

# DTCC

## 2015中国数据库技术大会

DATABASE TECHNOLOGY CONFERENCE CHINA 2015  
大数据技术探索和价值发现



# HAWQ

MPP SQL for HDFS of Hadoop

基于Hadoop原生HDFS的大规模并行SQL

# HAWQ Is The...

Enterprise platform that provides the fewest barriers, lowest risk, most cost effective and **fastest** way to enter in to big data analytics on HDFS of Hadoop



# HAWQ 简述

ANSI SQL 2003/2011 Support



Greenplum database re-platformed on Hadoop/HDFS

## SQL Engine

Cost-Based Query Optimization

Robust Query Optimizer

Complex Data Management

Sub-Partitioning

Distributions

Partitioning

CPU

Mem

Disk

Users

## Multi-User Platform

Resource Queues

Concurrency

Data Encryption

Role-Based Security

## Accessibility

ODBC/JDBC Driver L3,4

Parallel Loading/Unloading

HDFS Native Formats

Extendable...

txt

Avro

Seq

HBase

Hive

## Storage Options

Polymorphic Storage

Row/Columnar Storage

Built-in Compression

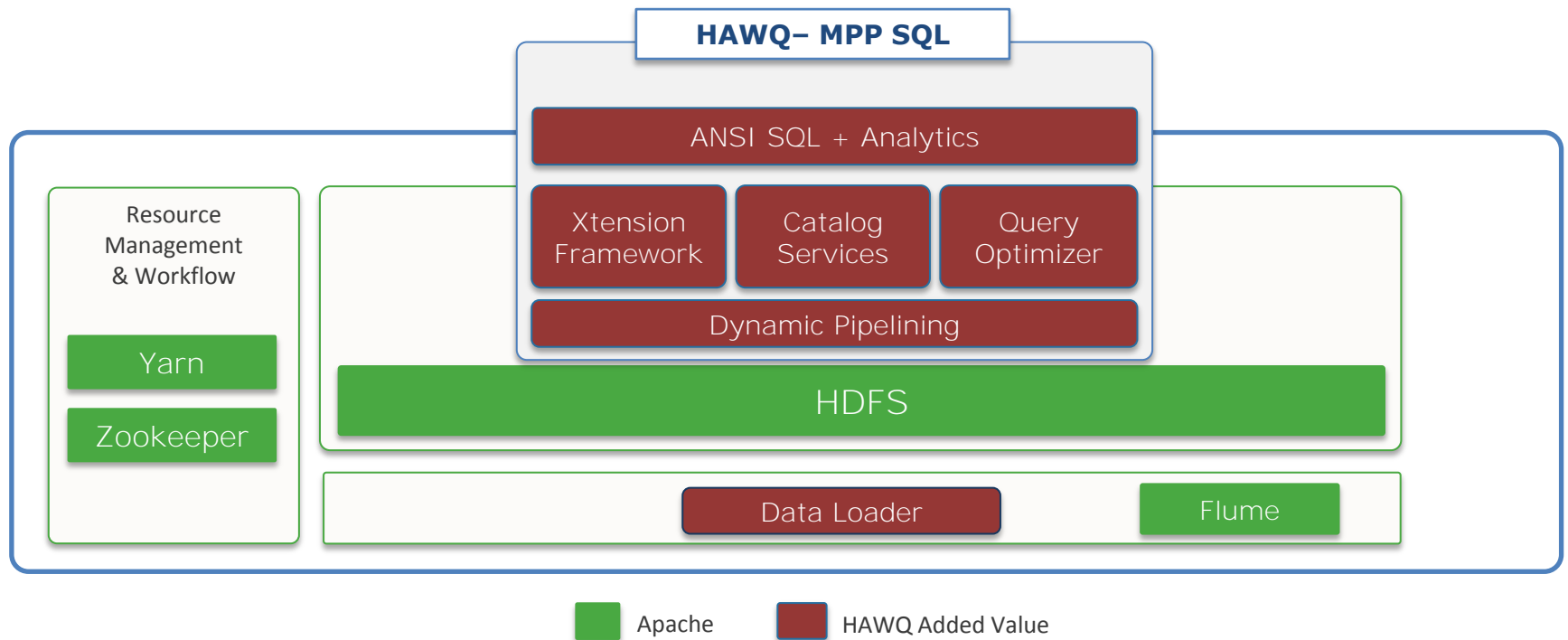
HDFS Native Formats

MapReduce Integration

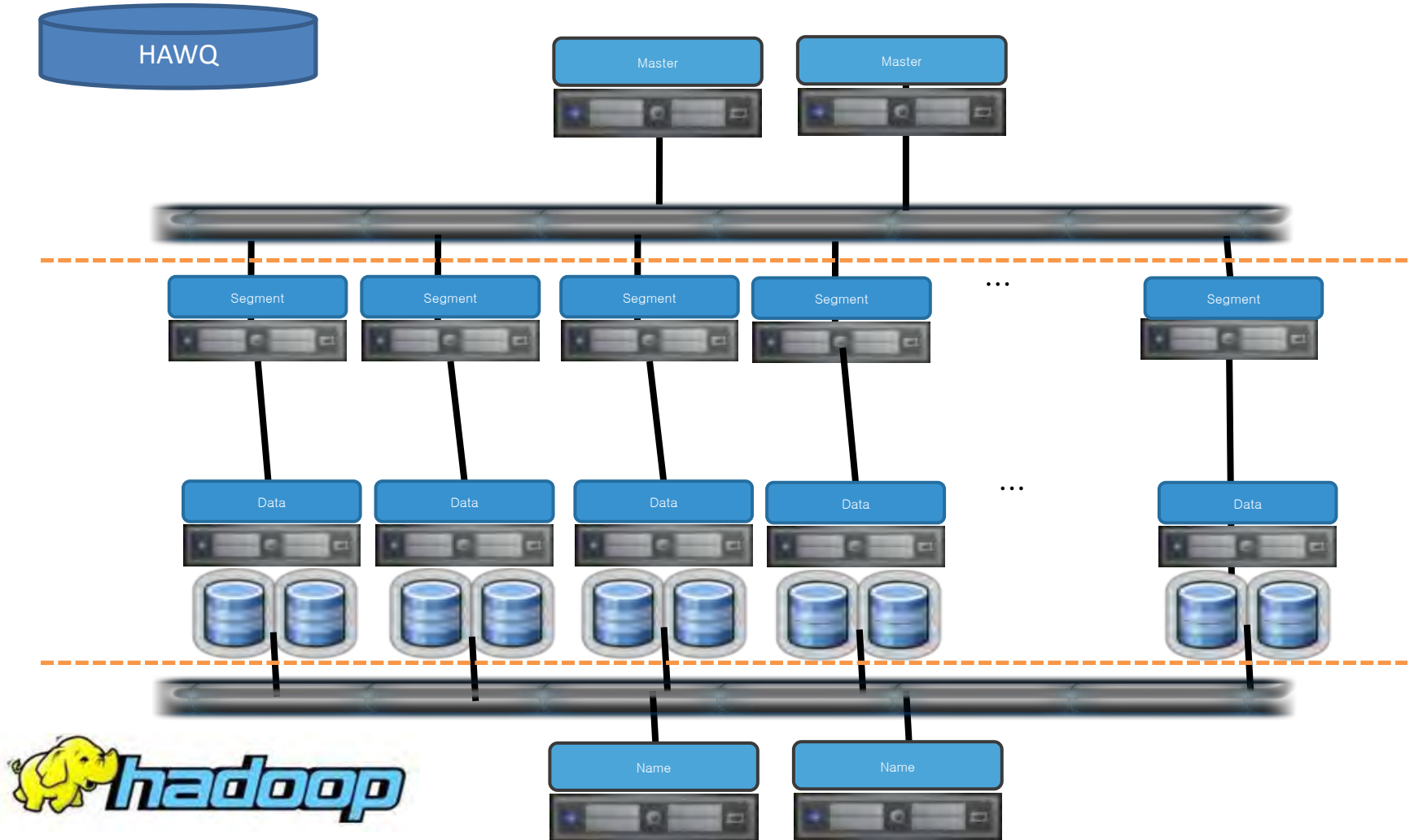
# HAWQ的优点...

