Costing: Non Traditional Data Stores versus Traditional DBMS Technologies

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Abstract

Storage in large scale data centers is changing dramatically. The move from high cost enterprise class storage systems, to storage nodes that are part application, part storage and part service is pervasive. These nodes make up new technology plays, like hadoop, hbase, mongodb, and cloud storage. This paper talks about real world use cases for building out these environments, the business drivers, the successes and failures. It provides details on the cost models, the changes of the paradigm and when and why this new paradigm should be used.

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High-level Agenda

- Purpose and Background for the conversation
- Proposed Hadoop implementation
- Cost Models for Hadoop versus DBMS
- Caveats and Other Options
- Other NoSQL solutions
  - MongoDB
  - Cassandra
  - MySQL Clustering – Not NoSQL but follows the same cost model
- Other Considerations
- Summary

Purpose of the Presentation

- The purpose of this presentation is to illustrate in detail one of the main drivers of the migration to NoSQL from traditional Data Bases. This driver is cost.
- Hadoop will be used as the illustrating example, but the cost model will hold true for similar technologies.

Disclaimers

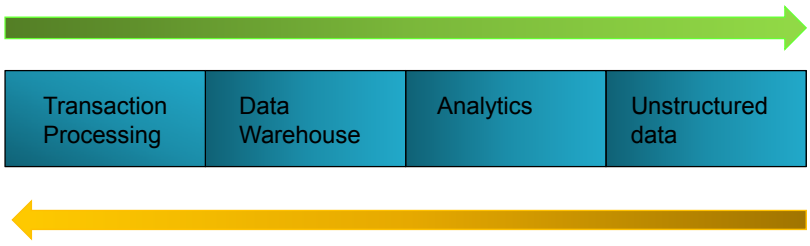
- Hadoop does not equal Oracle, it is not an Apples to Apples comparison. This comparison is accurate when comparing the use of these technologies for analytics, or data warehousing.
- Some would not consider Hadoop NoSQL – but it does have the same general cost model, and architecture
- There will be distinct changes required to the applications, monitoring and processes
- All of the numbers in this presentation are ball park figures. They are based on volume discounts and estimates. Other organizations numbers will be different
- This is not a recommendation for a specific product or technology
- Cost does not equal value. This presentation provides cost ball park numbers, however the true value would be dependant on the use case

The purpose of this presentation is to provide a viewpoint into the cost benefit of going to a NoSQL technology versus the traditional DBMS implementation

Mapping of Data in and Enterprise

Types of Data Stores in the enterprise

Traditional DBMS – Sweet spot in Transaction Processing



Non Traditional Data Stores and NoSQL – Sweet spot Unstructured Data and Analytics

Hadoop and other NoSQL solutions

First, let's discuss the energy and excitement about hadoop and other NoSQL solutions.

- Amazon is offering Hadoop as a PaaS..
  - http://www.eweek.com/c/a/Cloud-Computing/Amazon-Uses-Hadoop-for-New-Cloud-Computing-Initiative-330764/
- Here is a list of some of the companies and their cluster sizes
  - http://wiki.apache.org/hadoop/PoweredBy
- Cloudera the remora of hadoop
  - http://www.cloudera.com/

It isn't just Hadoop, other similar technologies like, MongoDB, Cassandra, BigTable etc are seeing large amounts of interest and adoption.

Why?

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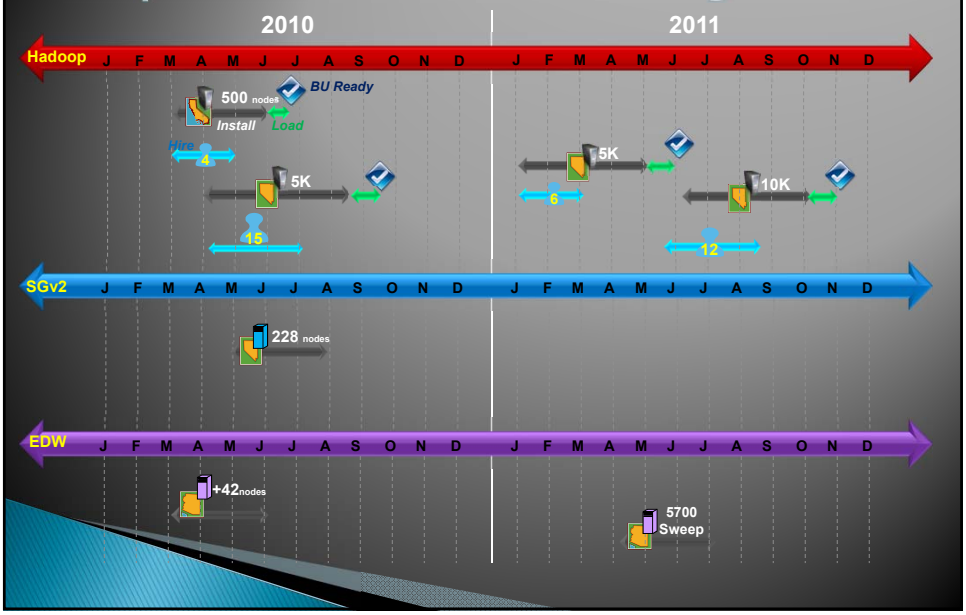
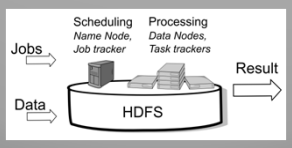
Proposed – Not executed against



