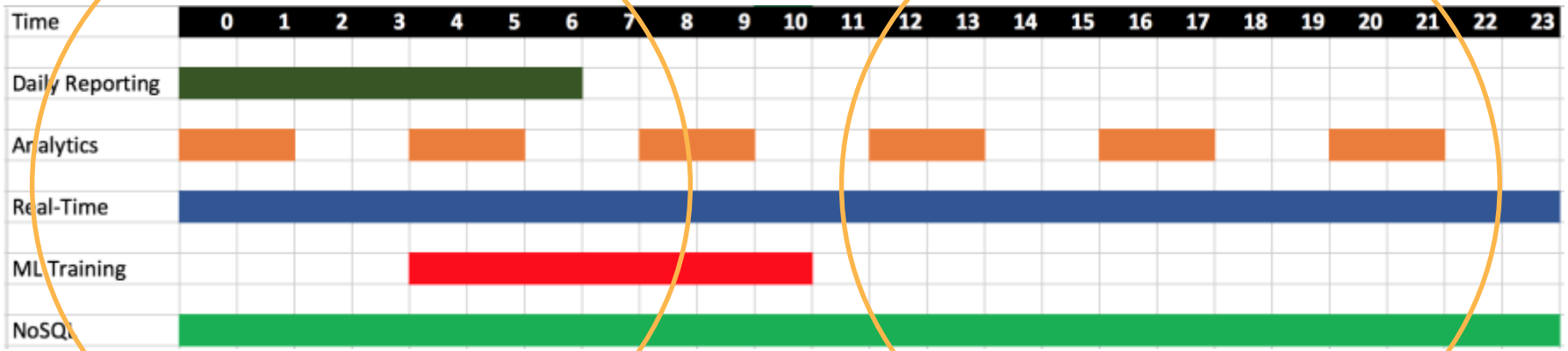
- **Large Scale ETL:** Apache Spark, Apache Hive with Apache Tez or Apache Hadoop MapReduce
- **Interactive Queries:** Apache Impala, Spark SQL, Presto, Apache Phoenix
- **Machine Learning and Data Science:** Spark ML, Apache Mahout
- **NoSQL:** Apache HBase
- **Stream Processing:** Apache Kafka, Spark Streaming, Apache Flink, Apache NiFi, Apache Storm
- **Search:** Elasticsearch, Apache Solr
- **Job Submission:** Client Edge Node, Apache Oozie
- Data warehouses like Pivotal Greenplum or Teradata

Security



- **Authentication:** Kerberos with local KDC or Active Directory, LDAP integration, local user management, Apache Knox
- **Authorization:** Open-source native authZ (i.e., HiveServer2 authZ or HDFS ACLs), Apache Ranger, Apache Sentry
- **Encryption:** local disk encryption with LUKS, HDFS transparent-data encryption, in-flight encryption for each framework (i.e., Hadoop MapReduce encrypted shuffle)
- **Configuration:** different tools for management based on vendor

Swim lane of jobs



Over utilized

Under utilized

Role of a Hadoop administrator

- Management of the cluster (failures, hardware replacement, restarting services, expanding cluster)
- Configuration management
- Tuning of specific jobs or hardware
- Managing development and test environments
- Backing up data and disaster recovery

Identifying challenges

Over utilization and idle capacity

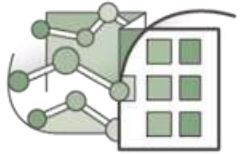
- Tightly coupled compute and storage requires buying excess capacity
- Can be over-utilized during peak hours and underutilized at other times
- Results in high costs and low efficiency

Management difficulties

- Managing distributed applications and availability
- Durable storage and disaster recovery
- Adding new frameworks and doing upgrades
- Multiple environments
- Need team to manage cluster and procure hardware

Migrating workloads to Amazon EMR

Why Amazon EMR?