- 支持Apache Hadoop原生HDFS的SQL大规模并行引擎（MPP SQL）
- GPFX External Tables 接口，使用SQL透明访问Hadoop上各类数据
  - HDFS, HBase, Hive, Parquet格式等等
- 还支持SQL透明访问NFS，HTTP其他格式的数据（可自定义）
- Performance and Scalability
  - Parallel Everything
  - Dynamic Pipelining
  - High Speed Interconnect（基于UDP）
  - HDFS access with C++ libhdfs3
  - Co-Located Joins & Data Locality
  - Partition Elimination（支持静态动态表分区）
  - Higher Cluster Utilization
  - Concurrency Control（资源作业优先级调度）

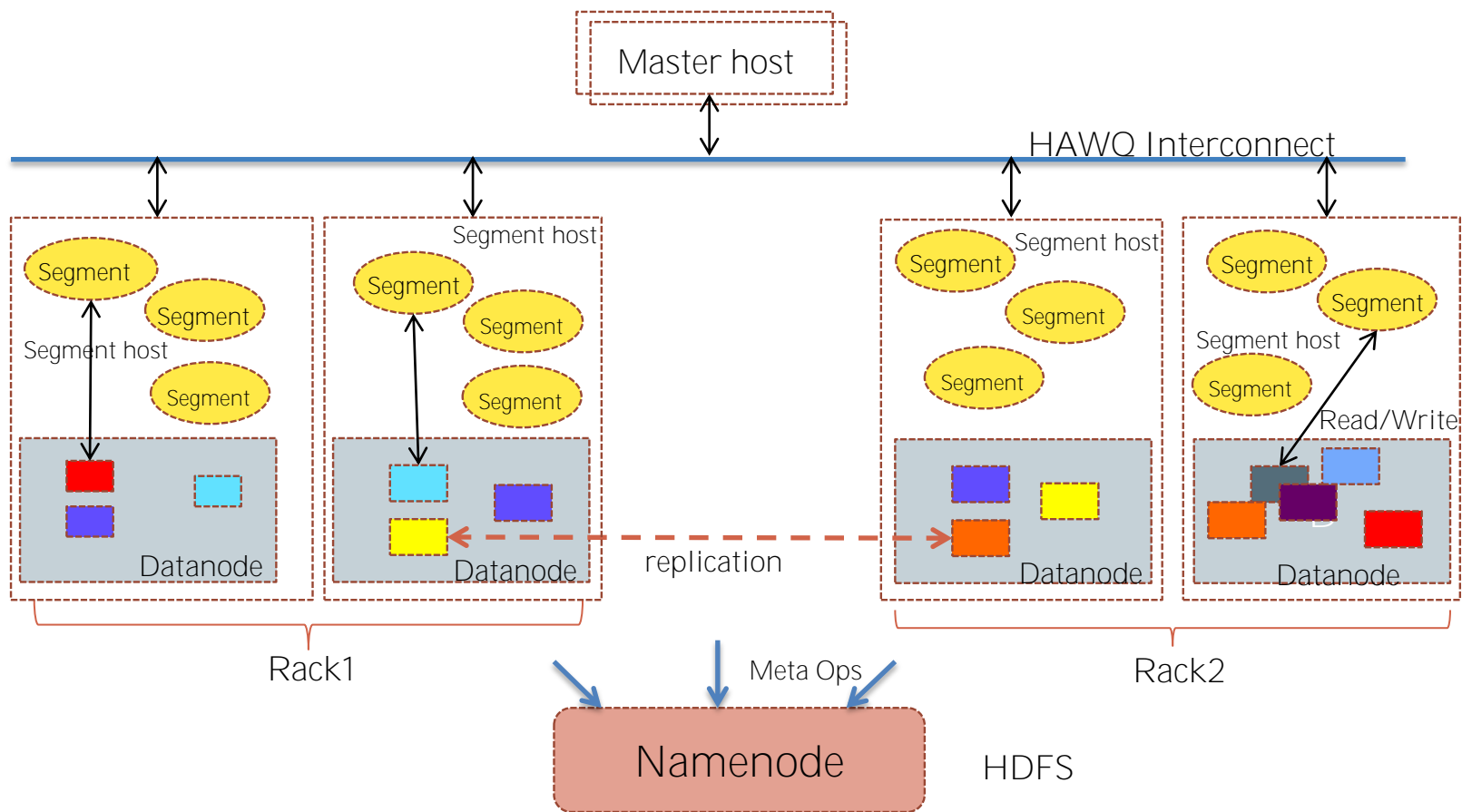
# HAWQ 及Hadoop软件栈



# HAWQ 与 Hadoop HDFS



# HAWQ 与 Hadoop HDFS 数据访问流



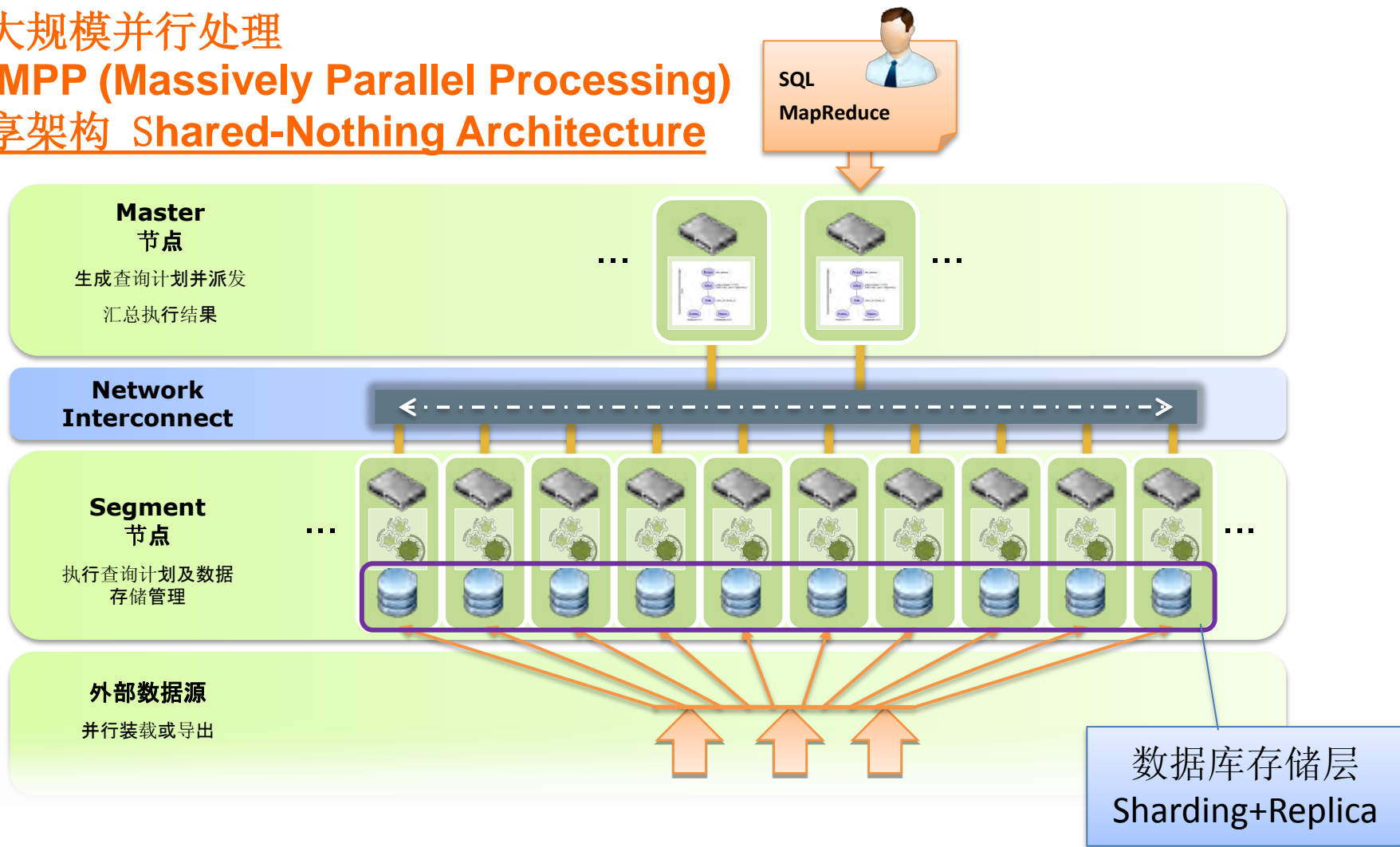


# HAWQ 对比 Greenplum DB 基本架构

SQL 大规模并行处理

SQL MPP (Massively Parallel Processing)

