P4.1 Reference Architectures for Enterprise Big Data Use Cases

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(A joint-venture between IBM Research Zurich and IBM Innovation Center DACH)

Agenda

- Motivation
- Use Cases
- How Databases scale
- Evolution of Large Scale Data Processing
- Requirements and Ingredients
- Architectural Proposal

Motivation – the World before 2000

.coms

Traditional Enterprises

MySQL, Postgres

DB2, Oracle, Teradata

Motivation – the World after 2000

.coms

Traditional Enterprises

NoSQL

DB2, Oracle, Teradata

Use Cases – Basic Idea

- Use ALL available data independently weather it is

Use Cases – Basic Idea

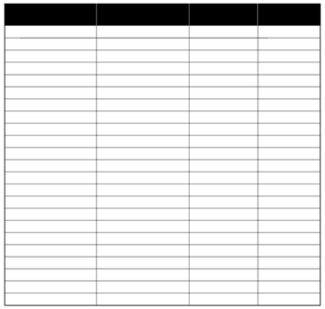
- Use ALL available data independently weather it is
  - Inside

Use Cases – Basic Idea

- Use ALL available data independently weather it is
  - Inside or outside your company

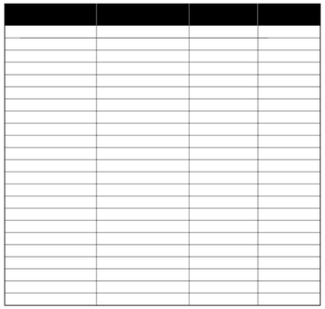
Use Cases – Basic Idea

- Use ALL available data independently weather it is
  - Inside or outside your company
  - Structured



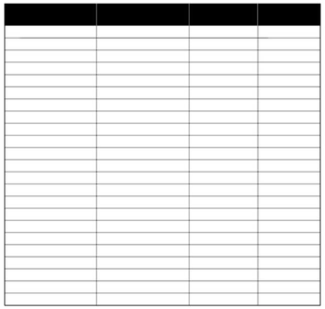
Use Cases – Basic Idea

- Use ALL available data independently weather it is
  - Inside or outside your company
  - Structured, semi-structured



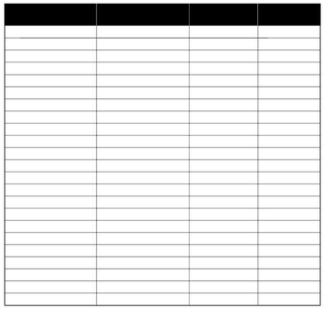
Use Cases – Basic Idea

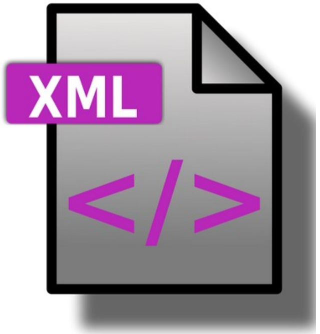
- Use ALL available data independently weather it is
  - Inside or outside your company
  - Structured, semi-structured, unstructured



