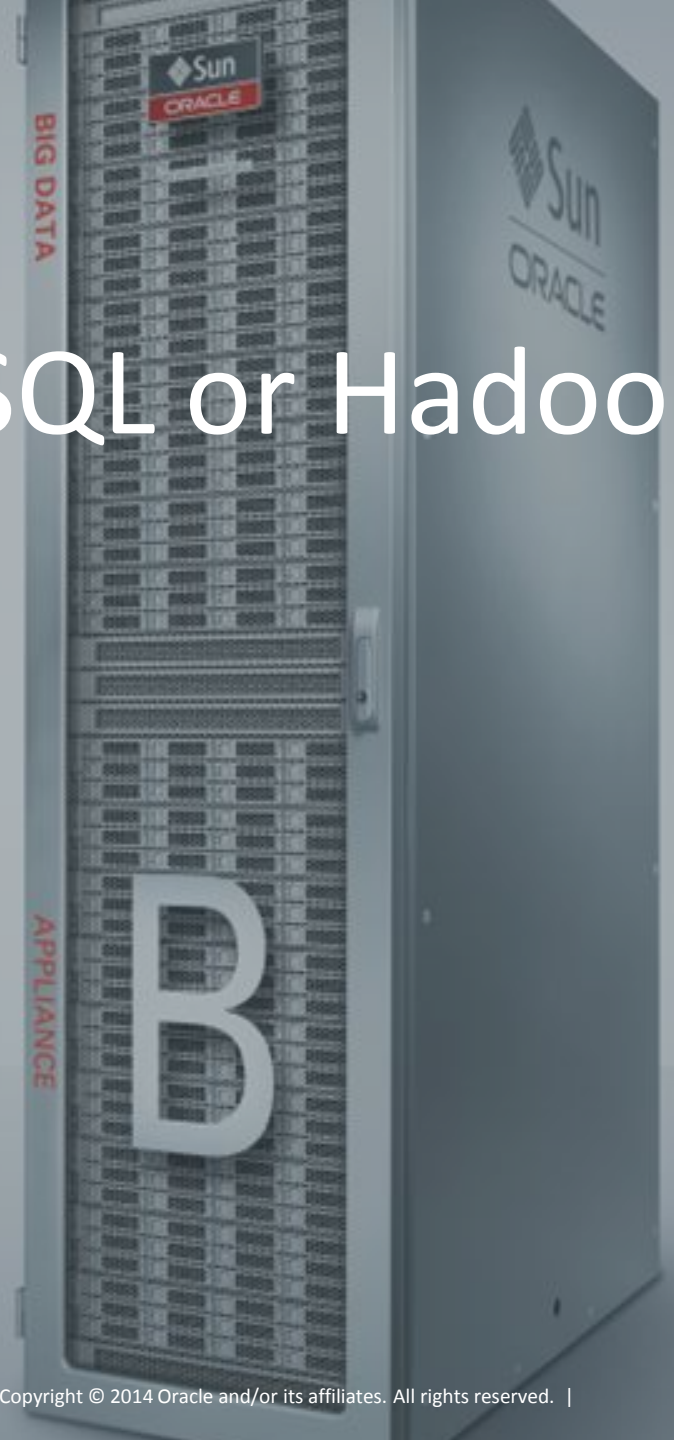
Choosing RDBMS, NoSQL or Hadoop?



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Big Data Product Management
Server Technologies