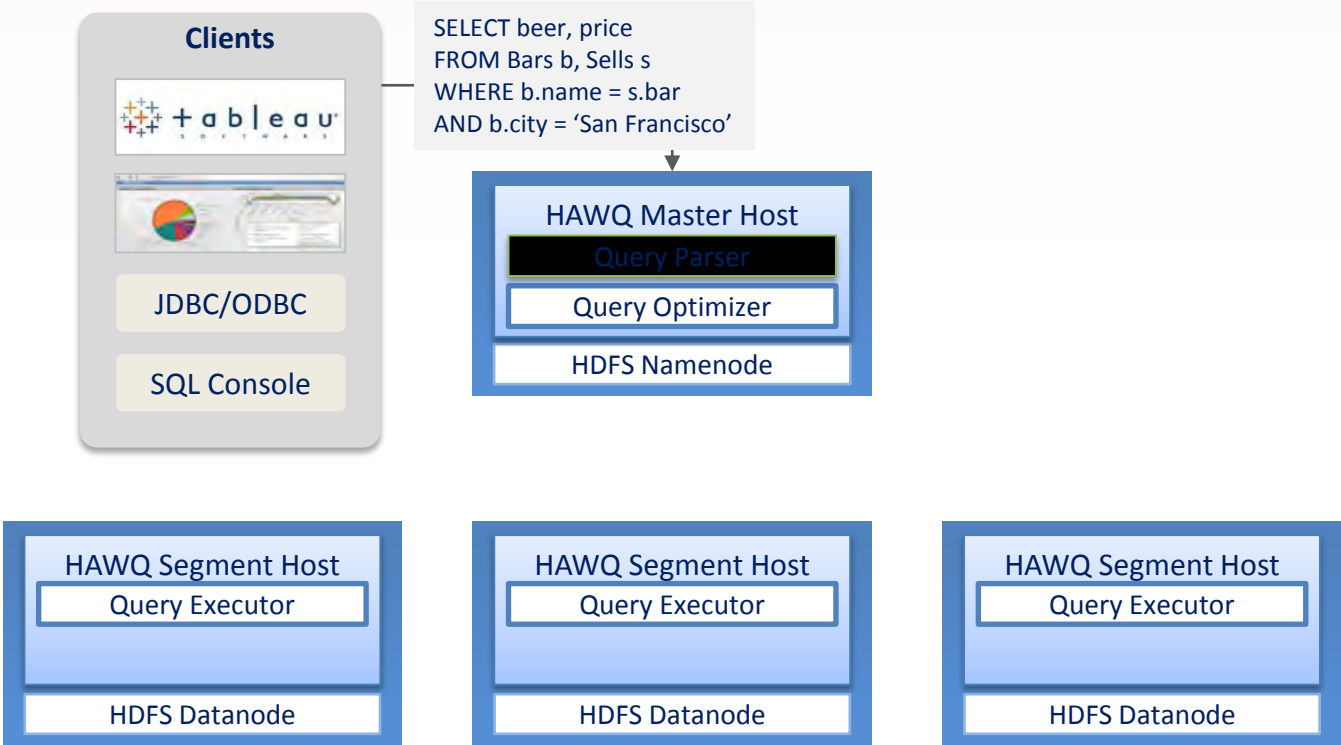
无共享架构 Shared-Nothing Architecture



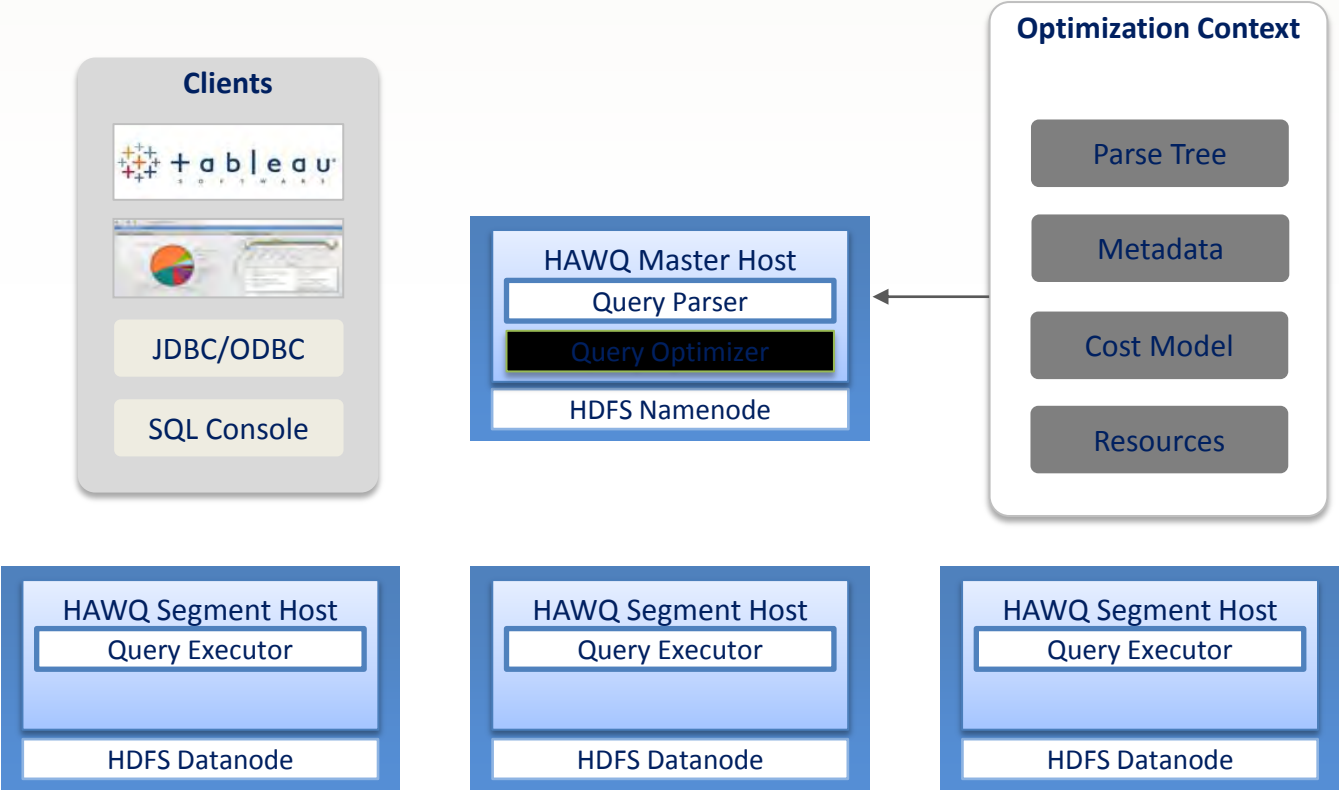
# 运行SQL，支持SQL2008及OLAP选项

```
-- Top 10 products for each category for all time
SELECT lineitems.product_id
,       products_dim.product_name
,       product_category_id
,       category_name
,       product_count
,       category_rank
FROM (SELECT product_id, product_category_id
,          SUM(item_quantity) AS product_count
,          row_number() OVER (PARTITION BY product_category_id ORDER BY SUM(item_quantity) DESC) AS category_rank
FROM retail_demo.order_lineitems
GROUP BY product_id, product_category_id
) AS lineitems |
INNER JOIN retail_demo.categories_dim on product_category_id = category_id
INNER JOIN retail_demo.products_dim on lineitems.product_id = products_dim.product_id
WHERE category_rank <= 10
ORDER BY product_category_id, category_rank
limit 100;
```