Easy to Use
Launch a cluster in minutes

Low Cost
Pay an hourly rate

Open-Source Variety
Latest versions of software

Managed
Spend less time monitoring

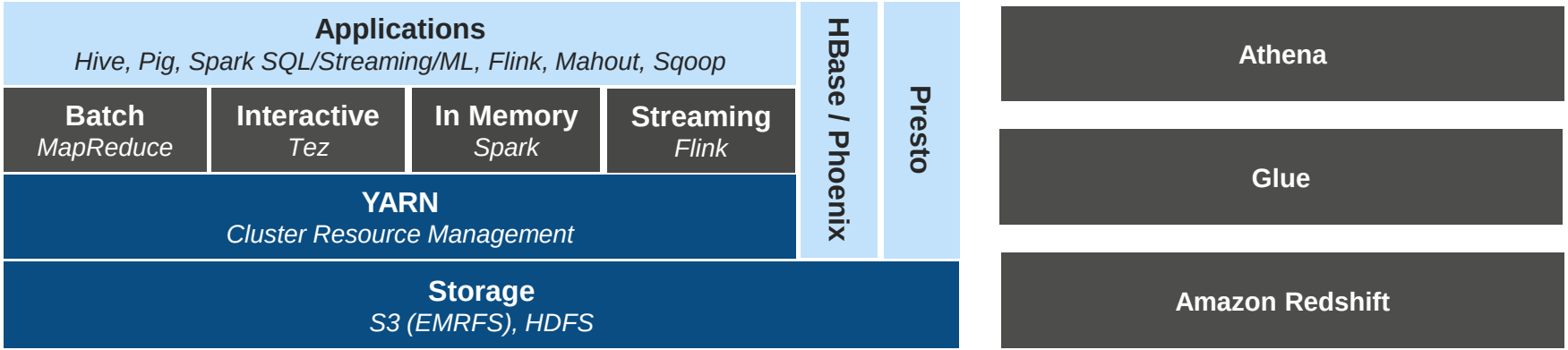
Secure
Easy to manage options

Flexible
Customize the cluster

Key migration and TCO considerations

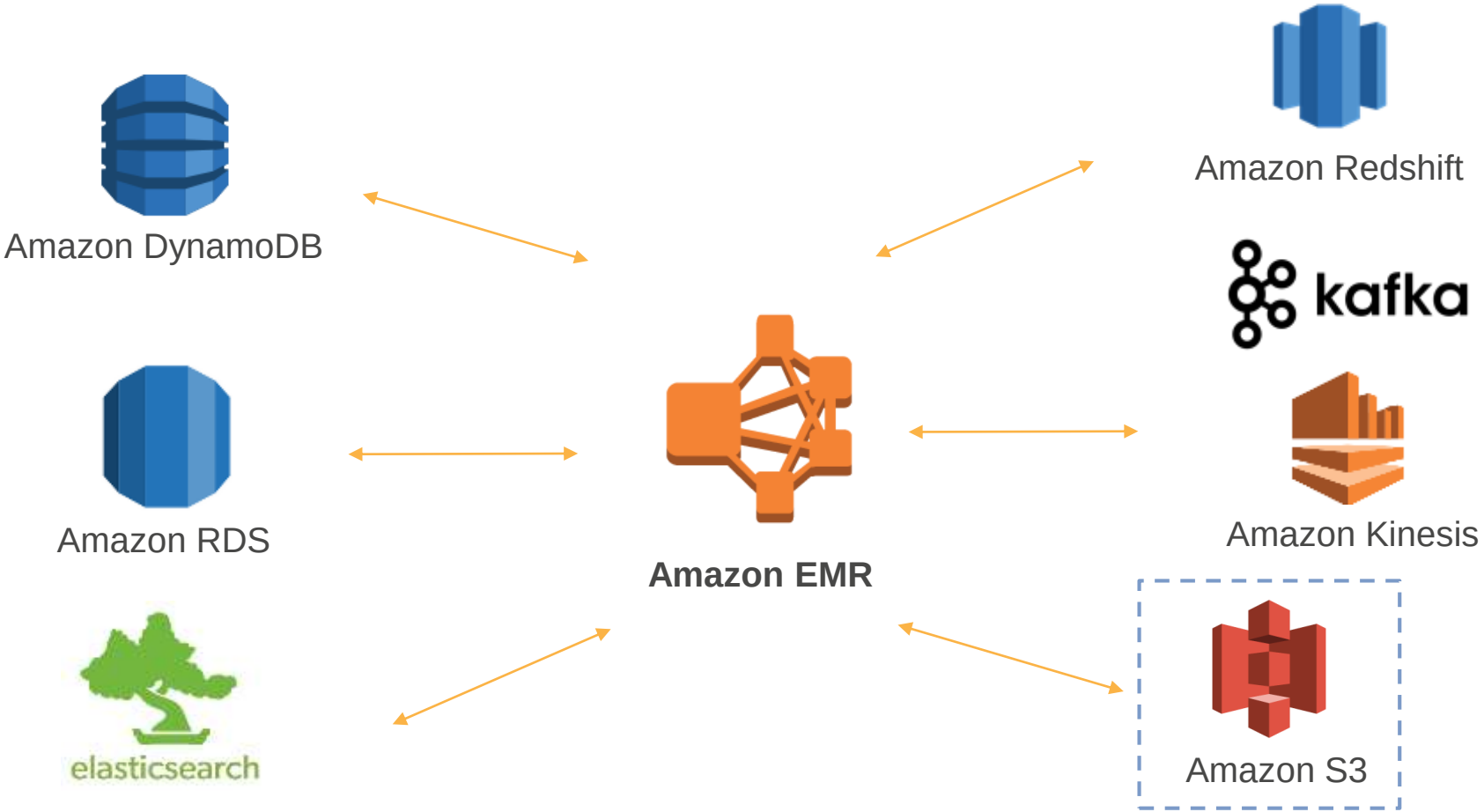
- DO NOT LIFT AND SHIFT
- Decouple storage and compute with S3
- Deconstruct workloads and map to open-source tools
- Transient clusters and auto scaling
- Choosing instance types and EC2 Spot Instances

Translate use cases to the right tools

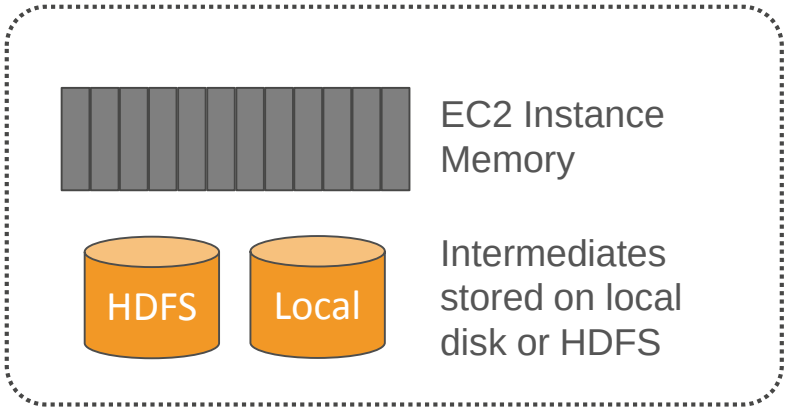


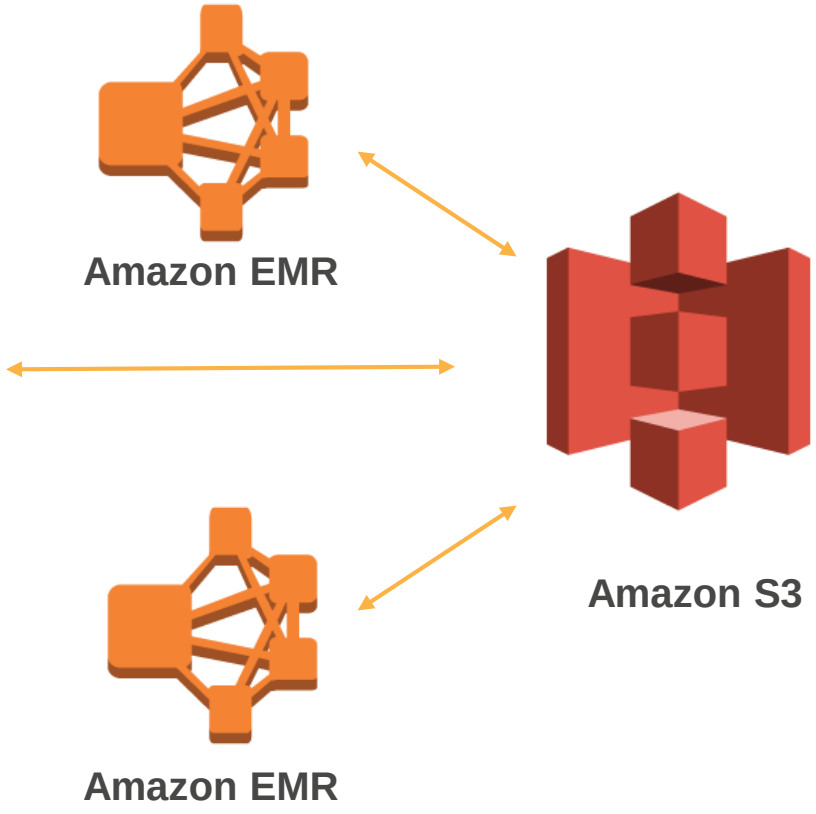
- Low-latency SQL -> Athena or Presto or Amazon Redshift
- Data Warehouse / Reporting -> Spark or Hive or Glue or Amazon Redshift
- Management and monitoring -> EMR console or Ganglia metrics
- HDFS -> S3
- Notebooks -> Zeppelin Notebook or Jupyter (via bootstrap action)
- Query console -> Athena or Hue
- Security -> Ranger (CF template) or HiveServer2 or IAM roles