Use Cases – Basic Idea

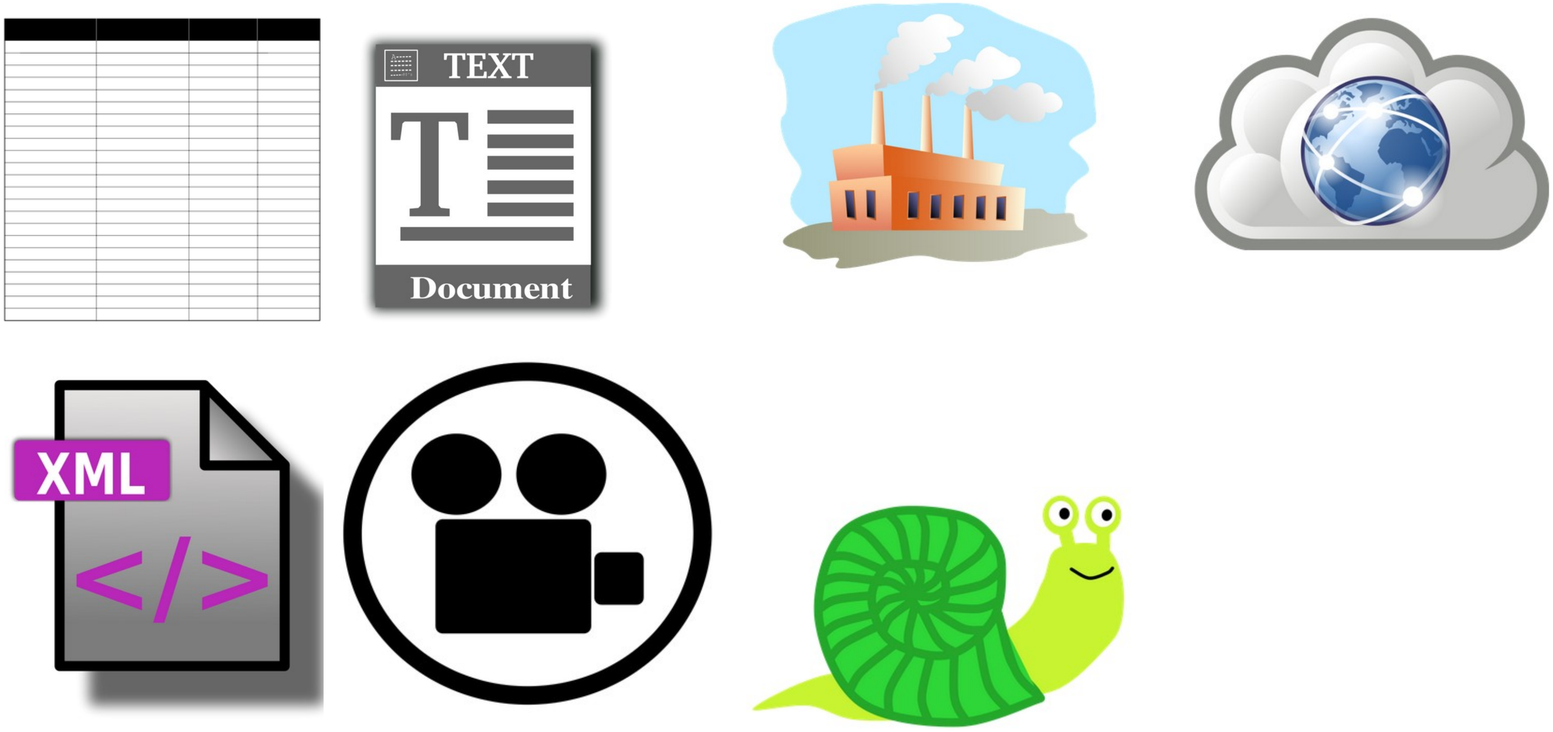
- Use ALL available data independently weather it is
  - Inside or outside your company
  - Structured, semi-structured, unstructured or binary





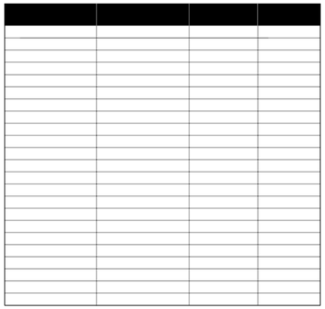
Use Cases – Basic Idea

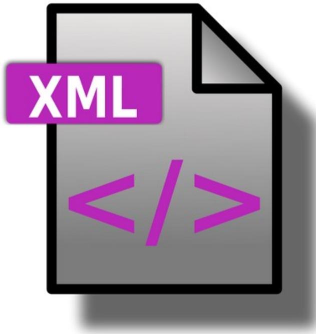
- Use ALL available data independently weather it is
  - Inside or outside your company
  - Structured, semi-structured, unstructured or binary
  - At rest