ORACLE

Agenda

Understanding the Technologies

- Ingest
- Disaster Recovery
- Accessing Data
- Performance
- Cost

Conclusion

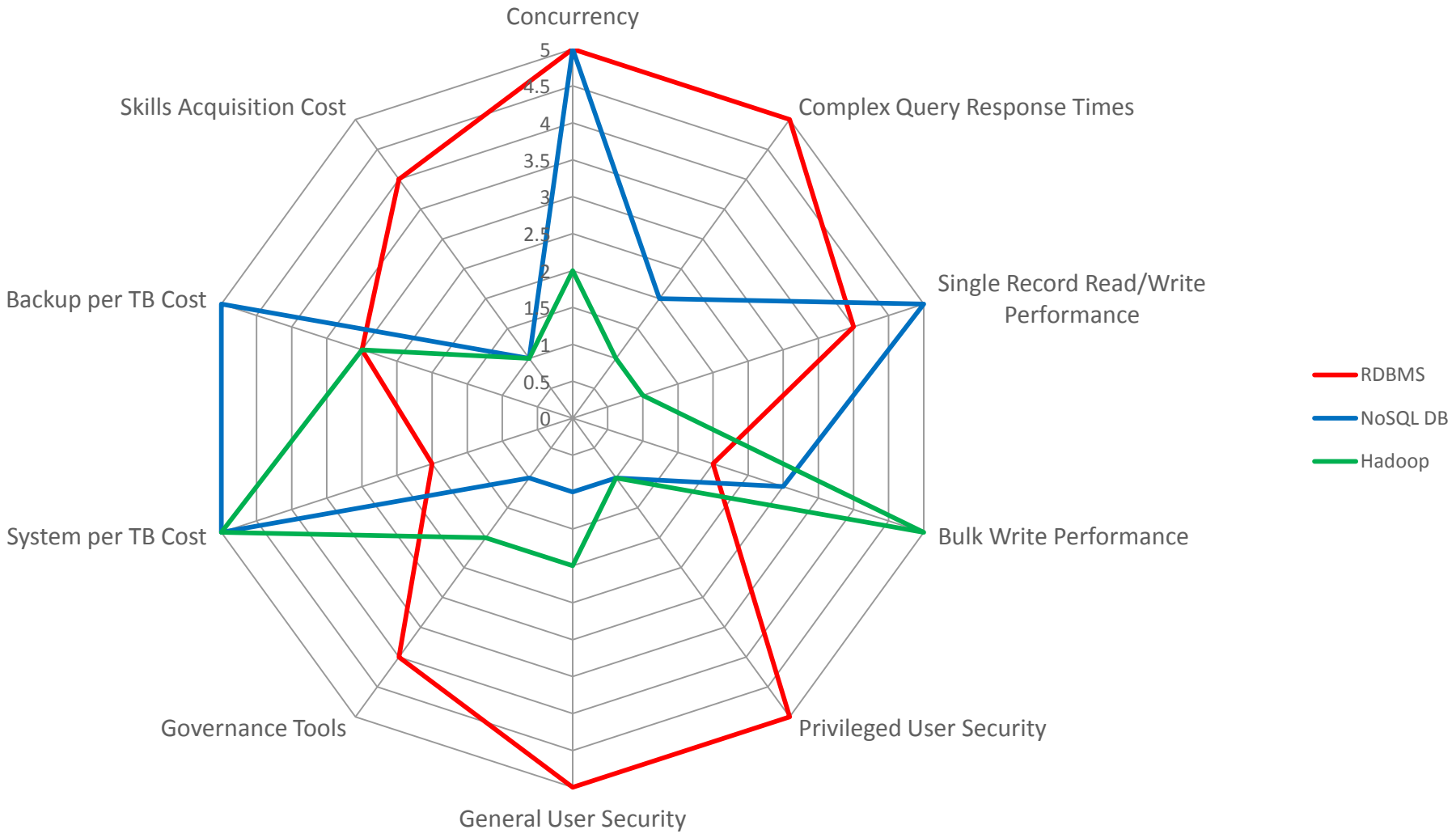