Many storage layers to choose from



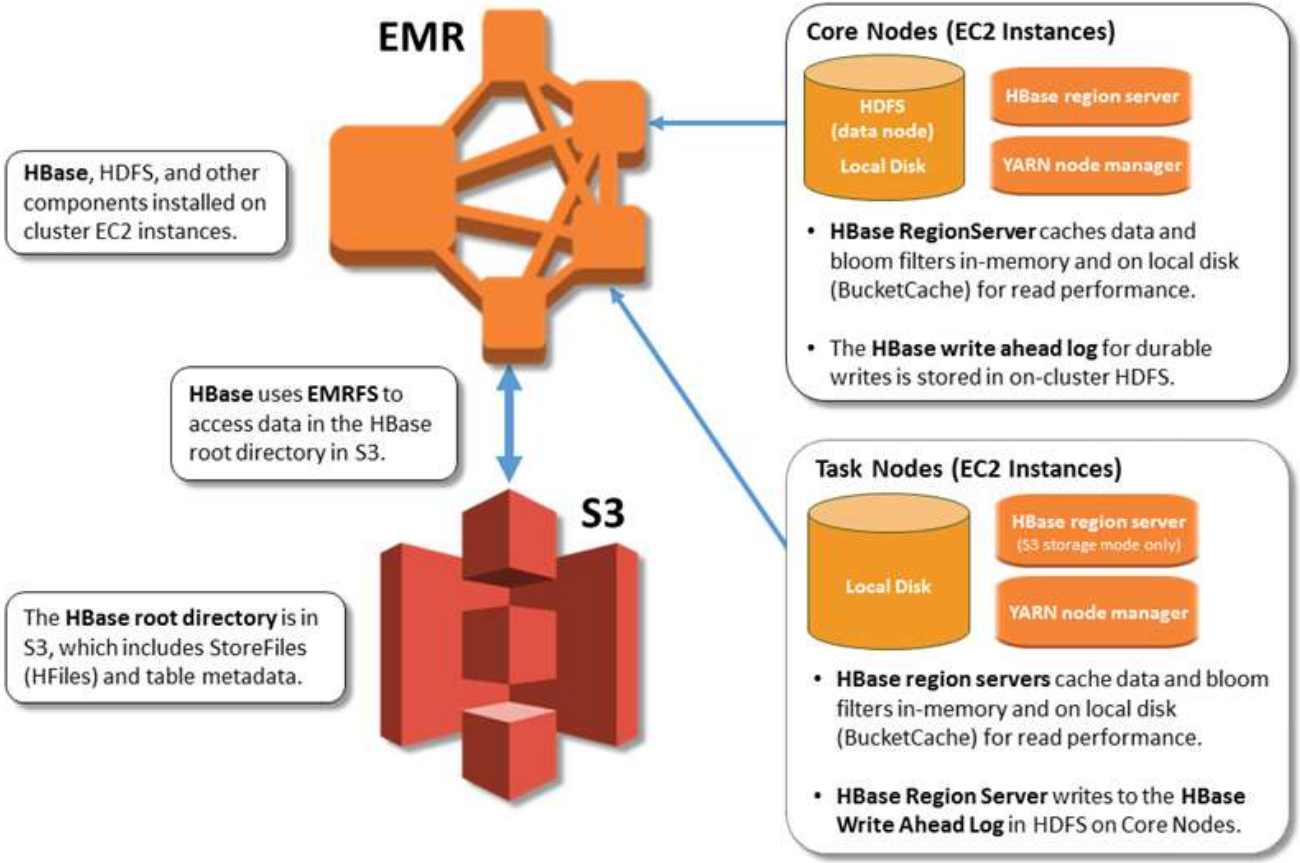
Decouple compute and storage by using S3 as your data layer





S3 is designed for 11 9's of durability and is massively scalable

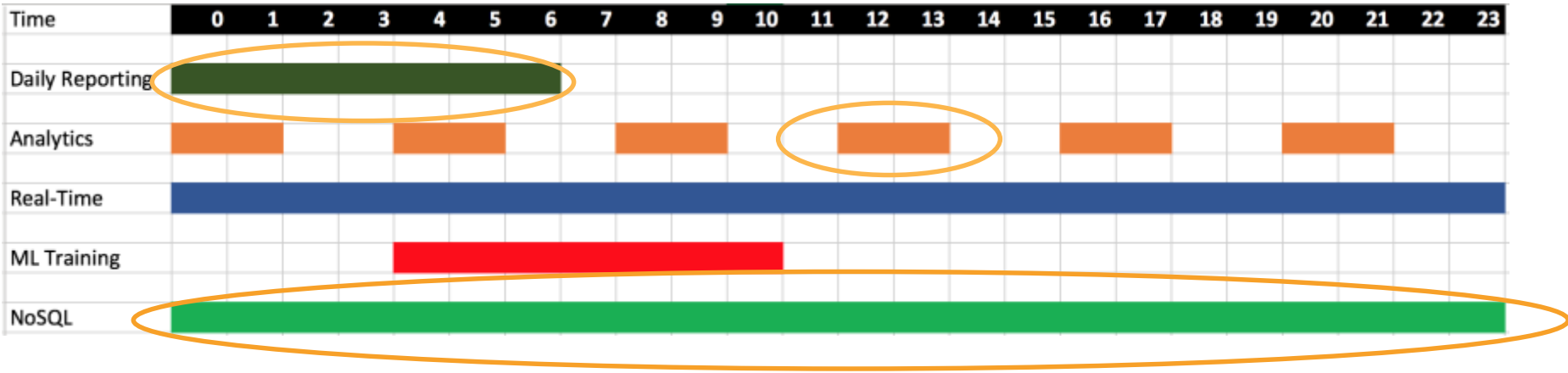
HBase on S3 for scalable NoSQL



S3 tips: Partitions, compression, and file formats

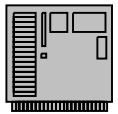
- Avoid key names in lexicographical order
- Improve throughput and S3 list performance
- Use hashing/random prefixes or reverse the date-time
- Compress data set to minimize bandwidth from S3 to EC2
    - Make sure you use splittable compression or have each file be the optimal size for parallelization on your cluster
- Columnar file formats like Parquet can give increased performance on reads

TCO – Transient or long running clusters



Options to submit jobs

Submit a Spark application



Amazon EMR Step API

Use AWS Lambda to submit applications to EMR Step API or directly to Spark on your cluster