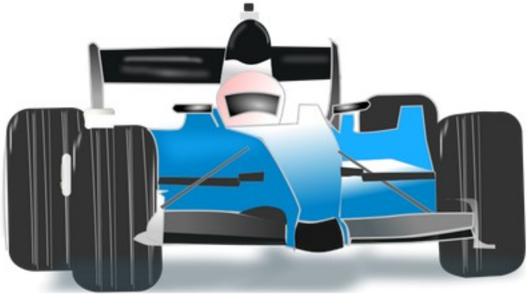


Use Cases – Basic Idea

- Use ALL available data independently weather it is
  - Inside or outside your company
  - Structured, semi-structured, unstructured or binary
  - At rest or in motion

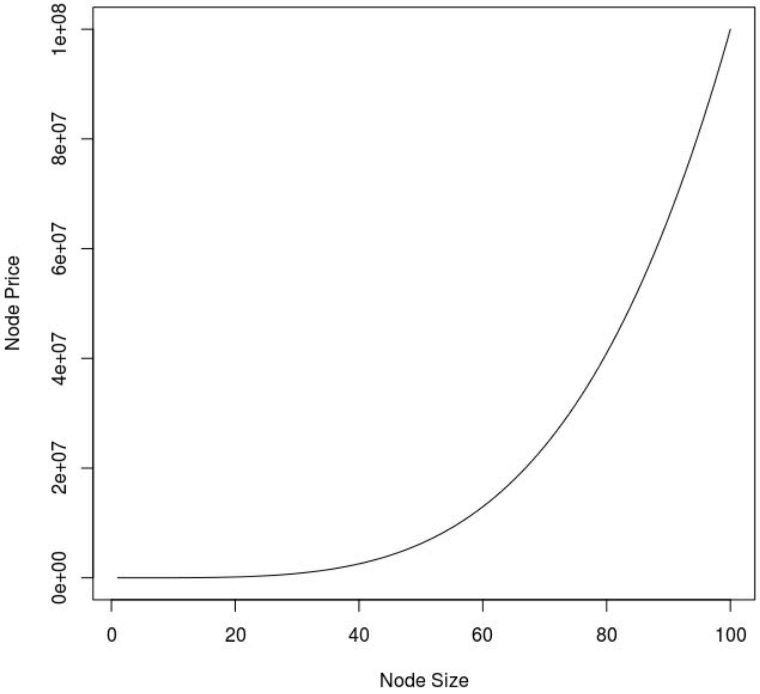






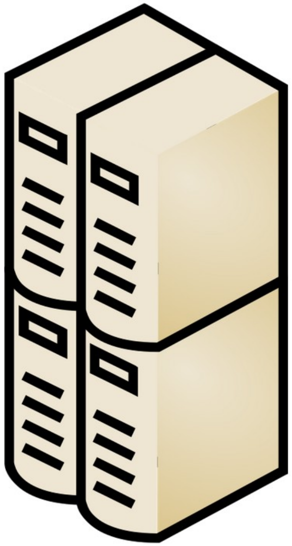
How do Databases Scale?

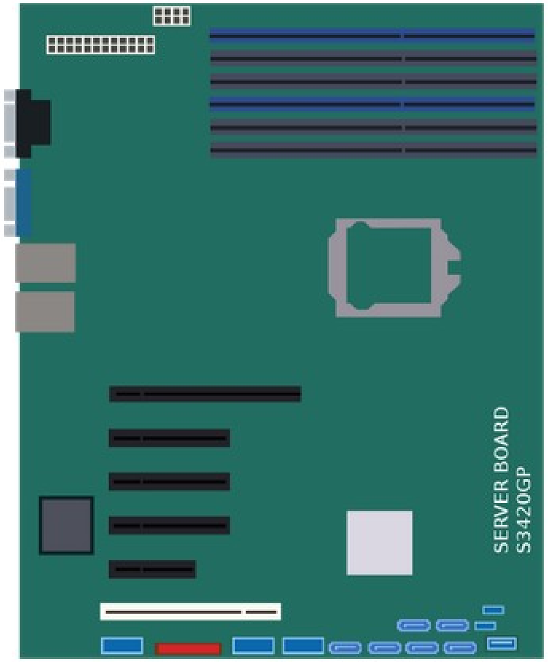
- Scale-out because Scale-up not possible
  - Why?
  - There is a sweet spot (global optimum) for the ideal node size
  - Determines the number of cluster nodes
  - Because node price vs node size is not linear