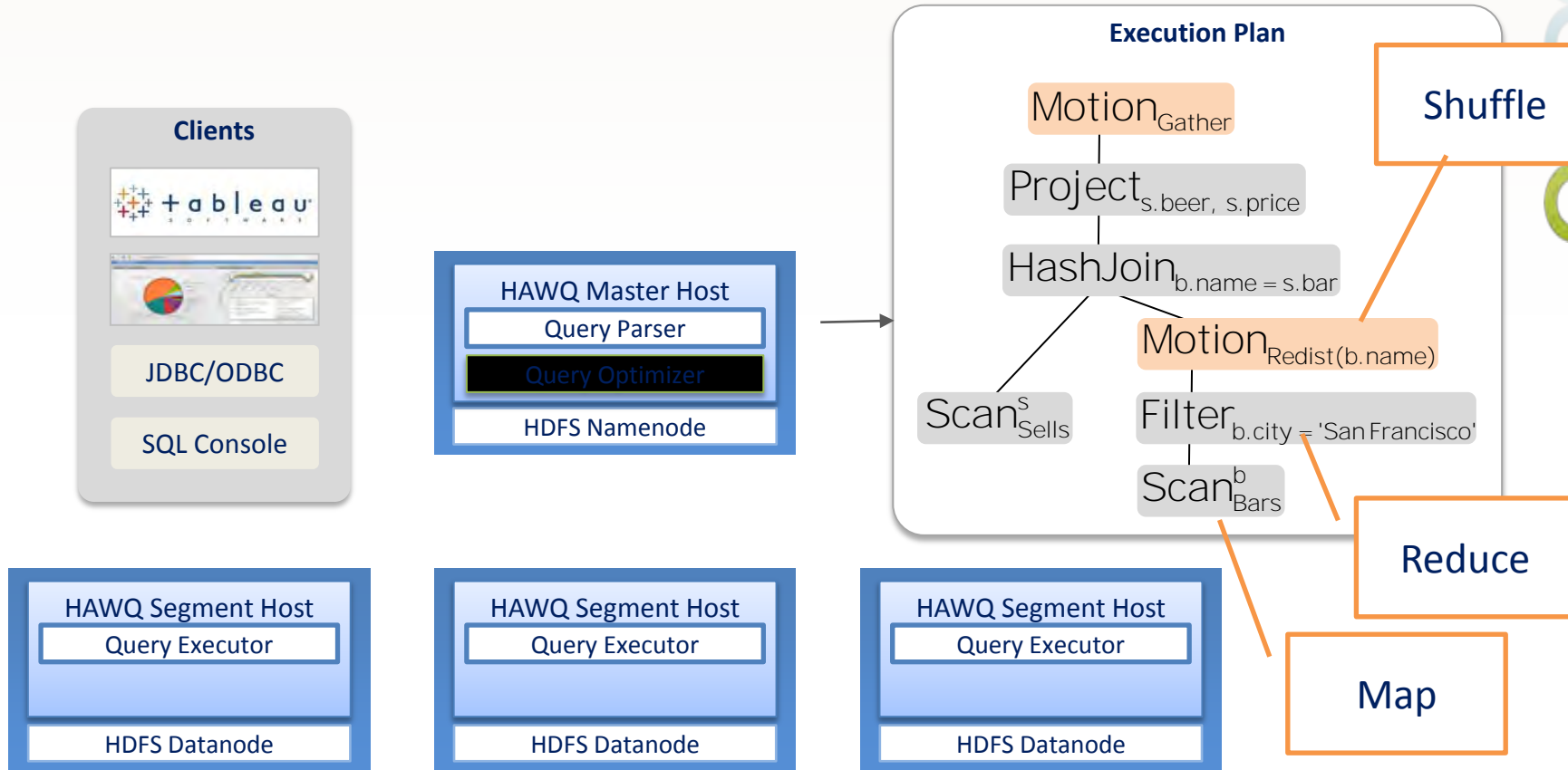
# HAWQ (SQL MPP) 机制-1



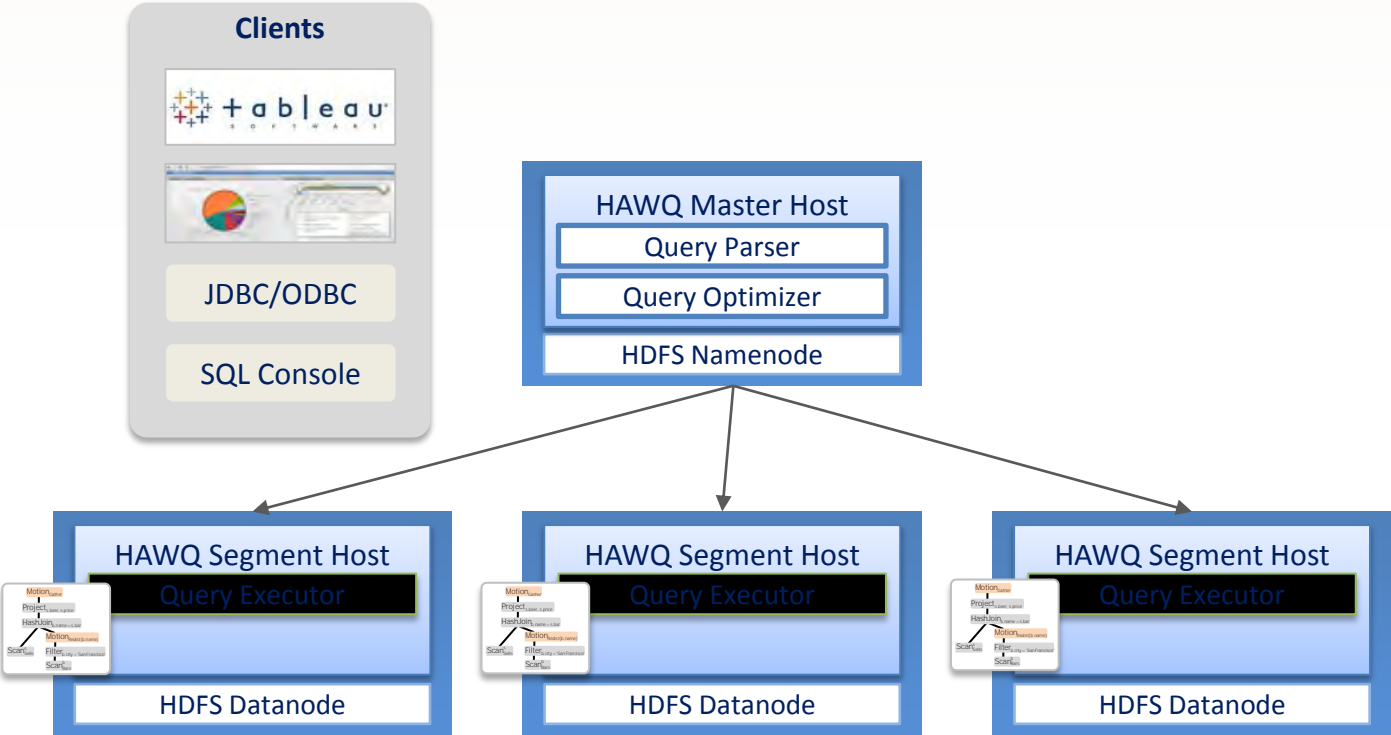
# HAWQ (SQL MPP) 机制-2



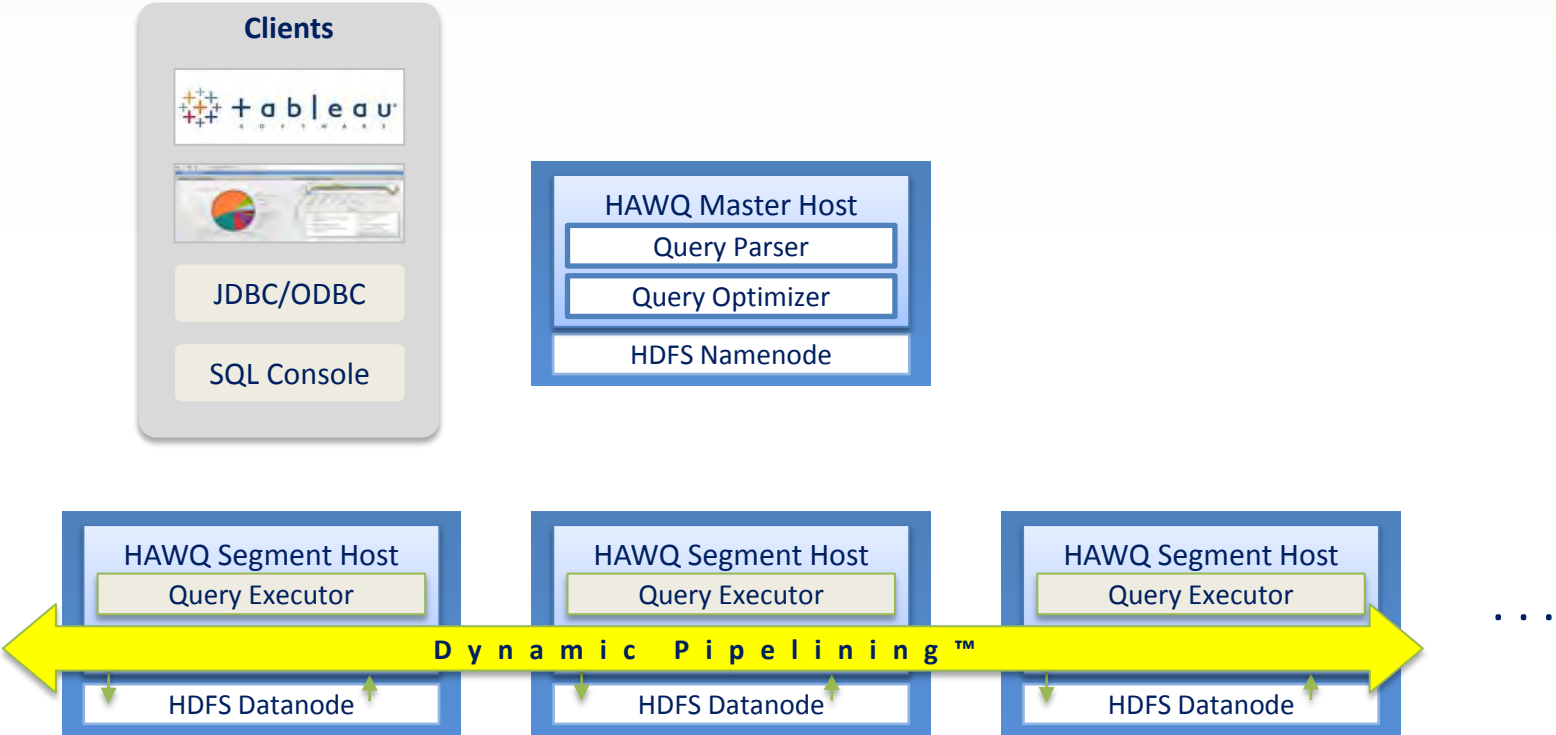
# HAWQ (SQL MPP) 机制-3



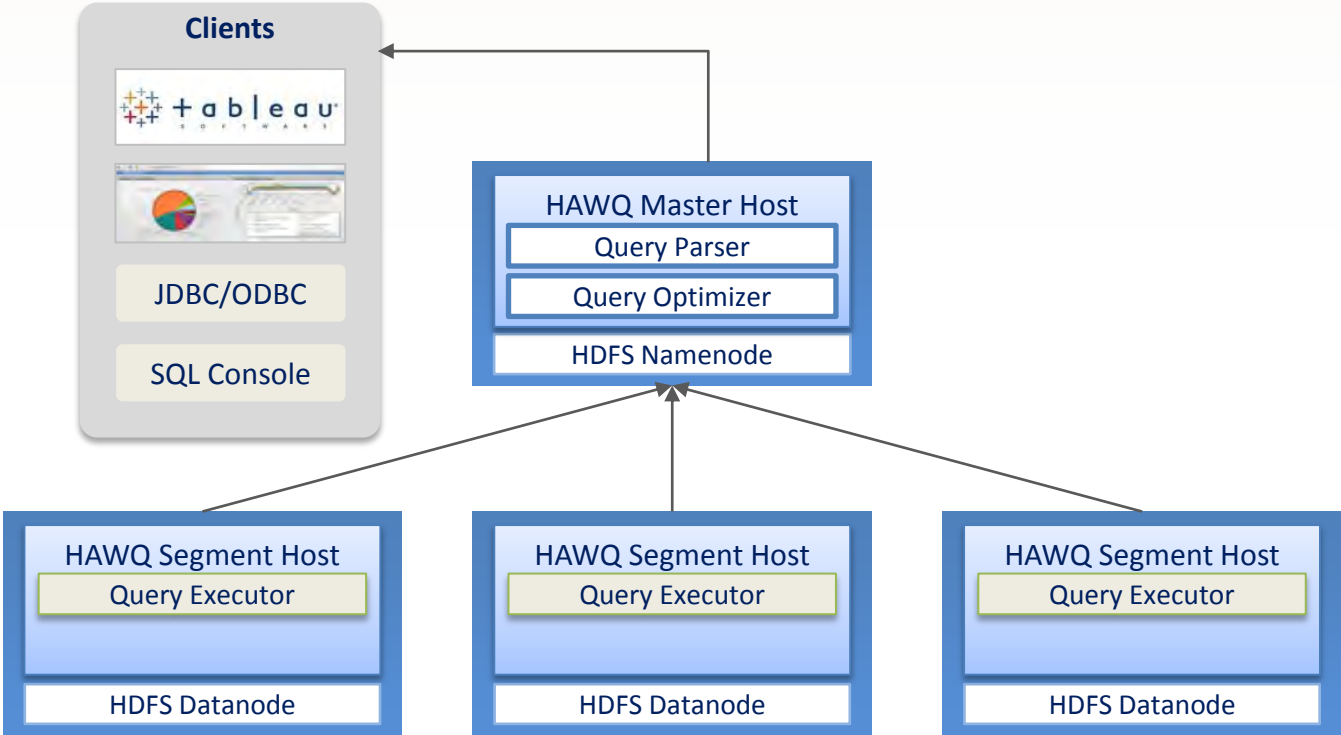