AWS Lambda

AWS Data Pipeline

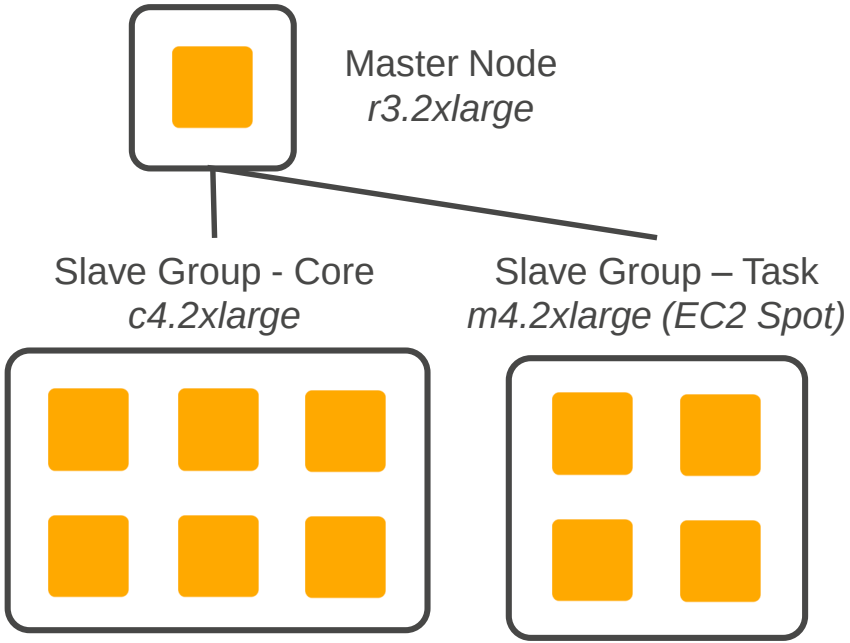
Create a pipeline to schedule job submission or create complex workflows

Airflow, Luigi, or other schedulers on EC2

Amazon EMR

Use Oozie on your cluster to build DAGs of jobs

Performance and hardware



Considerations

- Transient or long running
- Instance types
- Cluster size
- Application settings
- File formats and S3 tuning

On-cluster UIs to quickly tune workloads

SQL editor, Workflow designer, Metastore browser

Notebooks

Design and execute queries and workloads

Manage applications

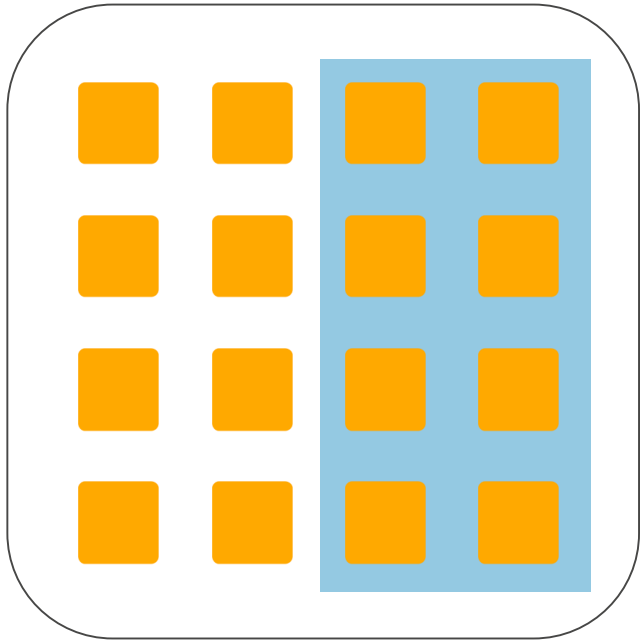
Use Spot and Reserved Instances to lower costs

Meet SLA at predictable cost

Exceed SLA at lower cost

On-demand for core nodes

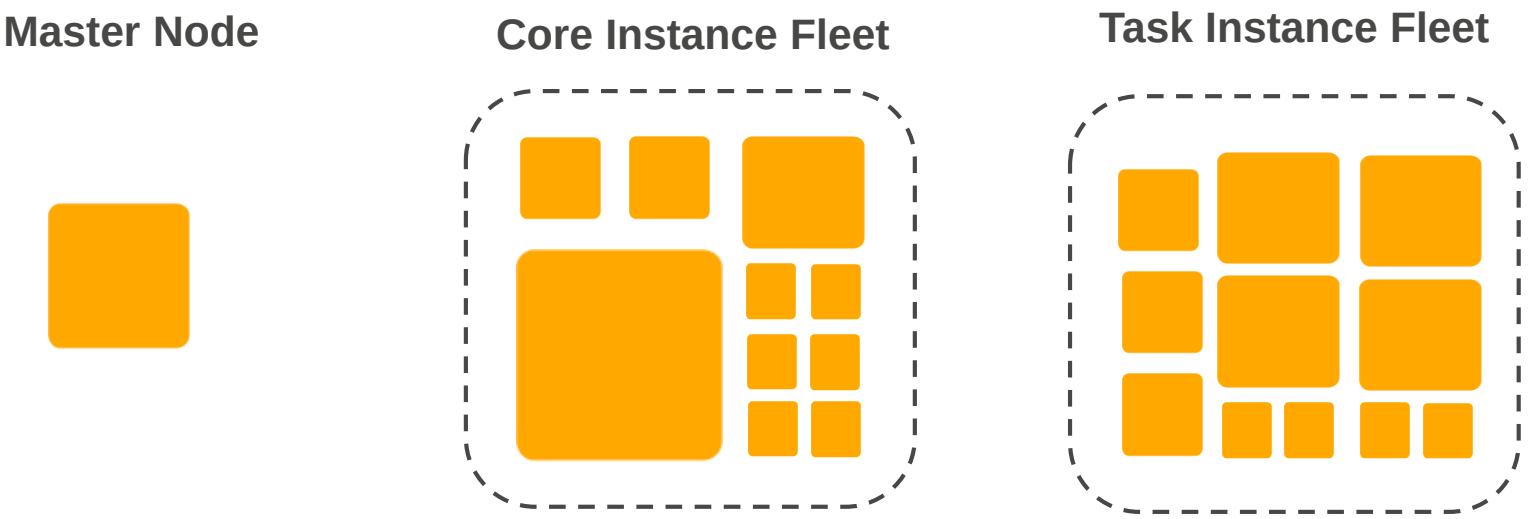
Standard Amazon EC2 pricing for on-demand capacity