Total Environment would be:

- 20,000 Systems for Hadoop
- 480 PB of raw disk space
- 360 PB of usable disk space
- 120 PB of unique data – if the replication is set to 3 copies
- 1,440,000 GB of on board memory
- 480,000 CPU's "cores X 2"
- 20,000 Gb of network bandwidth



This describes four 5K node clusters. These clusters are made up of:

- Data Nodes – The data repositories and where the work is done
- Name Nodes – The global name space – that has the pointers to the data
- Job Trackers – The managers for the jobs using the clusters

The work can be distributed across all four clusters. By default there are three replicated copies of the data. All three copies can be used by the different jobs

NoSQL Cluster Building Blocks

All of the nodes have a consistent hardware configuration, regardless of the role – This is an example, all of the major hardware manufactures have similar configurations and pricing.

- HP SE1170 - Model of system
- 11 4u chassis per rack x 16 racks, 704 nodes
- 2 x L5640 Westmere six core 2.26GHz CPU
- 72 GB Memory (6x4GB, 6x8GB)
- 12 x 2TB LFF HDD SATA
- 1 x 500GB SFF HDD (OS)
- 1 X 1Gb NIC

Total cost is ~ $7800 per system currently

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Cost Break Down for Hadoop Nodes – $7800 per Node

There are a number of ways to break out the costs. These are all based on CapEx Numbers. OpEx estimates will be included later in the presentation

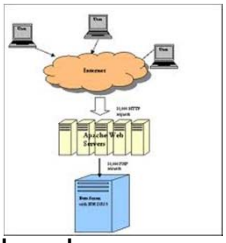
- Raw storage cost, including the system is: $325 per TB
- Usable write storage cost is: $1300 per TB
- Usable read storage cost is: $433.33 per TB
- Subtracting the cost of the system, the raw storage cost is: $112.50 per TB

This is based on the following:

- Each node has 24 TB of raw storage
- Each node has 6 TB of unique write storage, counting the overhead and the three copies
- Each node has 18 TB of data that can be used for reads
- The subtracting the system cost was calculated by taking the cost of a HPDL 360 "$5568" from the $7800 for the hadoop node. This is based on a large customer and a good discount.

Traditional DBMS Configuration

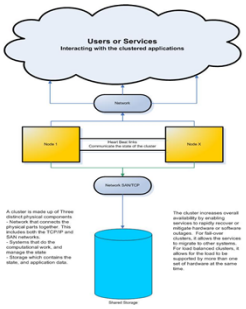
- Includes Oracle, DB2, MySQL, SQLServer, etc.
- One larger system
- SAN attached storage
- Clustered
- Consistent data state
- 1 to 20TB of storage
- Distinct data set
- Disaster Recovery implemented
- Replicated, Backed up, Closely managed and monitored



This is the primary repository for state and information within an online entity.

However the areas of growth are Analytics, Data Ware-housing etc.

Cost Break Down for Traditional DBMS Data Base



What is being used for comparison purposes is:

- SUN T4240
- 2x8 core
- 96 GB of memory
- OS Disks

For costing purposes, The Data Base license will be added in.

- The cost per GB of storage is $8.00 or $8000 per TB
- Base System Cost is: $36,382
- Fully loaded system cost is: $276,382
- Total cost of storage for 24 TB is: $192,000
- Total cost of storage for 16 TB is: $128,000
- Total cost of storage for 6 TB is: $48,000
- Total cost of storage "16TB" + System = $131,682
- Total cost of storage "16TB" + System + Data Base = $404,382

Note: Normally a DBMS data base is clustered. Clustering is not included in this estimate

The comparison that we can make is the final line above to the cost per gig for usable read storage in hadoop

$404,382 / 16TB = ~$25,274 per TB DBMS vs $433 per TB Hadoop

Note: This is taken directly from Oracle license price sheet with a 60% discount "March 2011"

CapEx and OpEx

Incremental Expense	2010 OpEx	2010 CapEx	2011 OpEx	2011 CapEx	2012 OpEx	2012 CapEx
Hadoop	$20.1 M	$50.9 M	$83.3 M	$144.6 M	$134.8 M	$0.0 M
Total	**$20.1 M**	**$50.9 M**	**$83.3M**	**$144.6 M**	**$134.8 M**	**$0.0 M**
FTE	19		18			

Costs that need to be considered

- Sites – There will be different power, and facility costs for each site
- Data Center Costs – Power, Cooling, Racks, Cabling etc
- Labor Costs
- Total Maintenance, including support etc
- Total Depreciation