# HAWQ (SQL MPP) 机制-4



# HAWQ (SQL MPP) 机制-5



# HAWQ (SQL MPP) 机制-6



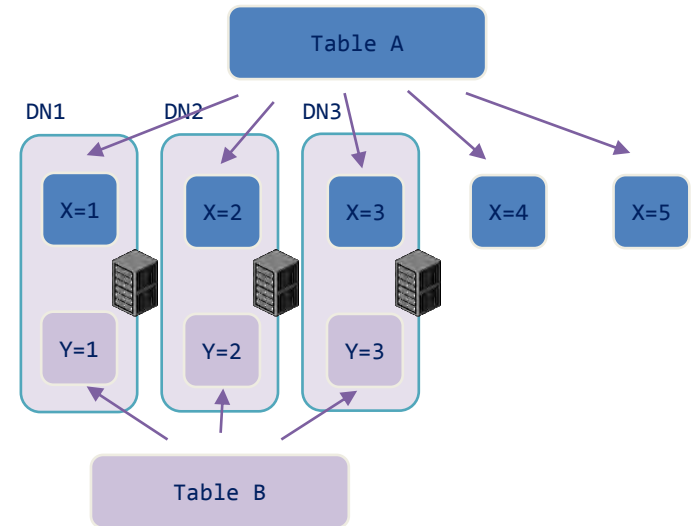


# 数据分布方式(Data Distribution)

- Data can be distributed based on a column or a composite of columns
- Tables distributed similarly are **co-located**
- Distribution scheme modifiable thru alter table