Spot for task nodes

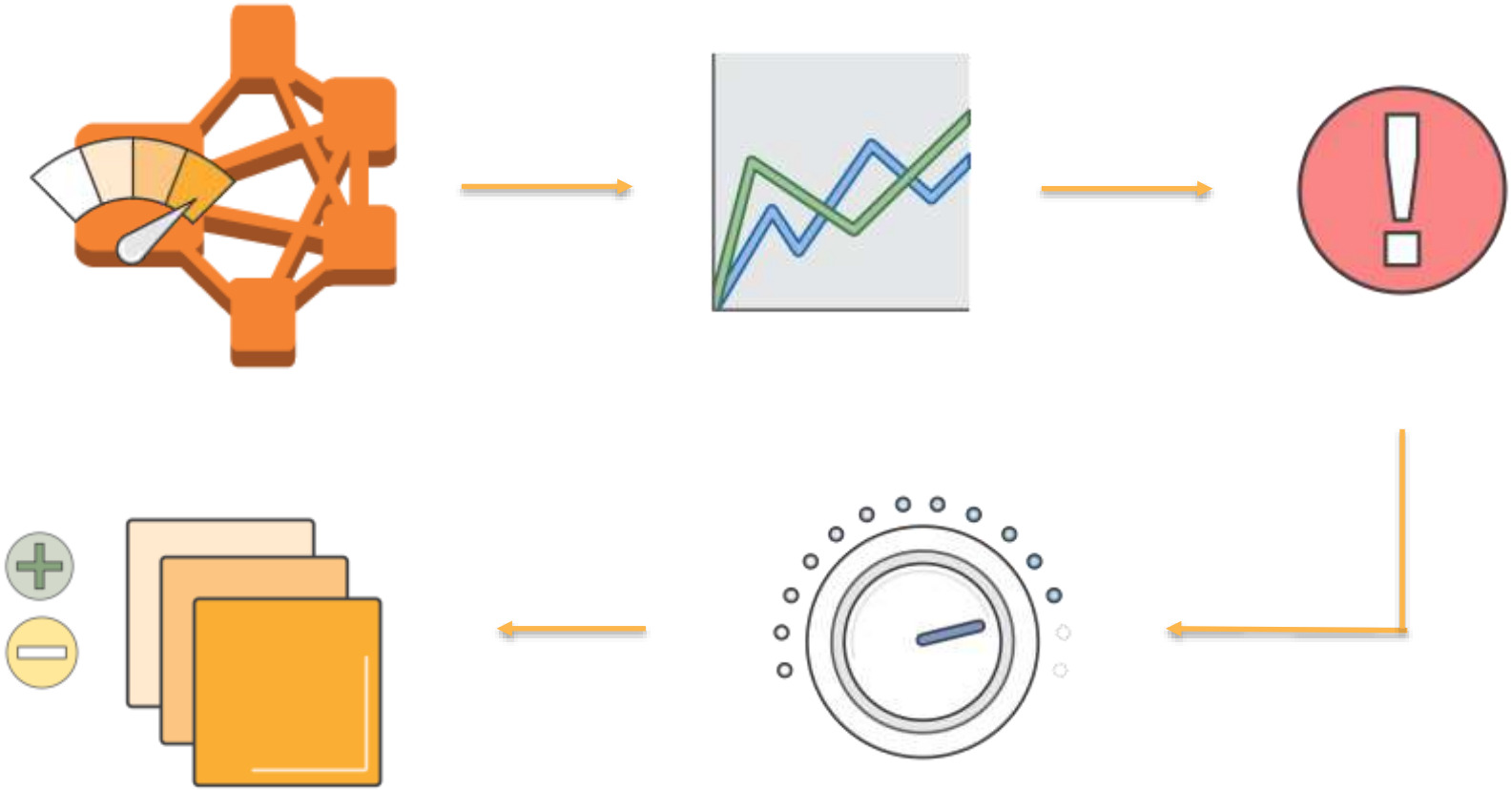
Up to 80% off EC2 On-Demand pricing

Instance fleets for advanced Spot provisioning

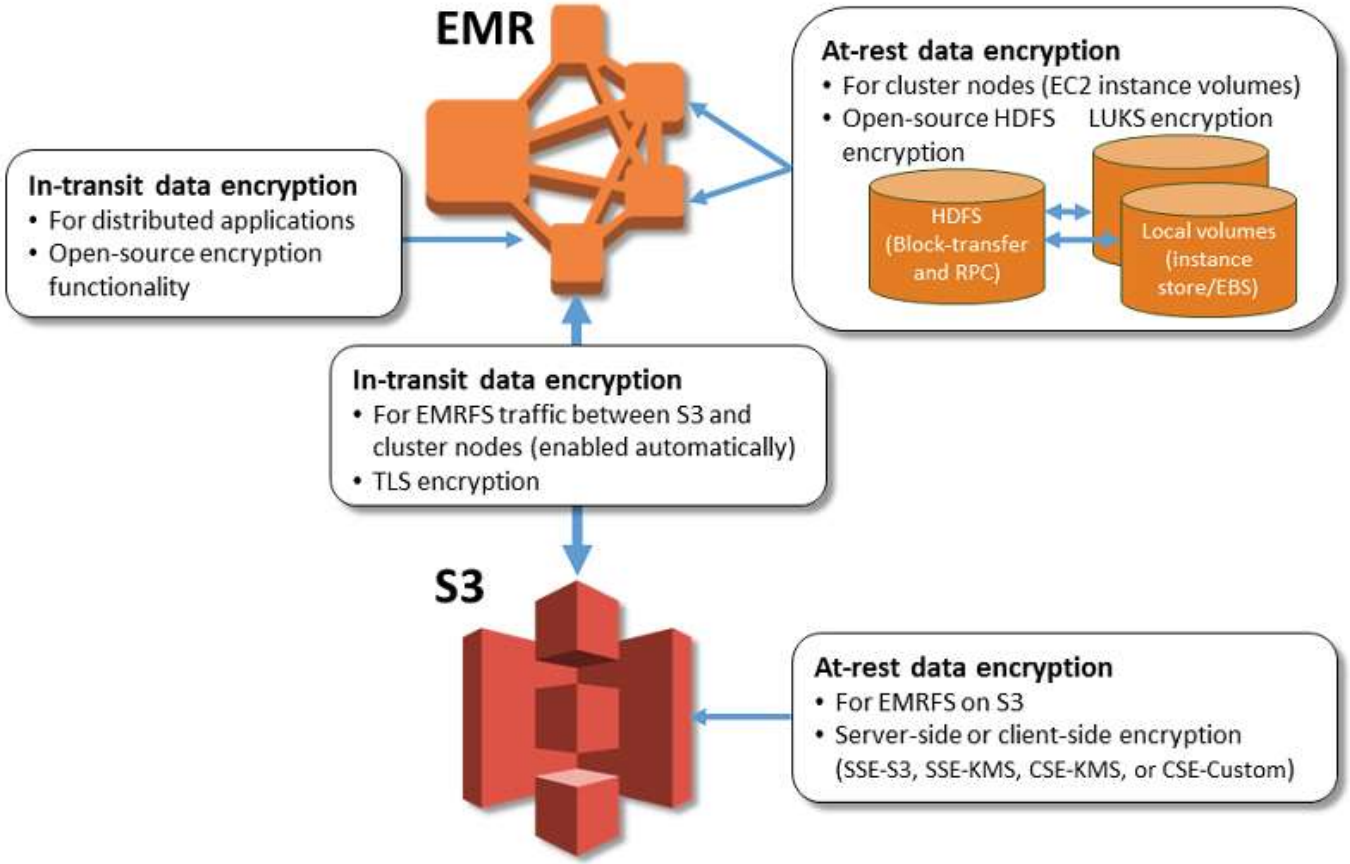


- Provision from a list of instance types with Spot and On-Demand
- Launch in the most optimal Availability Zone based on capacity/price
- Spot Block support