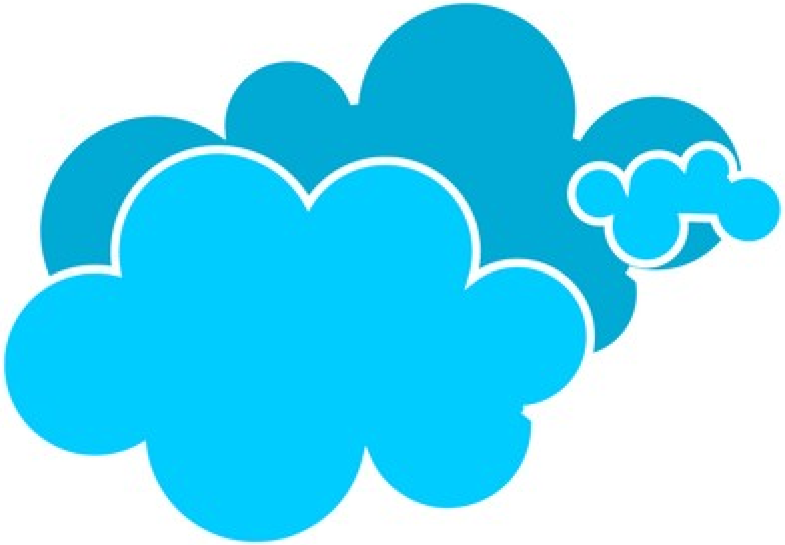


How do Databases Scale, Conclusion

- To minimize overall cluster price
  - Use many node because of rather small node size
  - Use commodity hardware
    - Fault tolerance
    - Won't go into CAP theorem here → Google
  - For dynamic workloads and dynamic scale-in/out → CLOUD