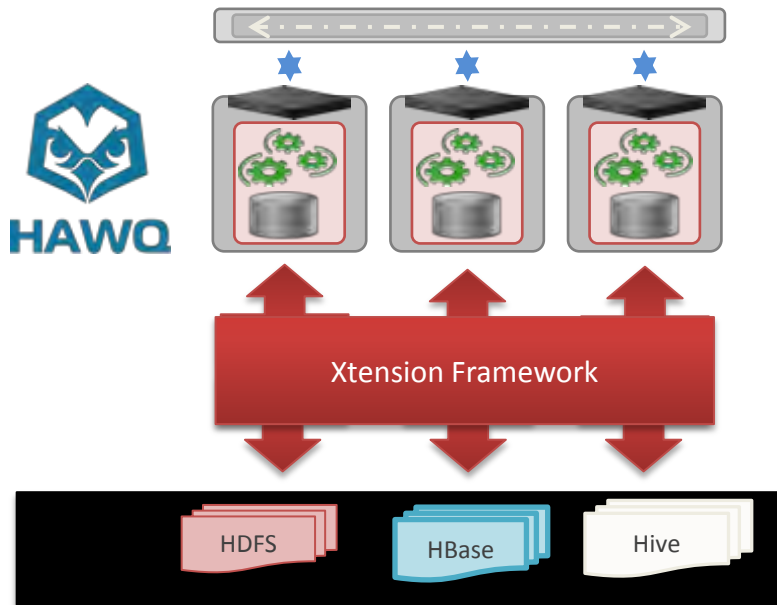
## Advantages:

- Co-located joins
- No data movement on joins or aggregates
- Improved performance on complex queries
- Query engine optimization



```
SELECT X FROM A,B WHERE A.X = B.Y  
SELECT SUM(X) FROM A GROUP BY A.X
```

# 数据互联框架(Xtension Framework)



- An advanced version of Greenplum DB external tables
- Enables combining HAWQ data and Hadoop data in single query
- Supports connectors for HDFS, Hbase and Hive
- Provides extensible framework API to enable custom connector development for other data sources

# 数据导入导出(Loading/Unloading Data)

gpload, gpfdist, External Tables 

Flat Files, CSV, Delimited, ...

Existing RDBMS Systems 

Web Tables, JSON, XML, HTML, ...

Executing Scripts, ... 

**DataLoader** 

File Farms 

Streaming || Batch Mode 

Flume, ... integration

Throttling, Compression, ... features

PXF {Native Hadoop Files} 

HDFS Flat Files, CSV, Delimited, 

Hive

HBase {w. predicate push-down} 

Avro, RCFile, SeqFile

Open extendable API 

Available on Github: Accumulo, JSON,...

Spring XD   


Java Development Framework

**Traditional Tools** 

Postgres insert, copy, ...

ODBC + JDBC drivers 

Pivotal Data Dispatch {PDD}

Integration with ETL tools...

HAWQ 里数据导入导出仍是全并行

# HAWQ External Tables



gpload, gpfdist, External Tables

Flat Files, CSV, Delimited, ...

Existing RDBMS Systems




Web Tables, JSON, XML, HTML, ...


Executing Scripts, ...




# HAWQ and Hadoop Native File Formats




**PXF {Pivotal eXtension Framework}**

HDFS Flat Files, CSV, Delimited, ... 