Lower costs with Auto Scaling



Security - Encryption



Security – Authentication and Authorization

EMR role
EC2 role
SSH key

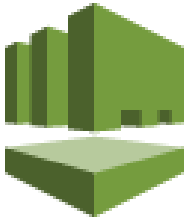
IAM user: `MyUser`

Tag: `user = MyUser`

```
{
    "Sid": "Stmt1479329681000",
    "Effect": "Allow",
    "Action": [
        "elasticmapreduce:AddTags",
        "elasticmapreduce:RunJobFlow"
    ],
    "Condition": {
        "StringEquals": {
            "elasticmapreduce:RequestTag/user": "MyUser"
        }
    },
    "Resource": [
        "*"
    ]
}
```

```
        "Effect": "Allow",
        "Action": [
            "elasticmapreduce:AddJobFlowSteps",
            "elasticmapreduce:DescribeCluster",
            "elasticmapreduce:DescribeStep",
            "elasticmapreduce:ListSteps",
            "elasticmapreduce:TerminateJobFlows"
        ],
        "Condition": {
            "StringEquals": {
                "elasticmapreduce:ResourceTag/user": "MyUser"
            }
        },
        "Resource": [
            "*"
        ]
    }
```

Security - Authentication and Authorization

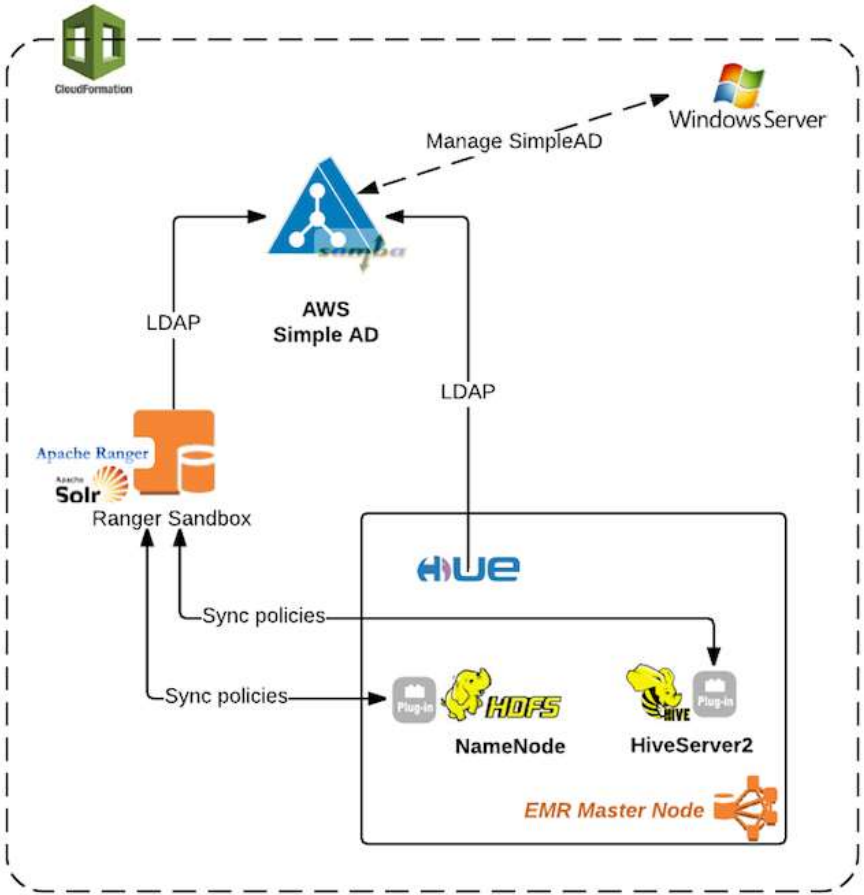


AWS Directory Service

Self-managed Directory

- LDAP for HiveServer2, Hue, Presto, Zeppelin
- Kerberos for Spark, HBase, YARN, Hive, and authenticated UIs
- EMRFS storage-based permissions
- SQL standards-based and storage-based authorization

Security - Authentication and Authorization



Apache Ranger

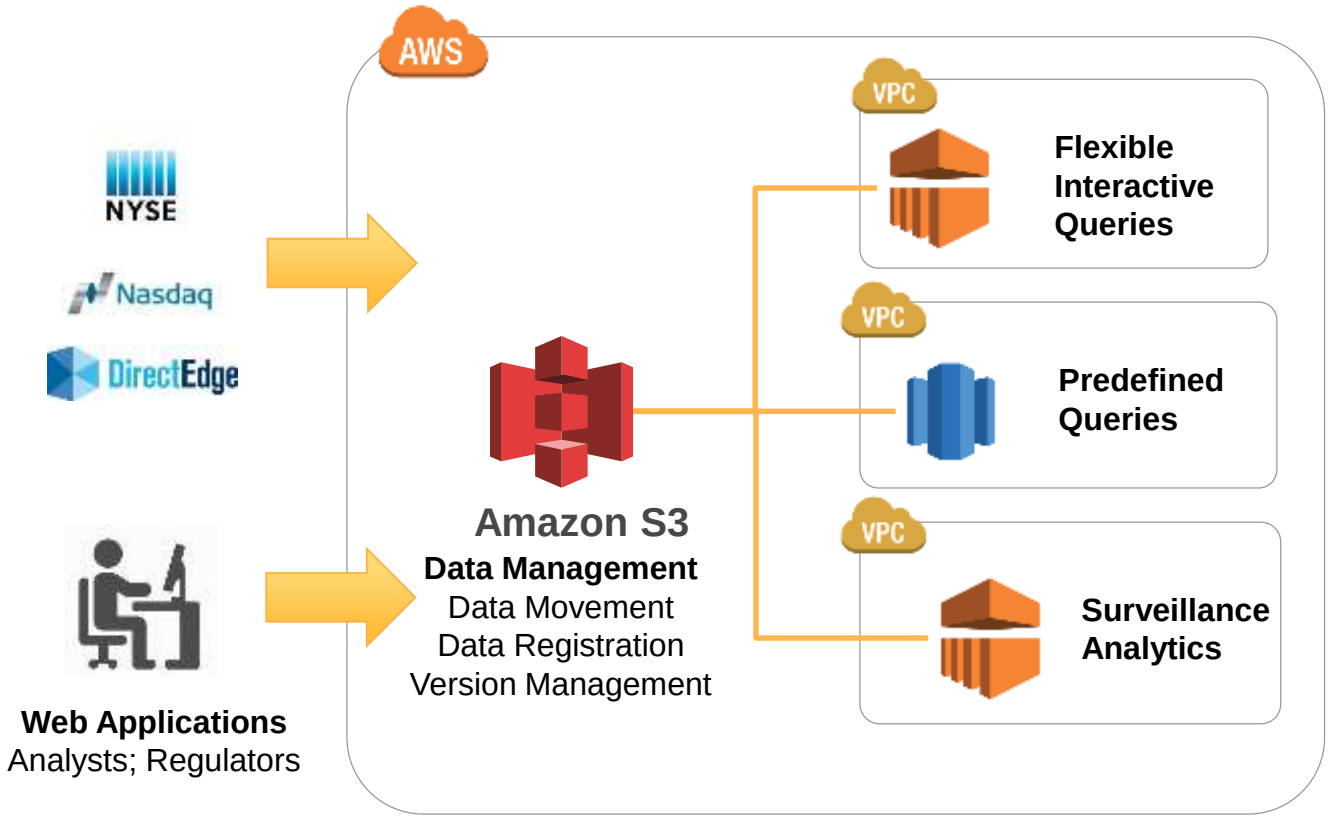
- Plug-ins for Hive, HBase, YARN, and HDFS
- Row-level authorization for Hive (with data-masking)
- Full auditing capabilities with embedded search
- Run Ranger on an edge node – visit the AWS Big Data Blog