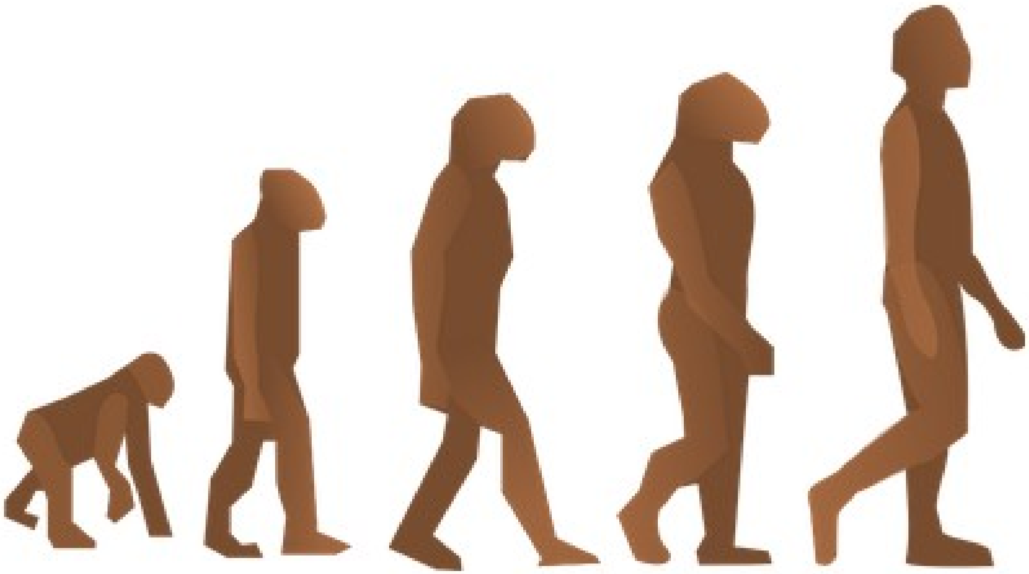


Current situation

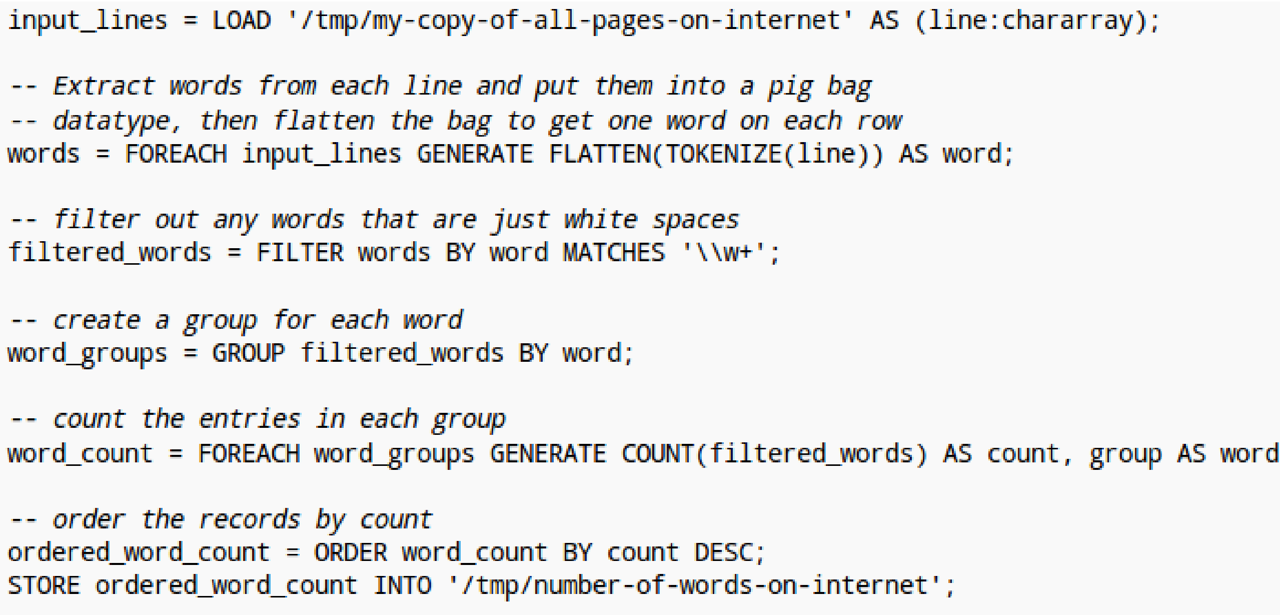
- Current situation in Enterprises
  - BI Tools
  - SQL (42%)
  - R (33%)
  - Python (26%)
  - Excel (25%)
  - Java, Ruby, C++ (17%)
  - SPSS, SAS (9%)
- Current situation in .coms
  - Writing MapReduce Jobs
  - Using proprietary query languages
  - Code everything from scratch