Hive

HBase {predicate push-down} 

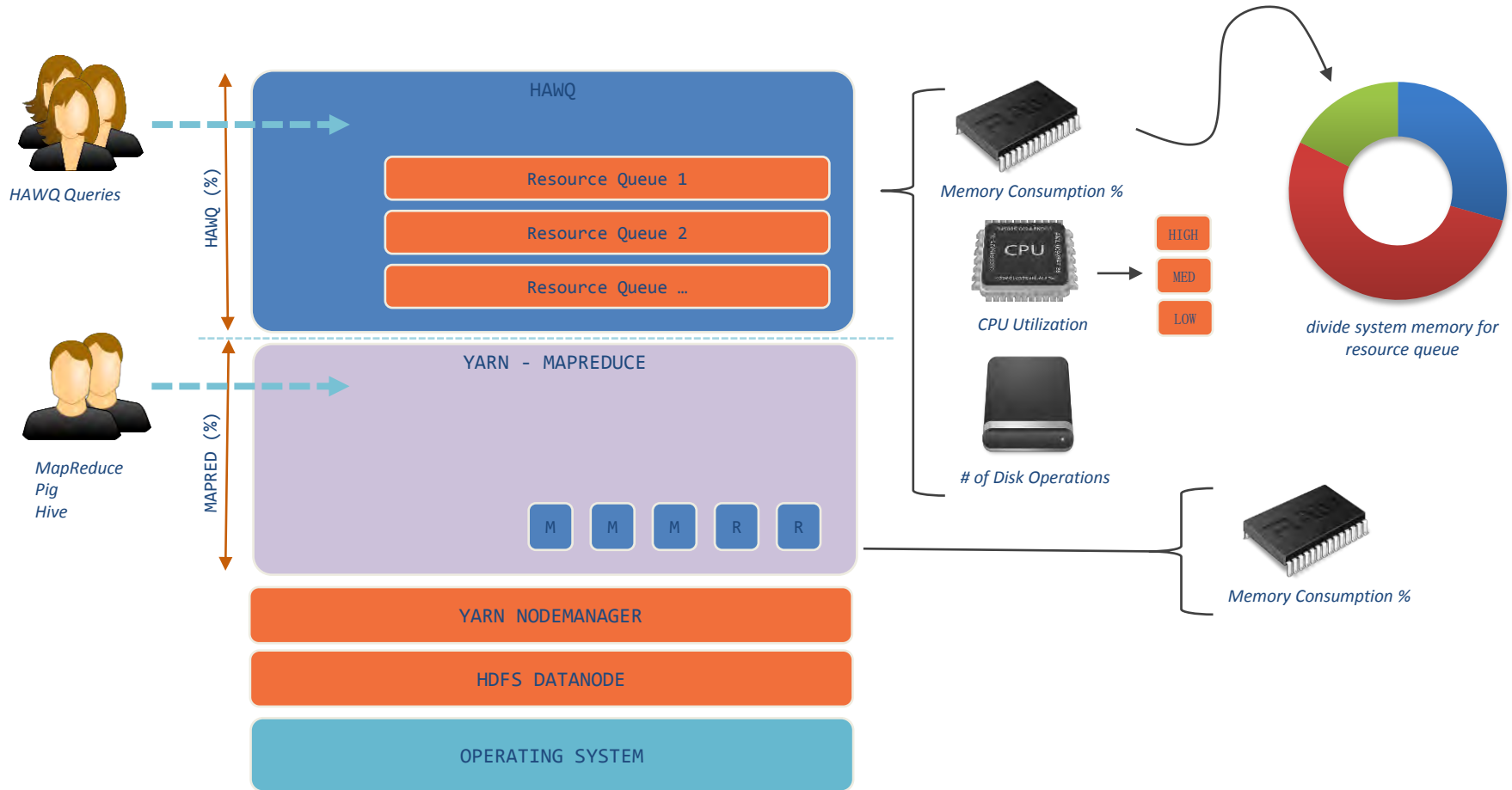
Avro, RCFile, SeqFile

Open extendable API 

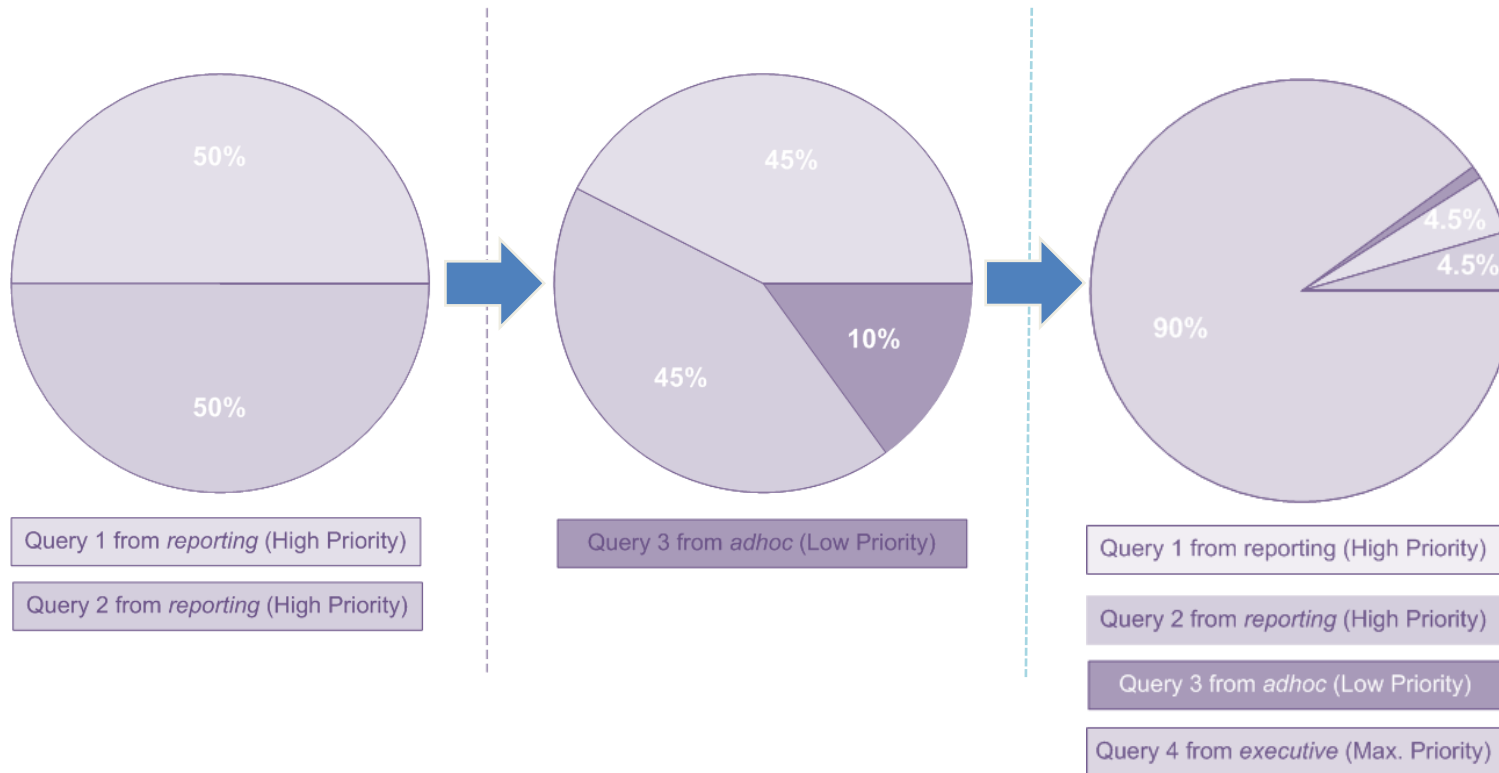
Available on Github: Accumulo, JSON,...

**Read/Write**

# 更强大的资源管理器,兼容YARN



# 运行时资源可控 (Dynamic Resources Allocation)



# SQL for Hadoop功能对比

Feature	Hive	Impala	HAWQ
Work with HDFS native file formats	✓	✓	✓
Polymorphic Storage	✓	✓	✓
Advance SQL (ANSI SQL2008 & OLAP support)	✗	✗	✓
Partitions and compression	✓	✓	✓
Data Locality	✓	✓	✓
Distributions, Join, Aggregate Locality	✗	✗	✓
Join Optimization	✗	✗	✓
Spill to disk (query must fit in memory)	✓	✗	✓
Fault tolerance during large query execution	✓	✗	✗
Granular Security and authentication	✗	✓	✓
Extendable (Serdes)	✓	✗	✓
Resource Management	✗	✗	✓
Open-source code	✓	✓	✓



# HAWQ 性能对比-1



User intelligence	4.2	37	9X
Sales analysis	8.7	596	69X
Click analysis	2.0	50	25X
Data exploration	2.7	55	20X
BI drill down	2.8	59	21X