And one more thing…

A simple set of criteria

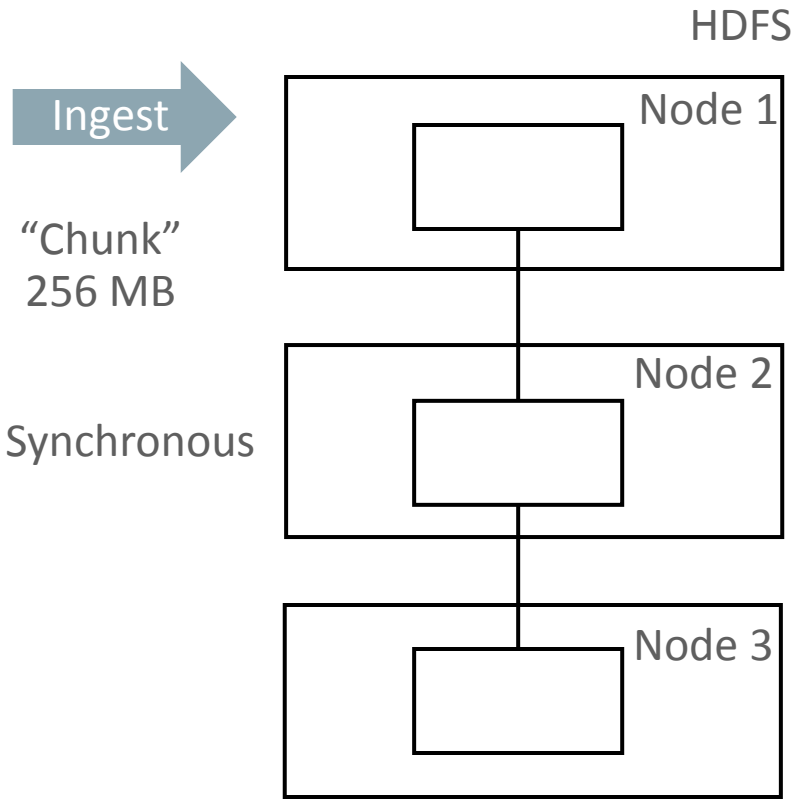
Performance

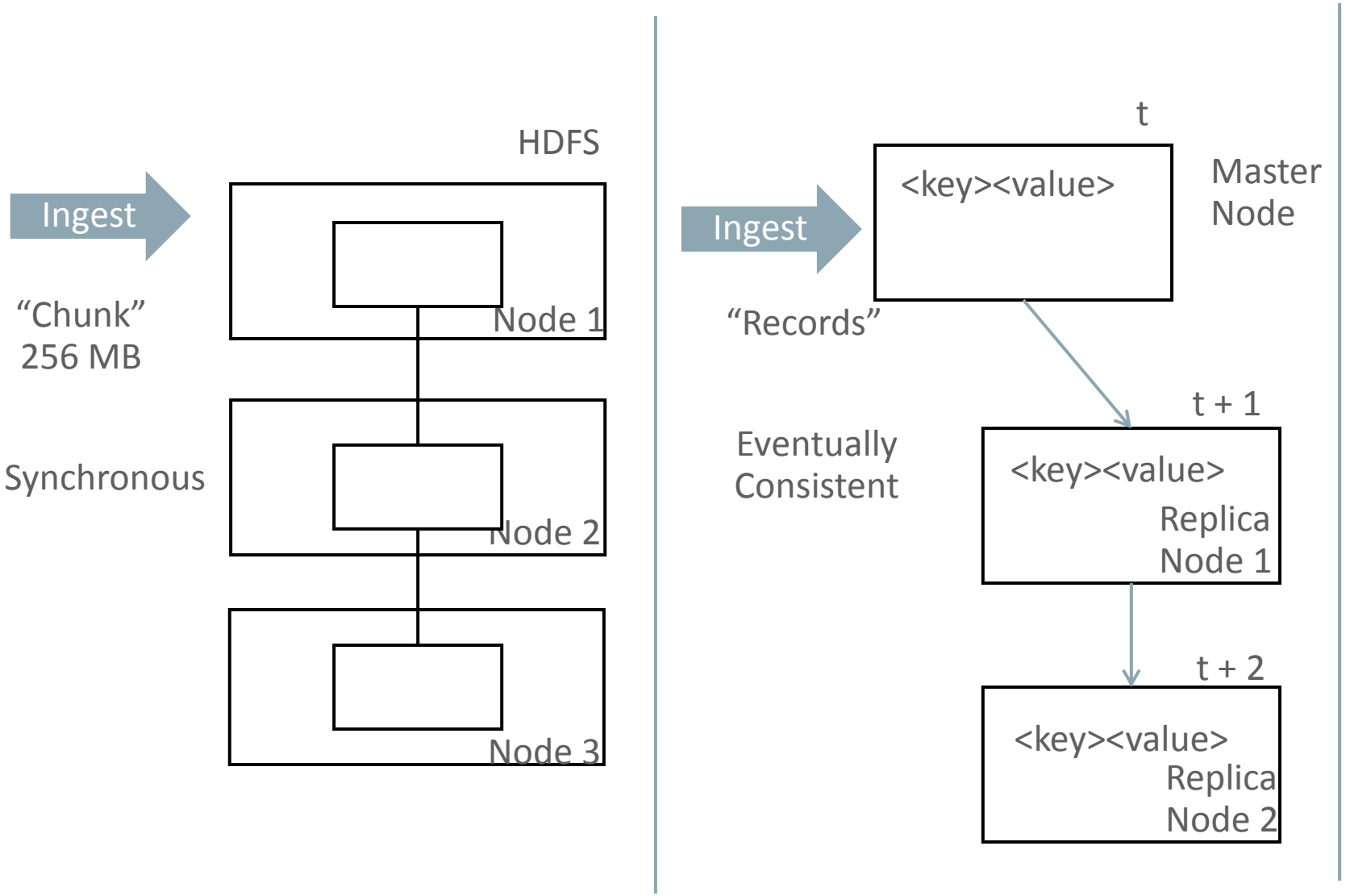
Security