Evolution

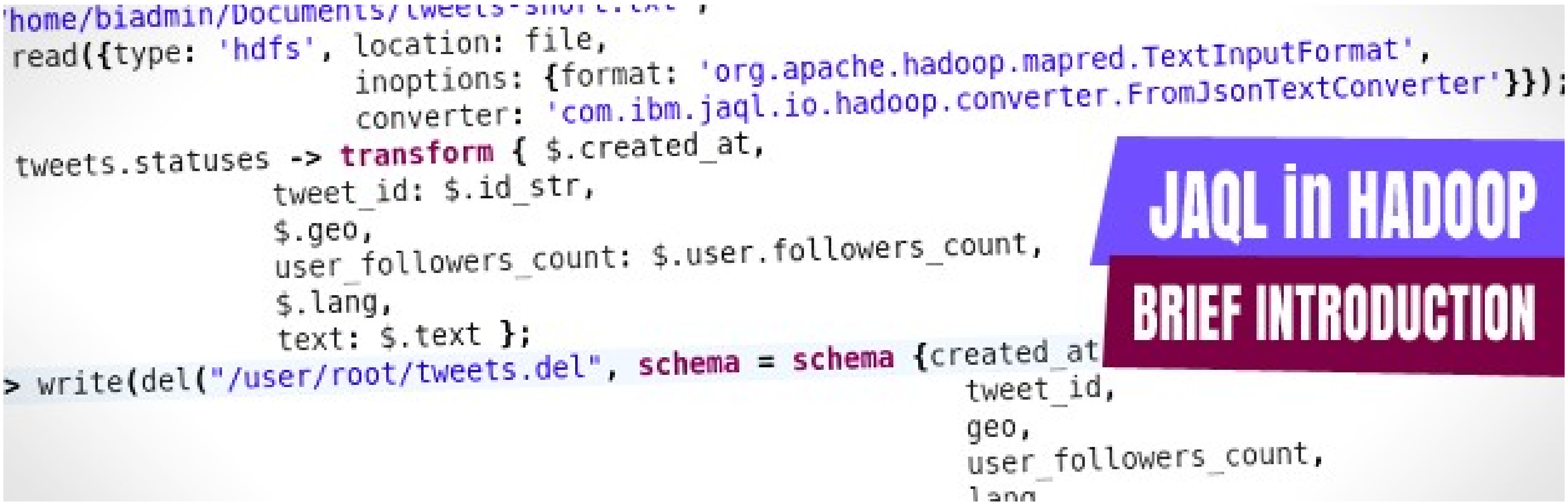
- Programing language implementations
- Usage of high level query languages
  - Pig
  - Jaql
- SQL or SQL like
  - BigSQL
  - HQL
  - CQL
- R push back
  - BigR
  - Rhadoop
- BigData spread sheets
- BI push back
- SPSS push back



Pig(Latin) / JAQL



```
input_lines = LOAD '/tmp/my-copy-of-all-pages-on-internet' AS (line:chararray);

-- Extract words from each line and put them into a pig bag
-- datatype, then flatten the bag to get one word on each row
words = FOREACH input_lines GENERATE FLATTEN(TOKENIZE(line)) AS word;

-- filter out any words that are just white spaces
filtered_words = FILTER words BY word MATCHES '\\w+';

-- create a group for each word
word_groups = GROUP filtered_words BY word;

-- count the entries in each group
word_count = FOREACH word_groups GENERATE COUNT(filtered_words) AS count, group AS word

-- order the records by count
ordered_word_count = ORDER word_count BY count DESC;
STORE ordered_word_count INTO '/tmp/number-of-words-on-internet';
```