Cost Savings and Value

Executive Claim – $100 Million of extra revenue from a 500 node Hadoop cluster

Because – Better data means:

- Less Risk – tracking IPs used for questionable activities for years instead of weeks
- Better Targeting of Products – Based on larger data sets for identifying patterns
- Compliance – Easier to retain data for extended periods of time
- Money savings – Existing functionality with less cost

For the 500 node Hadoop, this costs was approximately $3,897,000

For the same 500 nodes of DBMS data bases the cost would be approximately $202,192,000 ---

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Caveats

- Hadoop shouldn't be used for OLTP
- Hadoop shouldn't be used when point in time consistency is required
- Hadoop does not have the same High Availability characteristics as OLTP data bases do.
- Hadoop doesn't have the complexity of queries that OLTP data bases do
- Hadoop will require a different application model
- NoSQL is generally speaking also OpenSource, immature and agile
- OLTP data bases don't scale to the extent that hadoop does
- OLTP data bases are difficult to integrate into the Cloud

In summary hadoop is currently best used for the offline processing requirements. This is the area with the largest growth for most online sites.

Some of the other NoSQL options are closer to DBMS data bases in functionality

Other Options

- Using Hadoop or NoSQL in the cloud.
  - Purchase Hadoop or map reduce services from Amazon
  - Build a private cloud that has local disk space for data or hadoop nodes
  - Use one of the Remora Companies to craft a strategy
- Other Use Cases
  - Application logging and monitoring – Flume
  - StaaS – Storage as a service
  - Backups – More data and online
  - OLTP – MySQL Clustering, AzureSQL etc.
  - In Memory like performance – MongoDB
  - Etc

The cost point and ease of use provide a lot of tools for existing problems.

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Other NoSQL and Non Traditional Data Store Solutions

These technologies generally have the same cost model

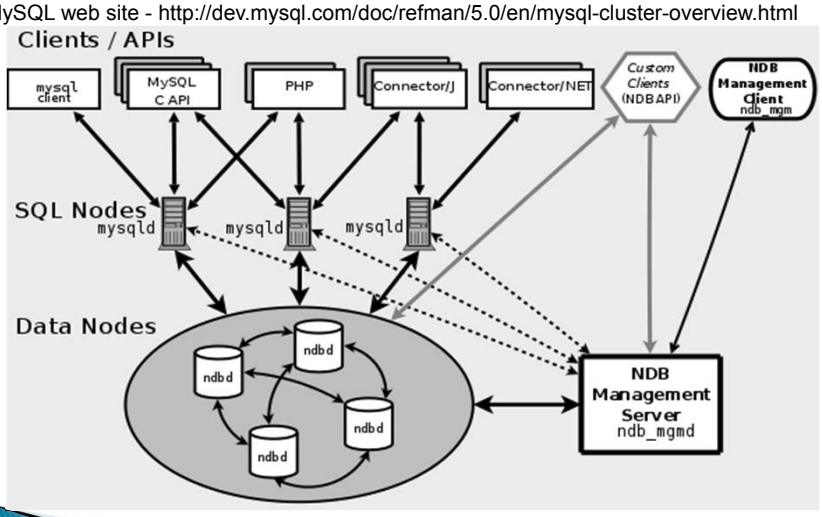
- MongoDB
- Cassandra Data Base
- BigTable
- STaaS
- Etc

What about energy?

- 20 2u enclosures in1 Rack = 480TB "3 Racks for redundancy" ~ 15Kw
- This is storage and compute.

MySQL Clustering

MySQL web site - http://dev.mysql.com/doc/refman/5.0/en/mysql-cluster-overview.html



MySQL Clustering – Attributes

- Shared nothing
- Data nodes
- Ingest nodes
- Management nodes
- Replication of data between systems
- Scales Horizontally

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Other Considerations

- Current business model – These technologies require a great desire for more agility and innovations.
- Technical Resources– Staff needs to have already embraced the open source software.
- Executive Sponsorship – Executives have to be convinced of the value.
- Cloud Focused – Works best when it is part of an overall cloud initiative.
- Willingness for outside consulting – Success is usually a result of using experienced professionals, if you are just starting, you probably don't have these individuals internally.

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Summary

- The storage costs decrease dramatically when technologies enable the use of commodity hardware
- Cloud Computing has given rise to a number of compelling technologies that use systems and storage in innovative ways
- While not replacing all functions of traditional structured storage, these technologies can be used in some of the areas that are growing the fastest

References

- Amazon – Hadoop http://www.eweek.com/c/a/Cloud-Computing/Amazon-Uses-Hadoop-for-New-Cloud-Computing-Initiative-330764/
- Hadoop Cluster Size http://wiki.apache.org/hadoop/PoweredBy
- Cloudera http://www.cloudera.com/
- Oracle Price List http://www.oracle.com/us/corporate/pricing/price-lists/index.html
- MySQL web site – http://dev.mysql.com/doc/refman/5.0/en/mysql-cluster-overview.html