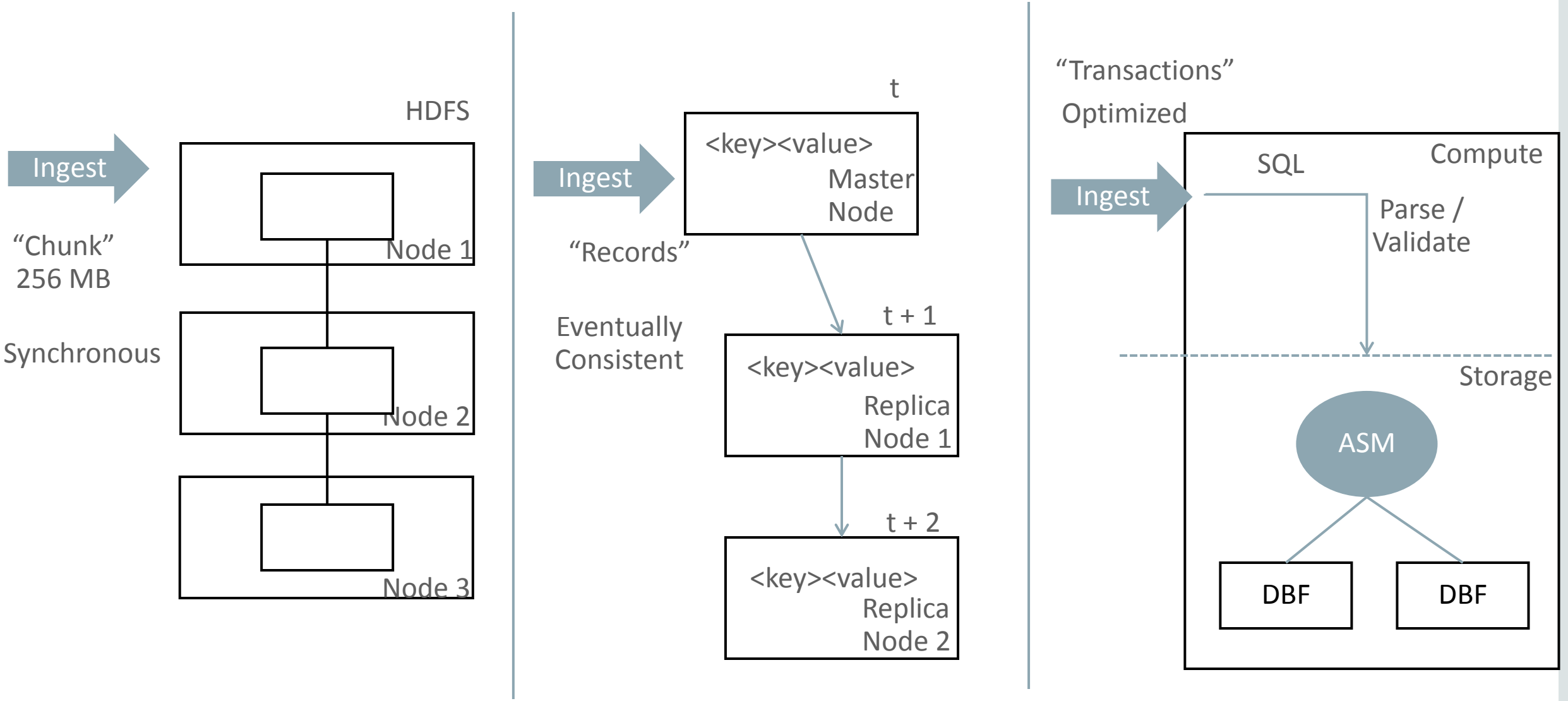
Cost



Data Ingest





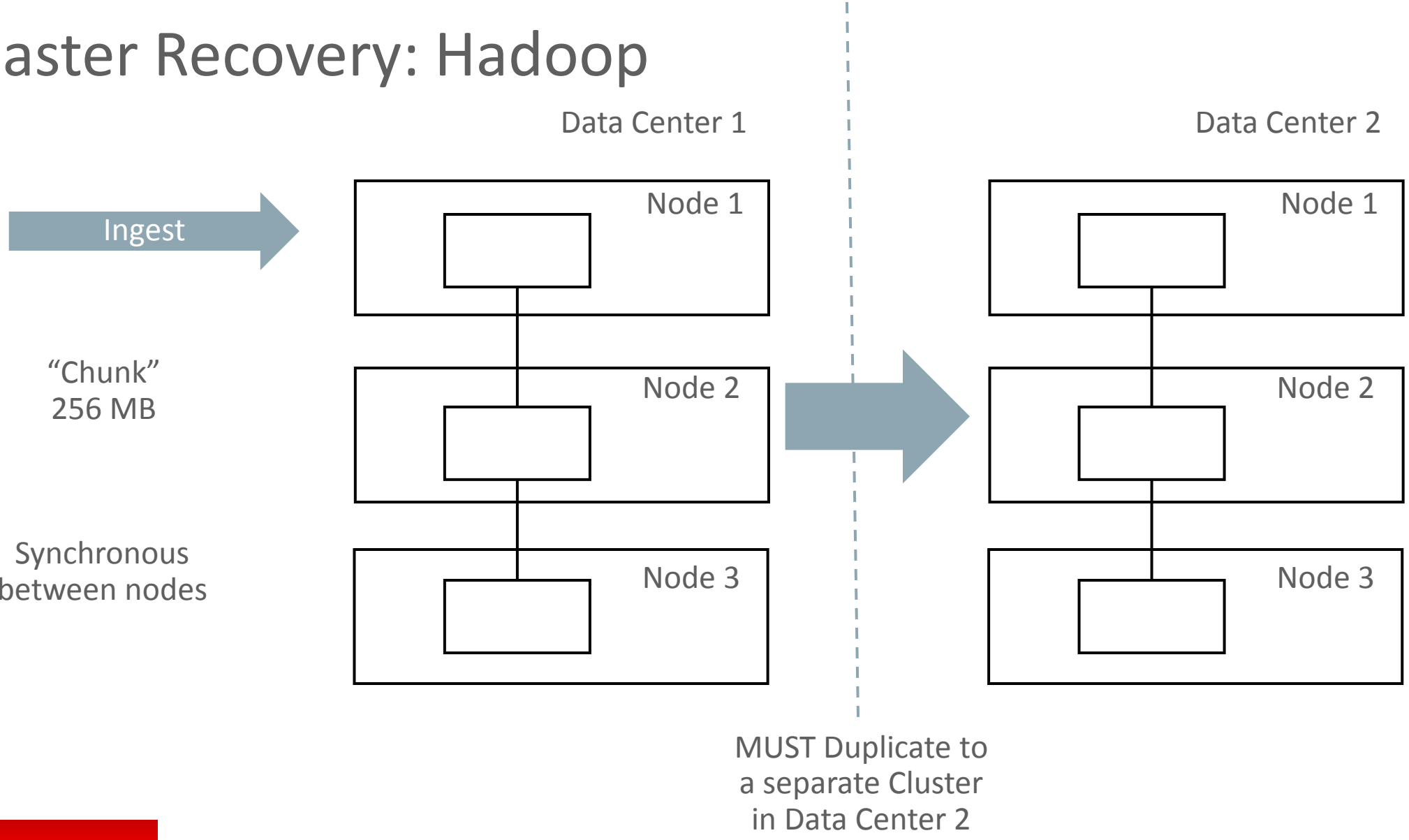


High-level Comparison

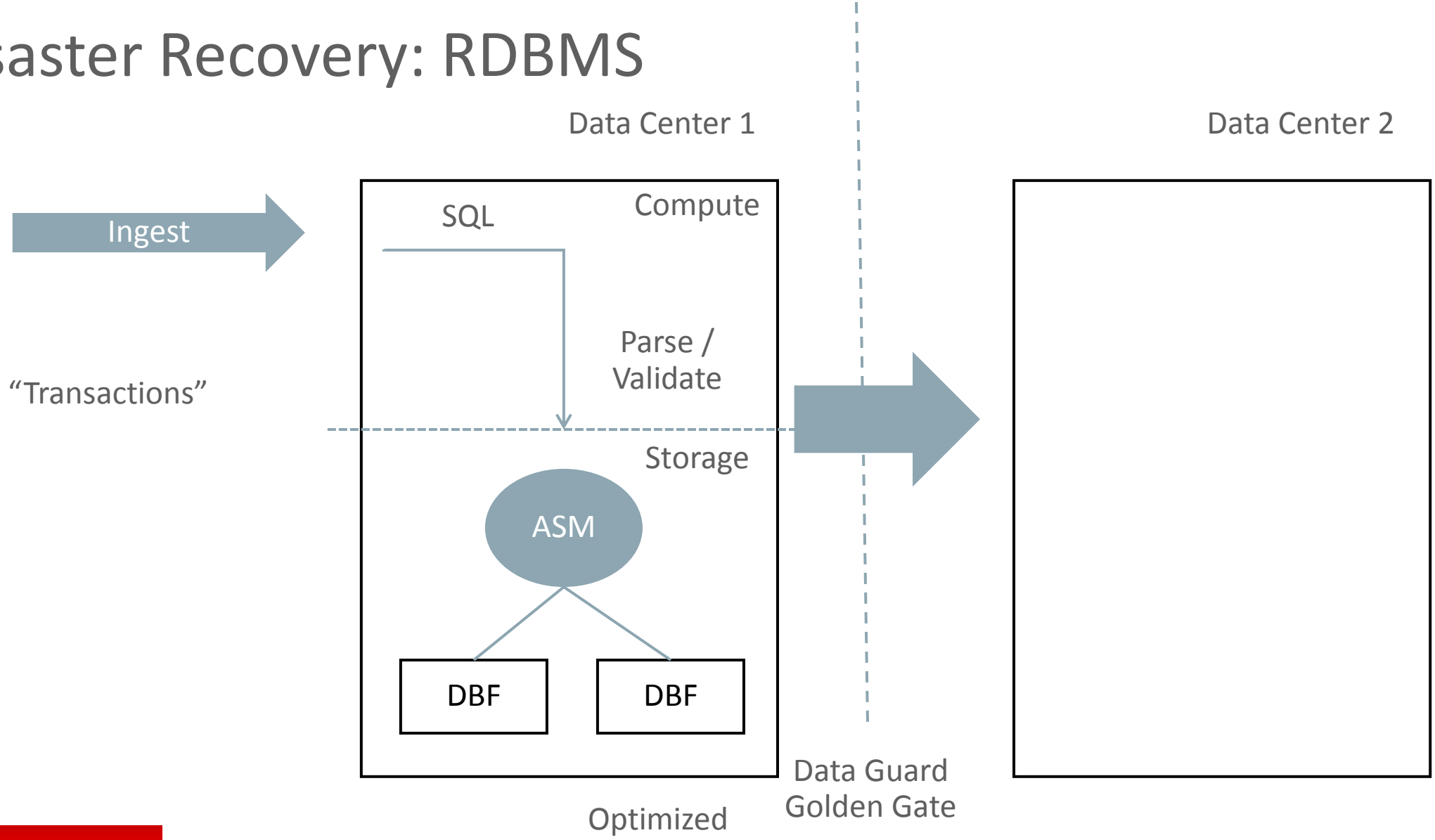
		HDFS	NoSQL	RDBMS
Ingest	Data Type	Chunk	Record	Transaction
	Write Type	Synchronous	Eventually Consistent	ACID Compliant
	Data Preparation	No Parsing	No Parsing	Parsing and Validation