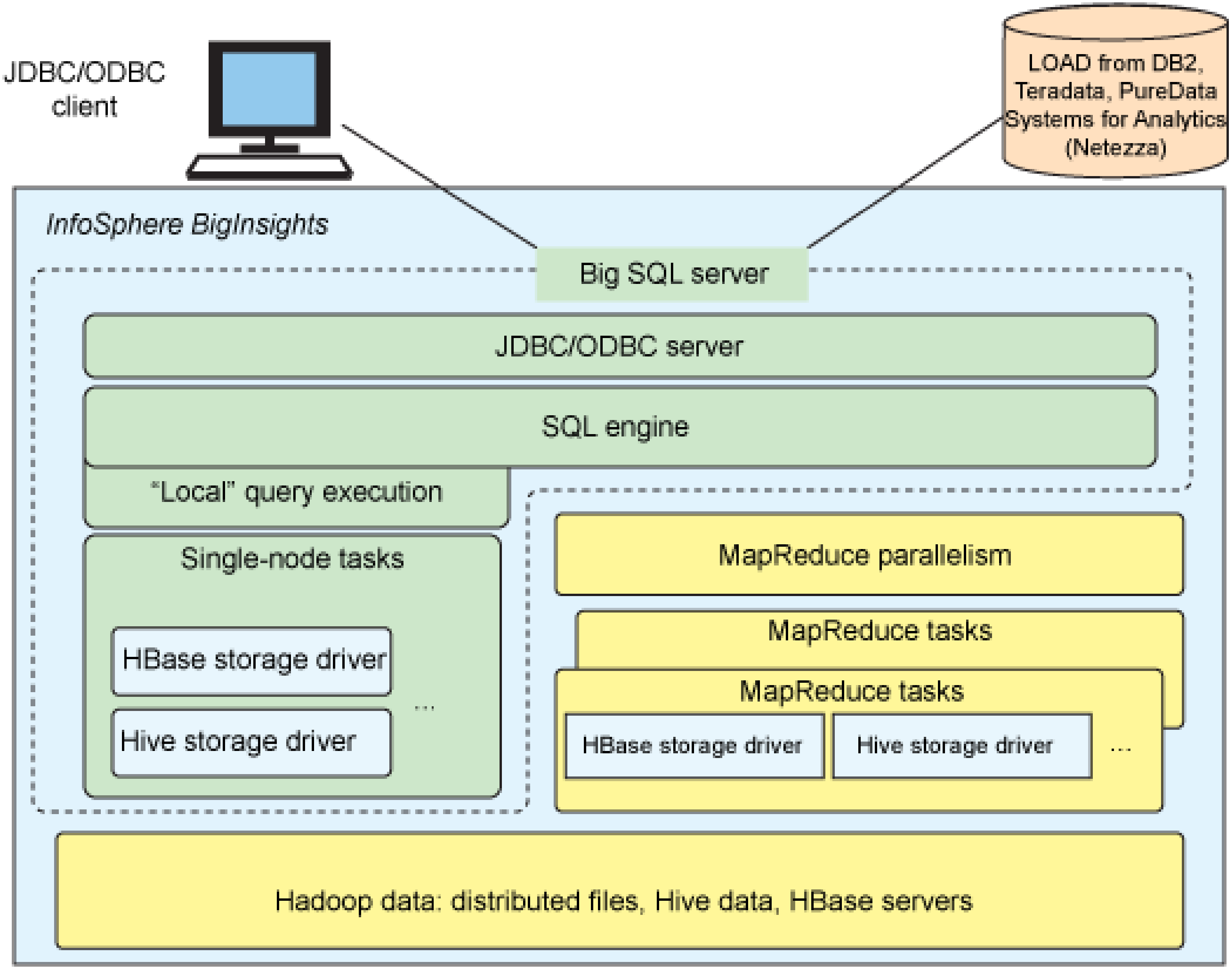


```
'home/biadmin/Documents/tweets-short.txt';
 read({type: 'hdfs', location: file,
               inoptions: {format: 'org.apache.hadoop.mapred.TextInputFormat',
               converter: 'com.ibm.jaql.io.hadoop.converter.FromJsonTextConverter'}});
 tweets.statuses -> transform { $.created_at,
            tweet_id: $.id_str,
            $.geo,
            user_followers_count: $.user.followers_count,
            $.lang,
            text: $.text };
> write(del("/user/root/tweets.del", schema = schema {created_at,
                                              tweet_id,
                                              geo,
                                              user_followers_count,
                                              lang
```