Security – Governance and Auditing

- AWS CloudTrail for EMR APIs
- S3 access logs for cluster S3 access
- YARN and application logs
- Ranger for UI for application level auditing

Customer Examples

FINRA: Migrating from on-prem to AWS

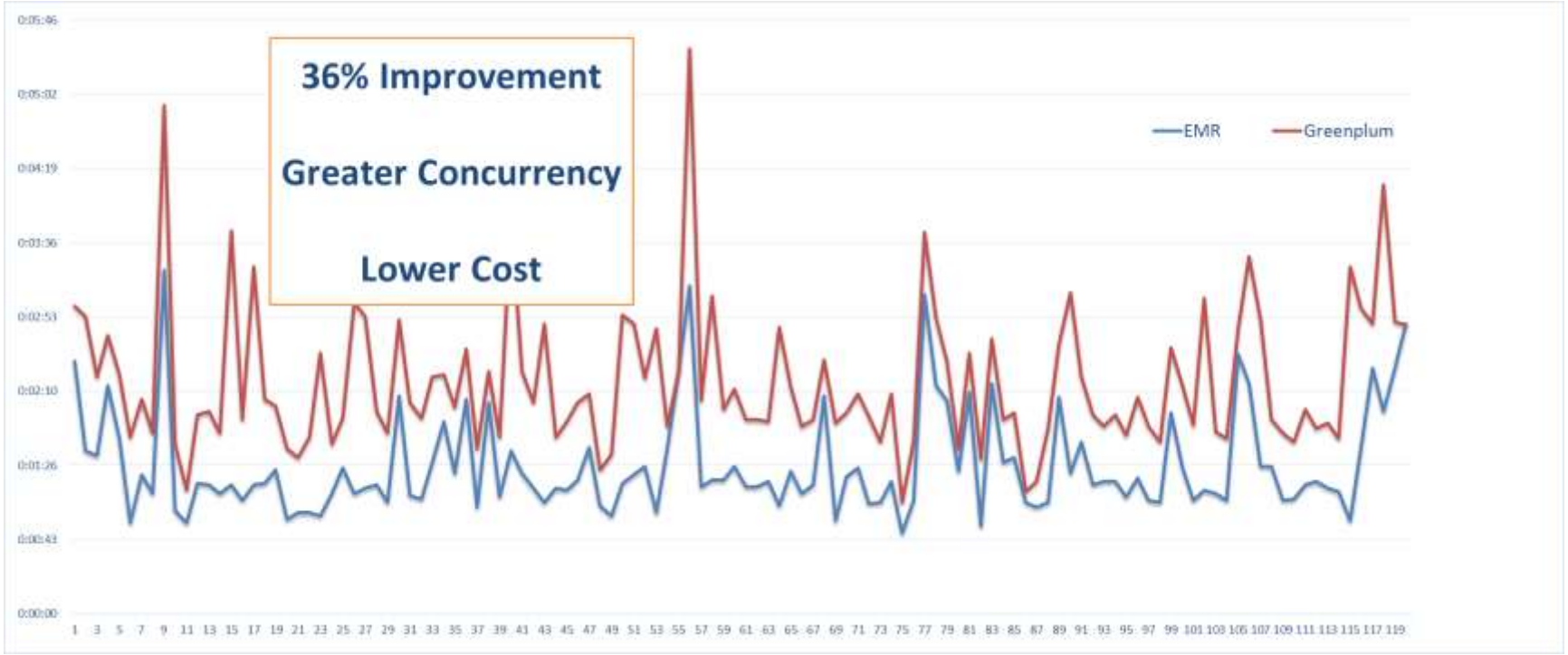


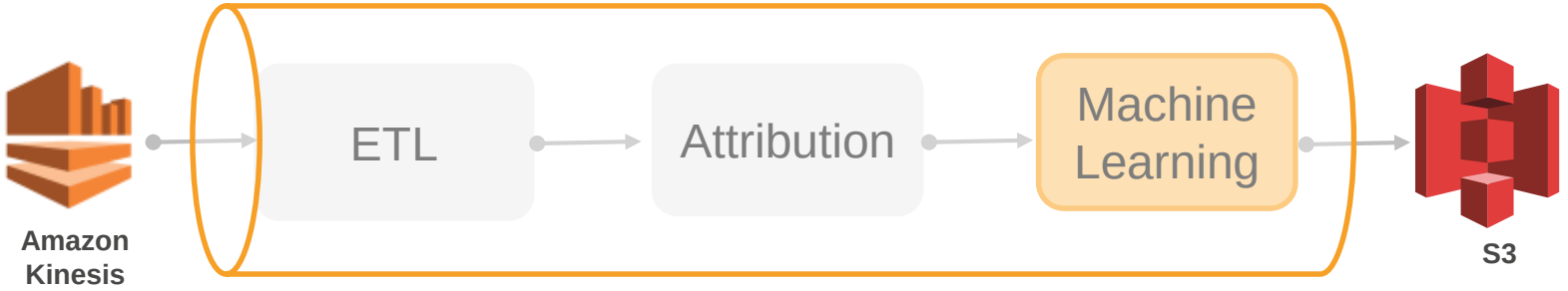
Petabytes of data generated on-premises, brought to AWS, and stored in S3

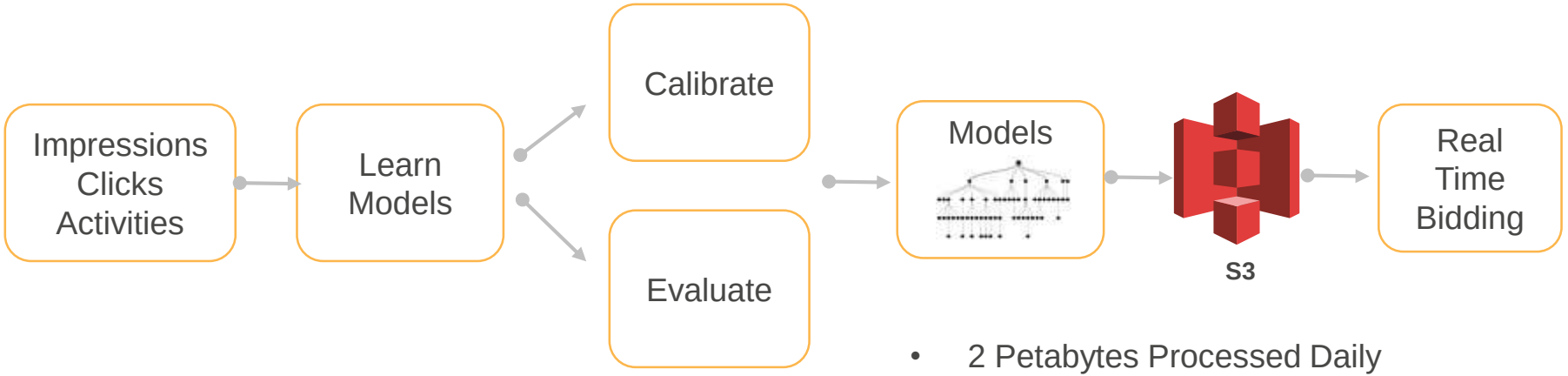
Thousands of analytical queries performed on EMR and Amazon Redshift.