Disaster Recovery - High Availability across Geography

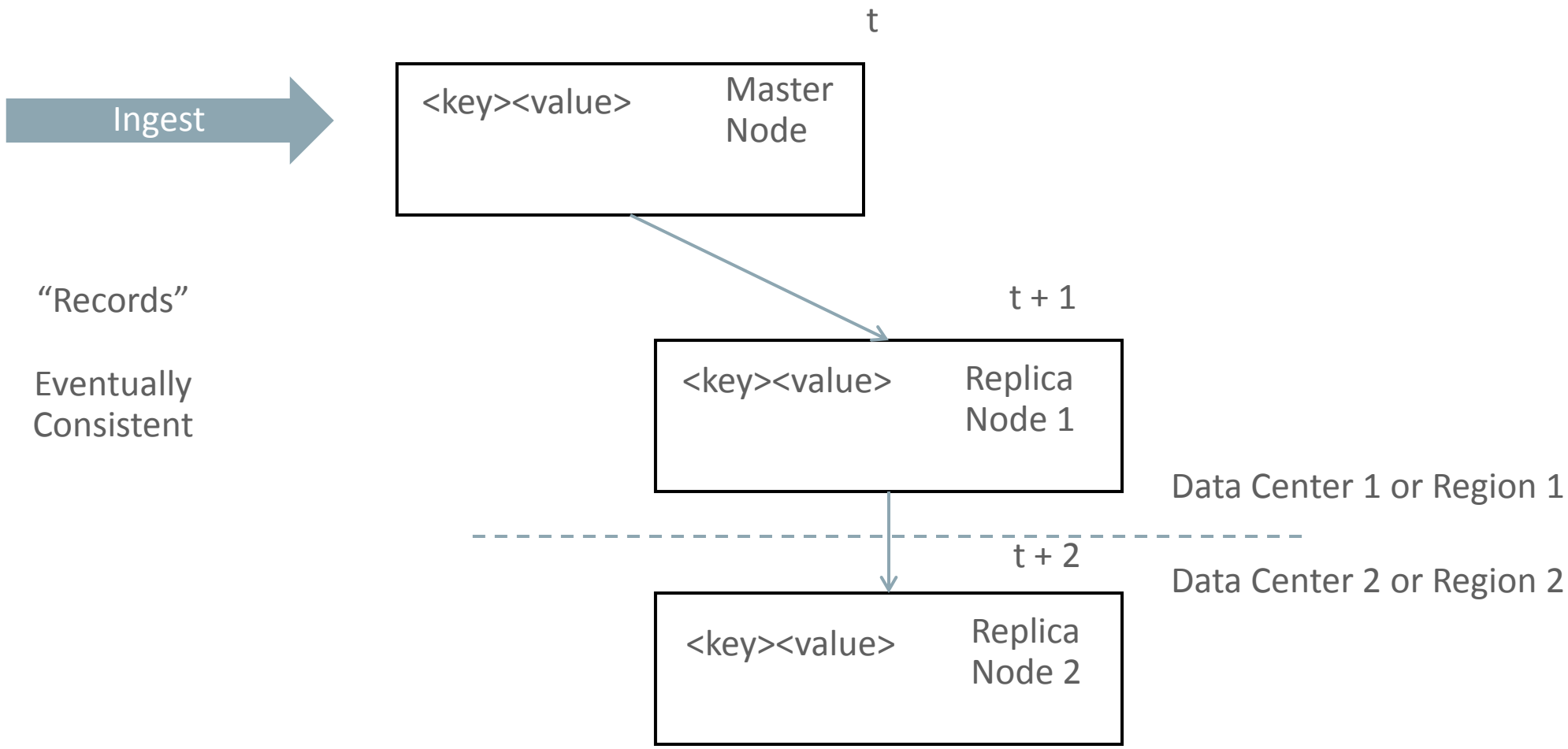
Disaster Recovery: Hadoop



Disaster Recovery: RDBMS



Disaster Recovery: NoSQL Option



Big Data Appliance includes Cloudera BDR

- Oracle packages this on BDA as a Cloudera option called BDR (Backup and Disaster Recovery)
- BDR = DistCP + Scheduled Job
  - Distributed copy method leveraging parallel compute (MapReduce like)
- BDR is NOT like Data Guard or GG
  - Because of HDFS technology, you cannot catch transactions
  - Most importantly, think of BDR as a batch process not a trickle
- Network bandwidth matters
- BDR is included (no extra charge) on BDA

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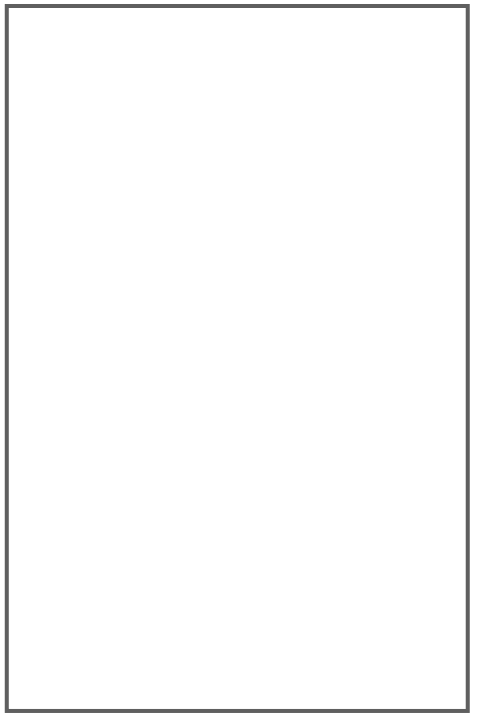
	DR Unit	File	Record	Transaction
	DR Timing	Batch	Record	Transaction

Access Paths to Data Sets

Data Sets and Analytical SQL Queries: Hadoop

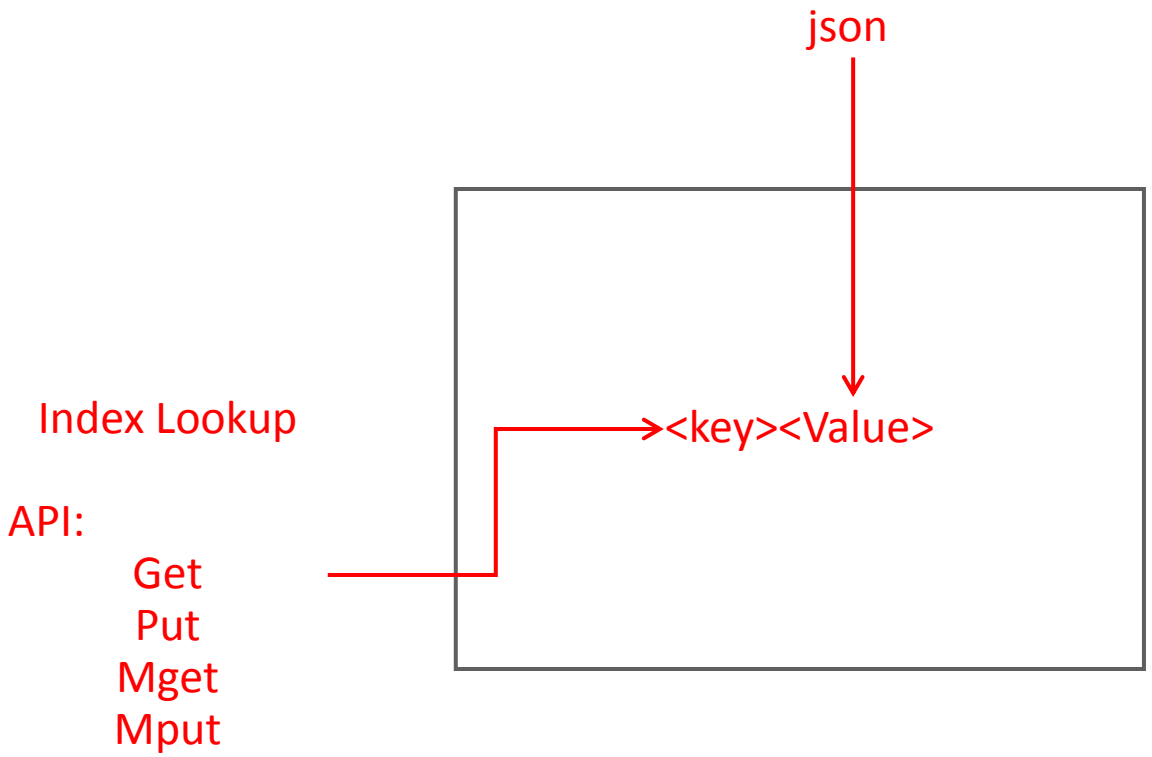


INSERT
- Data is NOT parsed on ingest, example JSON document is not parsed. Original files loaded an broken into chunks
- Does not like small files