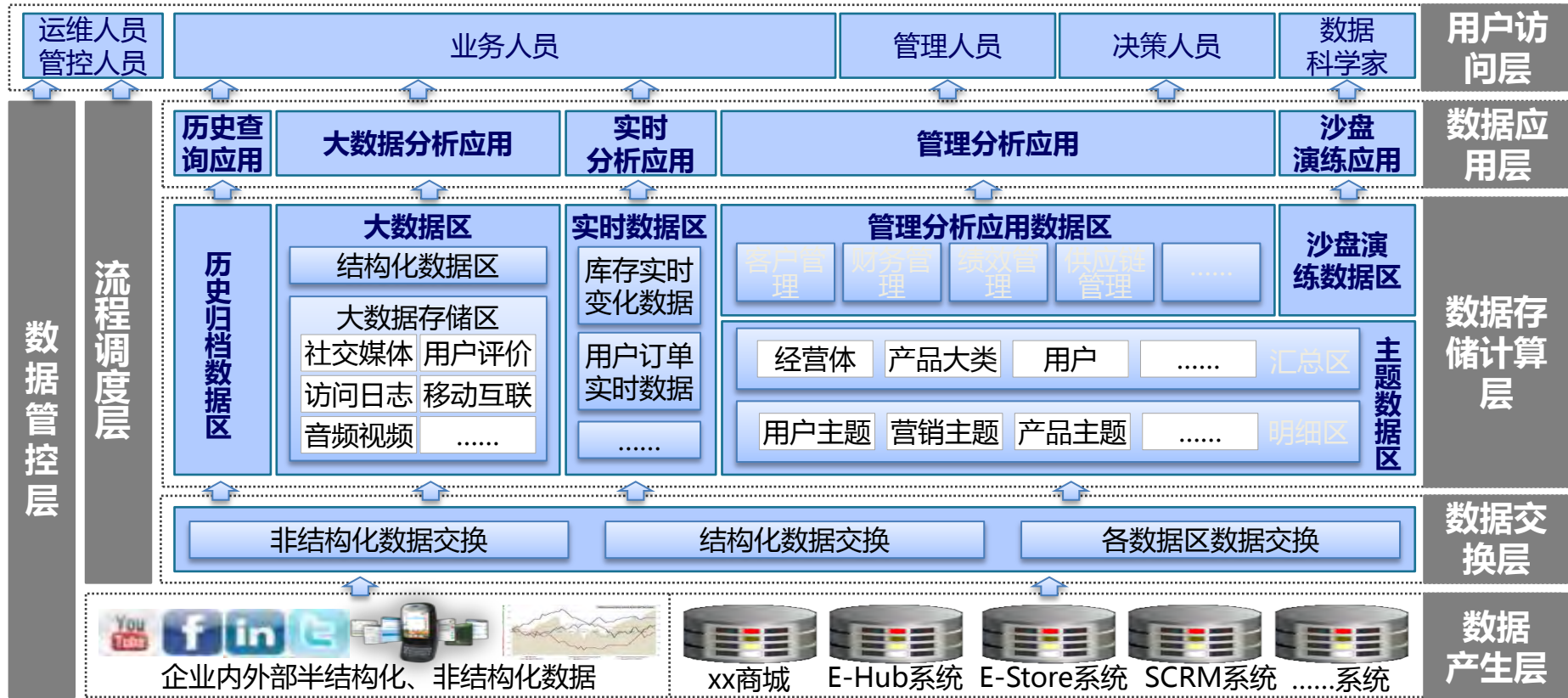
# HAW性能对比-2



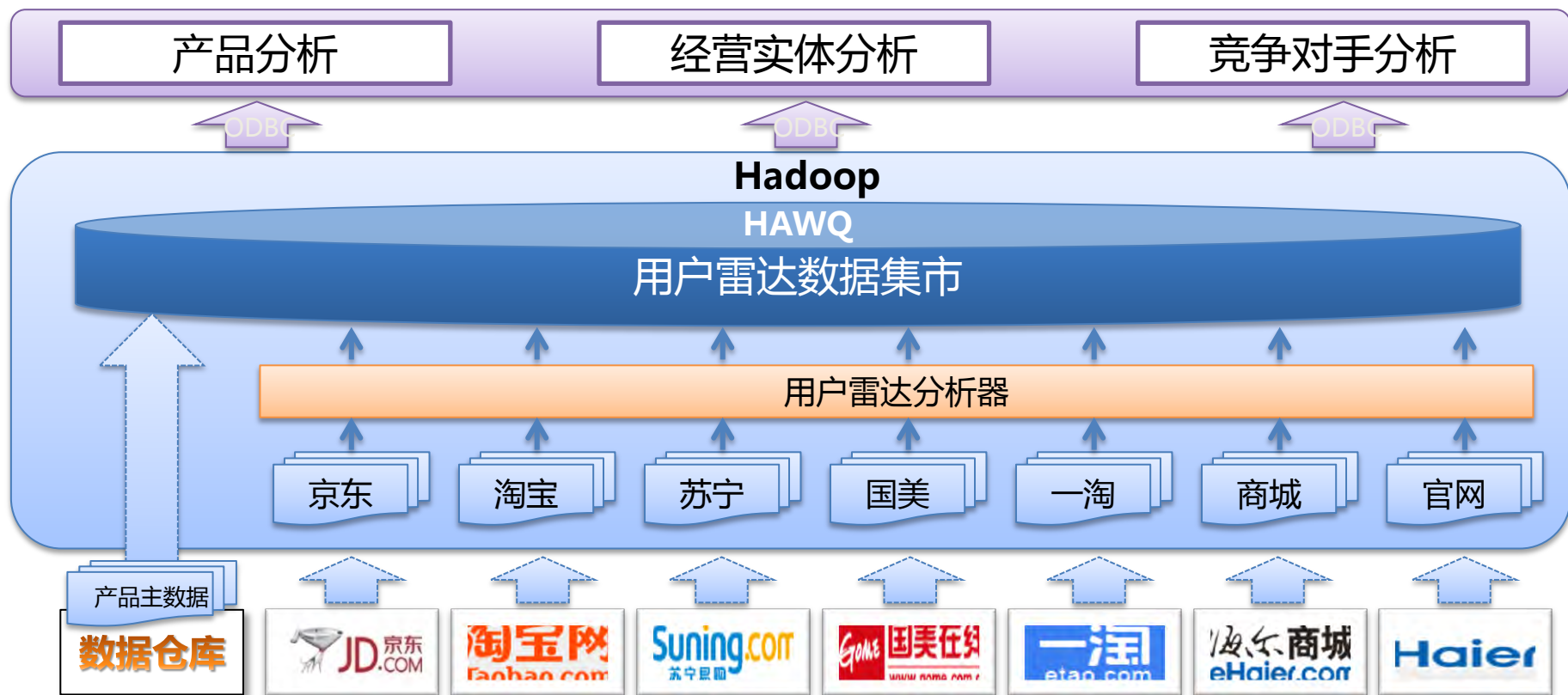
User intelligence	4.2	198	47X
Sales analysis	8.7	161	19X
Click analysis	2.0	415	208X
Data exploration	2.7	1,285	476X
BI drill down	2.8	1,815	648X

# 部分应用案例

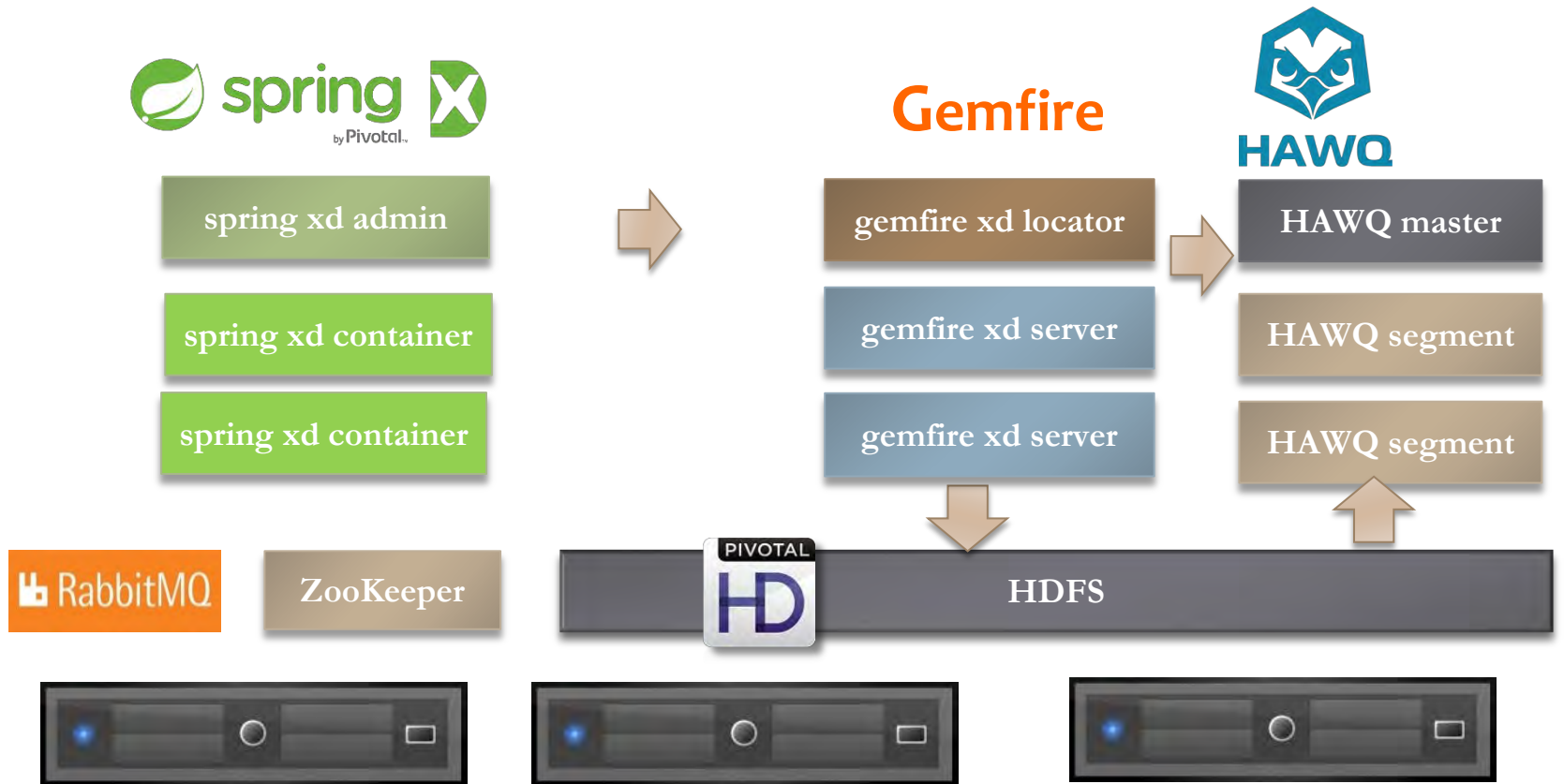
# 某企业解决方案



# 大数据分析应用：用户雷达



# 方案架构图





THANKS