Stringent security requirements met by leveraging VPC, VPN, encryption at-rest and in-transit, CloudTrail, and database auditing

Lower Cost and Higher Scale than On-Premises





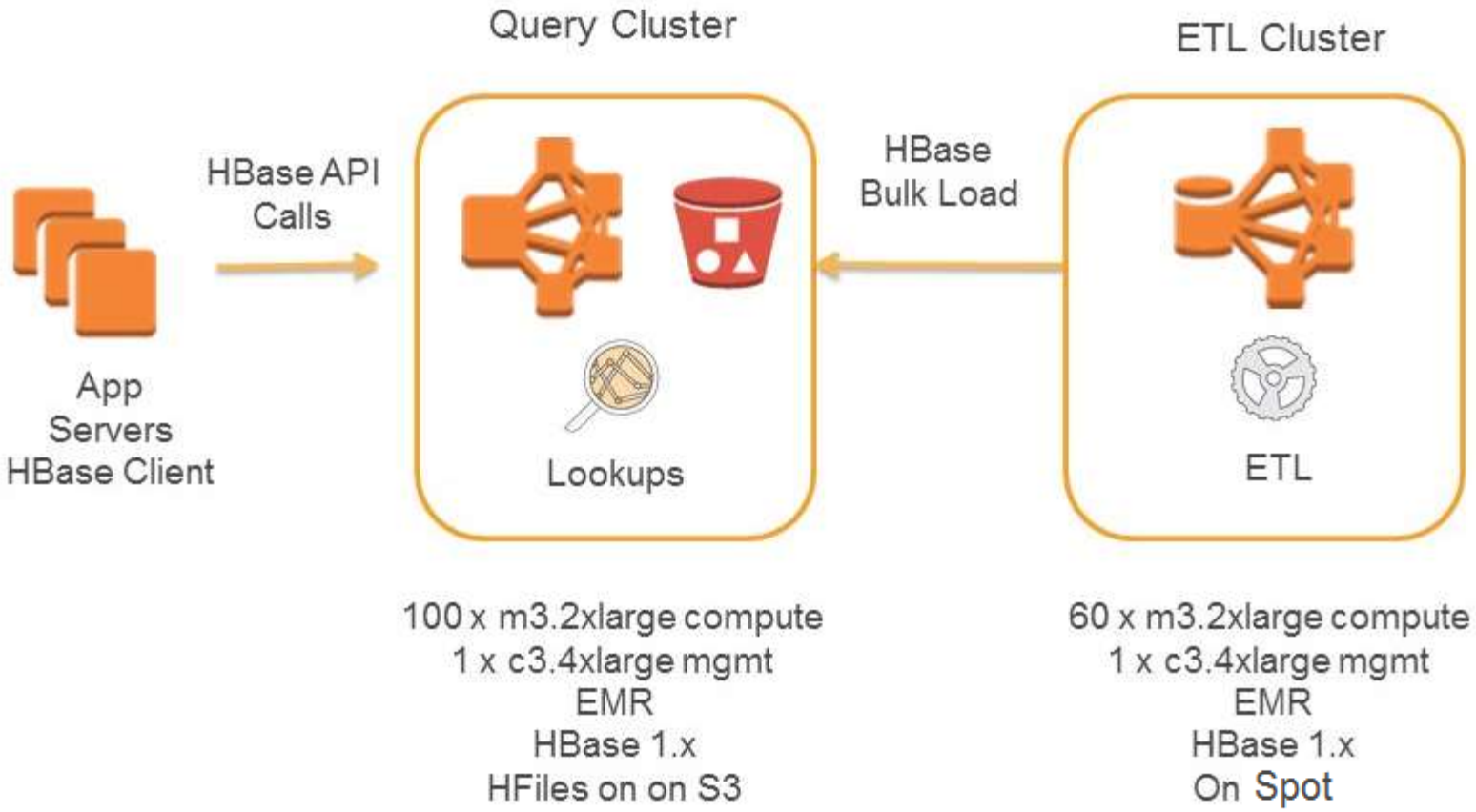


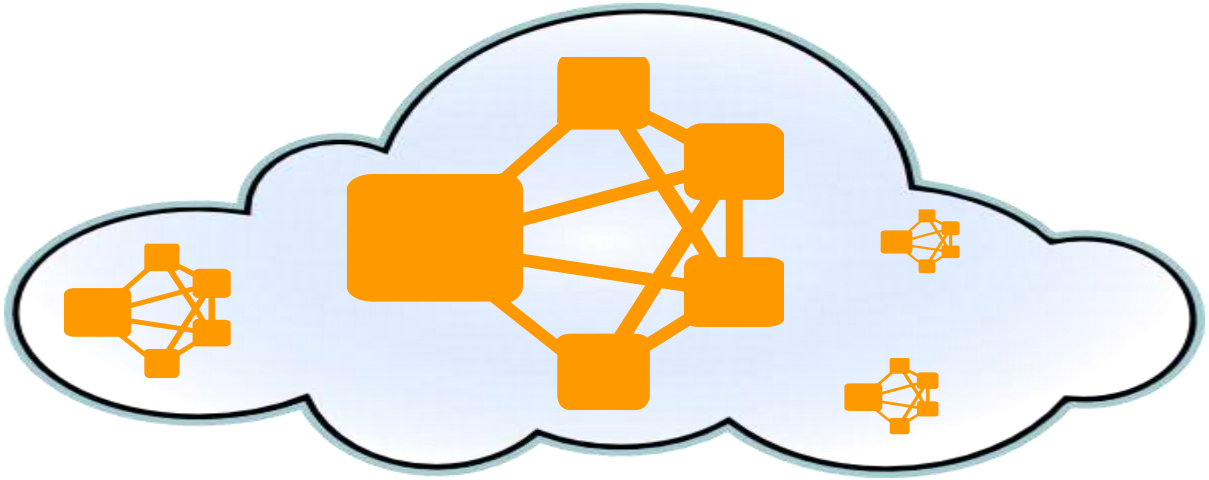
DataXu®

Data. Insight. Action.

- 2 Petabytes Processed Daily
- 2 Million Bid Decisions Per Second
- Runs 24 X 7 on 5 Continents
- Thousands of ML Models Trained per Day

FINRA saved 60% by moving to HBase on EMR





Q+A Thank you!

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