UDPATE
- NO update allowed (append only)
  - Expensive to update a few KB by replacing a 256MB chunk (as part of a file replacement)

SELECT
- Scan ALL data even for a single "row" answer
- SQL access path is a "full table scan"
- Hive optimizes this with
  - Metadata (Partition Pruning)
  - MapReduce in Parallel to achieve scale

Data Sets and Analytical SQL Queries: NoSQL



PUT (Insert)

- Data is typically not parsed, example, JSON document is loaded as a value with a key

GET (Select)

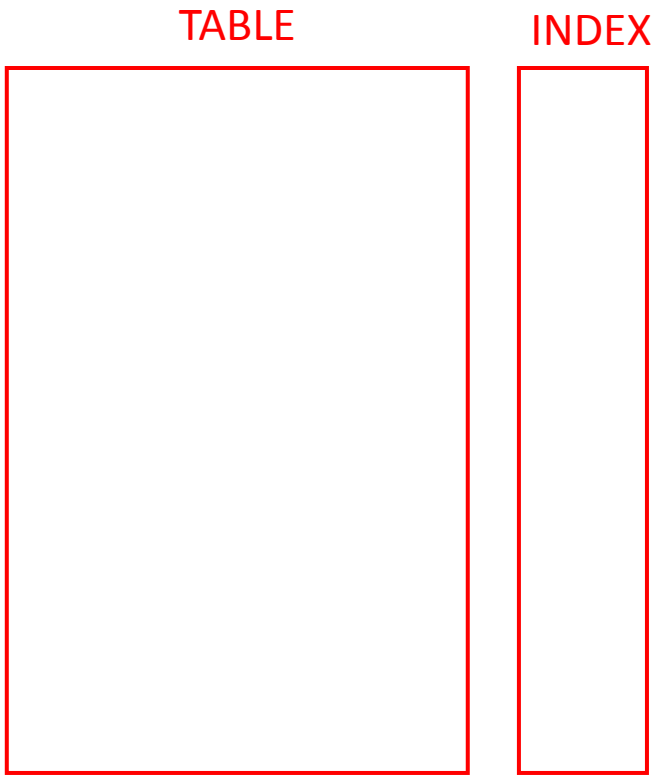
- Data Retrieval through “Index Lookup” based on KEY
  - Only access path is index (primary or secondary)
- If retrieving from Replica may not be consistent (yet)
- Generally do not issue SQL over NoSQL
- Not used for large analysis, instead used to receive and provide single records or small sets based on the same key

Data Sets and Analytical SQL Queries: RDBMS

Data is parsed

Metadata is available on write

Auxiliary structures enable myriad of access paths



INSERT
- Parse data and optimize for retrieval
- Adhere to transaction consistency

UPDATE
- Enables individual records to be updated
- With read-consistency
- Row level locking etc.

SELECT
- Read-consistent guaranteed
- SQL Optimization:
  - Choose the best access path based on the question and database statistics
  - Optimized joins, spills to disk etc.
  - Supports very complex questions

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	Query Speed	Slow	Fast for simple questions	Fast
	# of Data Access Methods	One (full table scan)	One (index lookup)	Many (Optimized)

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Affordable Scale

Low Predictable Latency

Flexible Performance

Performance Aspects

Ingest and Query

Ingest Performance Considerations

HDFS

- No parsing
- Fastest for Ingesting Large Data Sets, like log files
- Bulk write of sets of data, not individual records
- Slower write on a record-by-record basis than NoSQL

NoSQL

- No parsing
- Fastest for Writing Individual Records to the master
- Direct writes on a per-record basis
- Best for Millisecond Write

RDBMS

- RDBMS does work to data (parsing) on ingest
- Ingest speed is slower than NoSQL on a record by record basis due to parsing
- Ingest speed is slower than Hadoop on a file by file basis due to parsing
- Benefits of RDBMS parsing become evident on query performance…

Query Performance Considerations

HDFS

- Requires parsing
- Slowest on Query Time
  - Due to Full Table Scans on top of parsing
  - No query caching
- Able to run complex queries
  - Requires use of MR or Spark programs
  - SQL immature (SQL-92)

NoSQL

- No parsing
- Fastest on Query Time for "get"
- Consistently fast is the goal
- No syntax available to run complex queries

RDBMS

- Fastest SQL query times because of parsing work done on ingest
  - Completely optimized storage formats for IO
  - Oracle knows how to pick stuff out, metadata on files..
  - Least amount of I/O to retrieve records
  - Advanced Caching
- RDBMS can run more complex SQL queries than NoSQL or Hadoop

Concurrency

Concurrency Comparisons

HDFS

- Most Hadoop systems have small number of users running large number of jobs
  - Batch or very frequent micro batch calculations
- Customers report Impala struggles with concurrency (much like Netezza, or worse)
- Immature resource management, not all solutions work nicely

NoSQL

- Very high concurrency
- Geographically distributed
- Must deal with consistency issues
- Great reader farm for publishing data to for example web apps
- Load balancing built-in

RDBMS

- Hundreds of users, hundreds of queries running at the same time
- Queries are balanced over the system
- Resource Management able to control the whole system
- Proven in many large organizations

Cost

Cost

- Customers want to reduce cost by moving from RDBMS to Hadoop
  - Hadoop delivers lowest cost per TB
- But which workloads can move from RDBMS to Hadoop?
  - Dealing with transactions? Stay in RDBMS
  - Running Advanced SQL queries? Stay in RDBMS
  - Large numbers of concurrent users? Stay in RDBMS
- Will hit high performance penalty for moving DW to Hadoop because of full table scans

Can SQL on Hadoop solve the problems without sacrifice?

No…

Impala

- Solution to speed up Hive and MR
  - Wrote own optimizer and query engine
- Large speedup but at the cost of:
  - No MR so loses scalability
  - Less SQL capabilities so loses BI transparency
  - System cost increases to run Impala (needs add'l memory) so loses some cost advantage

Impala with Parquet

- Convert files into columnar data blocks (Parquet file format)
- Speed up because of columnar formats etc:
- But at a cost:
  - Must run ETL to Parquet (comparable to ingest into RDBMS)
  - Loose schema on read => flexibility
  - Double the data
- Essentially a new columnar DB on HDFS

Conclusion

Conclusion

- The fact that something is a hype and cool, does not mean it solves your business problem
- So:
  - Spend a little time looking at the fundamental design themes of a technology
  - Understand the limitations / strengths that flow from the design
  - Map to your business problems
  - Decide on the technology
  - Combines technologies to really solve your problem

One more thing…

… how to deal with the inherent fragmentation?

Relational Stores

- Relational
- Spatial
- Graph
- Document
- Real-time Analytics

Big Data Stores

- Logs
- Streaming
- Archive
- Spatial
- Web Analytics

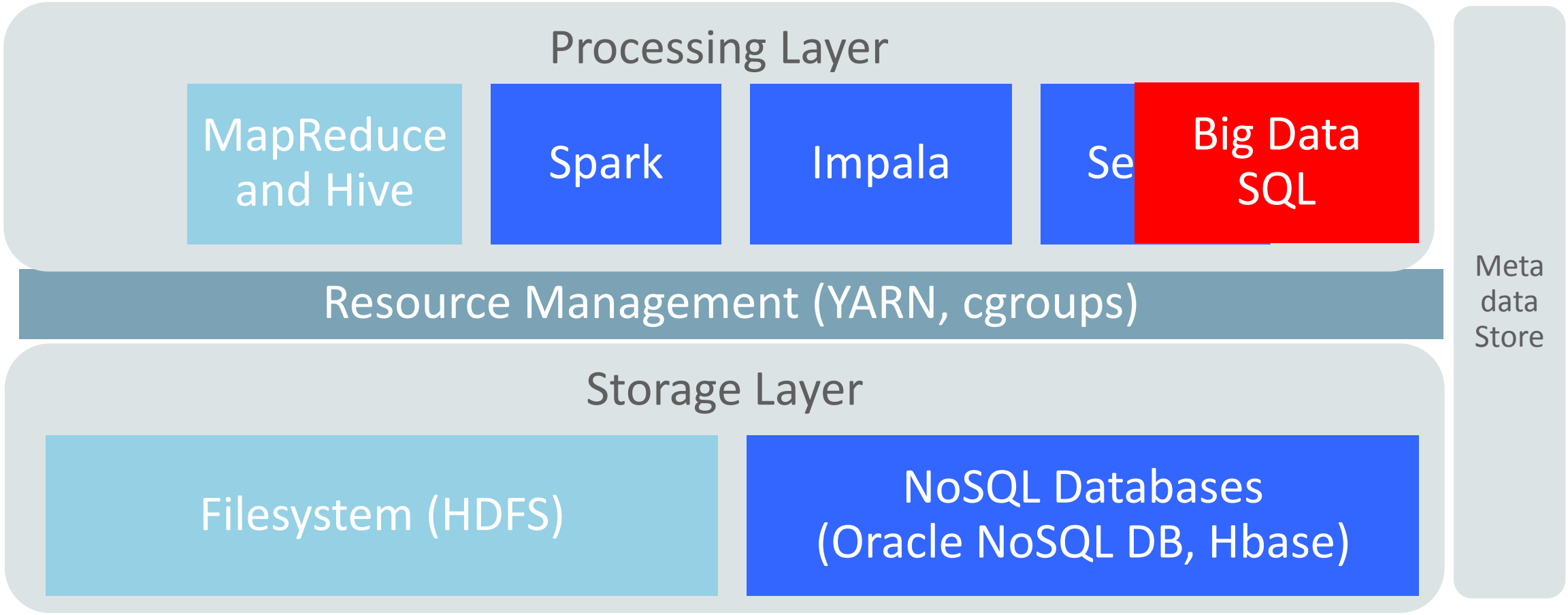
NoSQL Stores

- Key-value
- Graph
- Document

Data Virtualization

Oracle Big Data SQL

Big Data SQL: Another Hadoop Processing Engine



Metadata: Extend Oracle External Tables

```
CREATE TABLE movielog (
  click VARCHAR2(4000))
ORGANIZATION EXTERNAL (
  TYPE ORACLE_HIVE
  DEFAULT DIRECTORY DEFAULT_DIR
  ACCESS PARAMETERS
  (
com.oracle.bigdata.tablename logs
com.oracle.bigdata.cluster mycluster
  ))
REJECT LIMIT UNLIMITED;
```

- New types of external tables
  - ORACLE_HIVE (leverage hive metadata)
  - ORACLE_HDFS (specify metadata)
- Access parameters for Big Data
  - Hadoop cluster
  - Remote Hive database/table
    - DBMS_HADOOP Package for automatic import

Hardware and Software

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