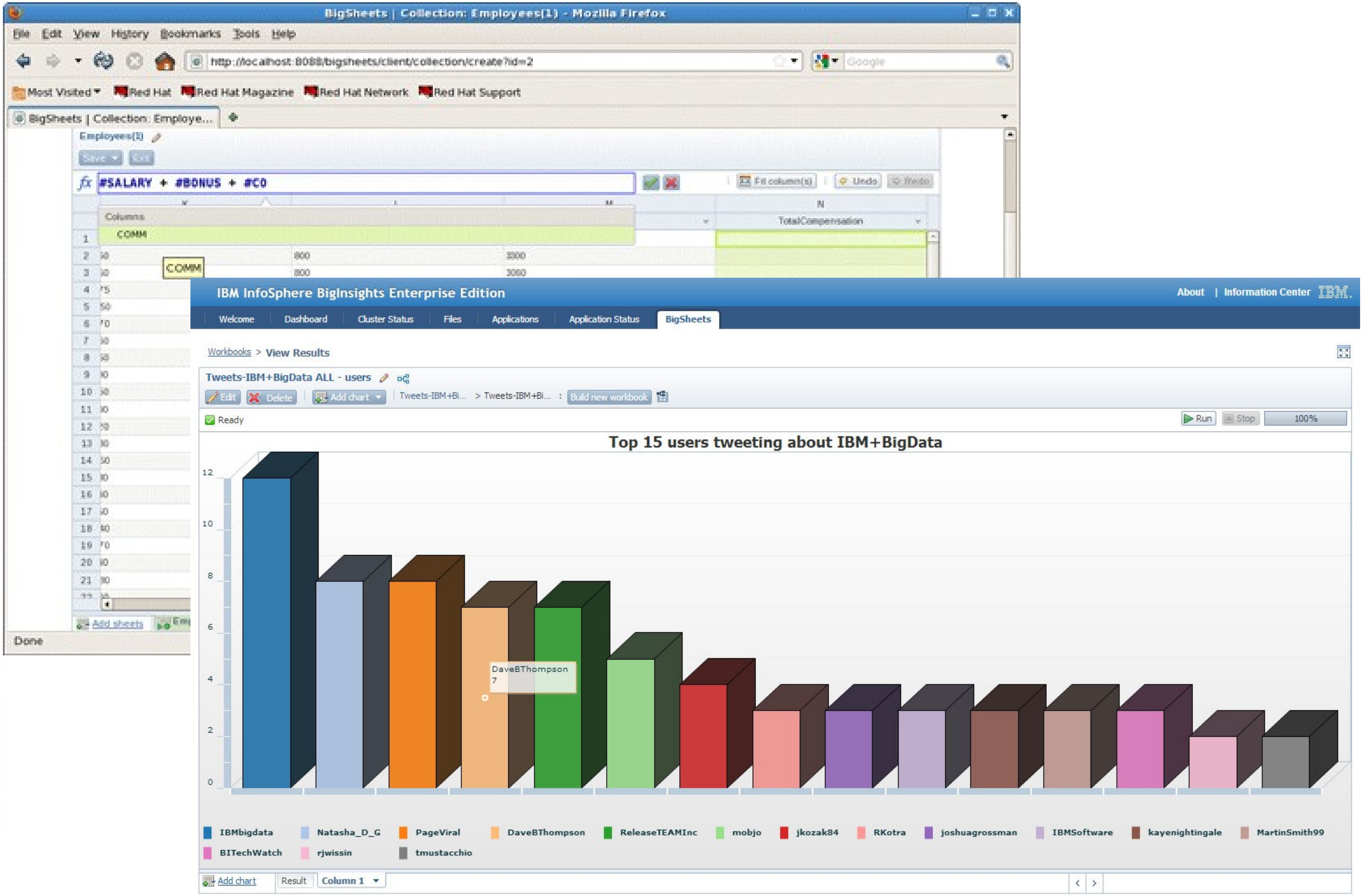
JAQL in HADOOP

BRIEF INTRODUCTION

BigSQL


JDBC/ODBC client
LOAD from DB2, Teradata, PureData Systems for Analytics (Netezza)
InfoSphere BigInsights
Big SQL server
JDBC/ODBC server
SQL engine
"Local" query execution
Single-node tasks
HBase storage driver
Hive storage driver
...
MapReduce parallelism
MapReduce tasks
MapReduce tasks
HBase storage driver
Hive storage driver
...
Hadoop data: distributed files, Hive data, HBase servers

Big Spreadsheets

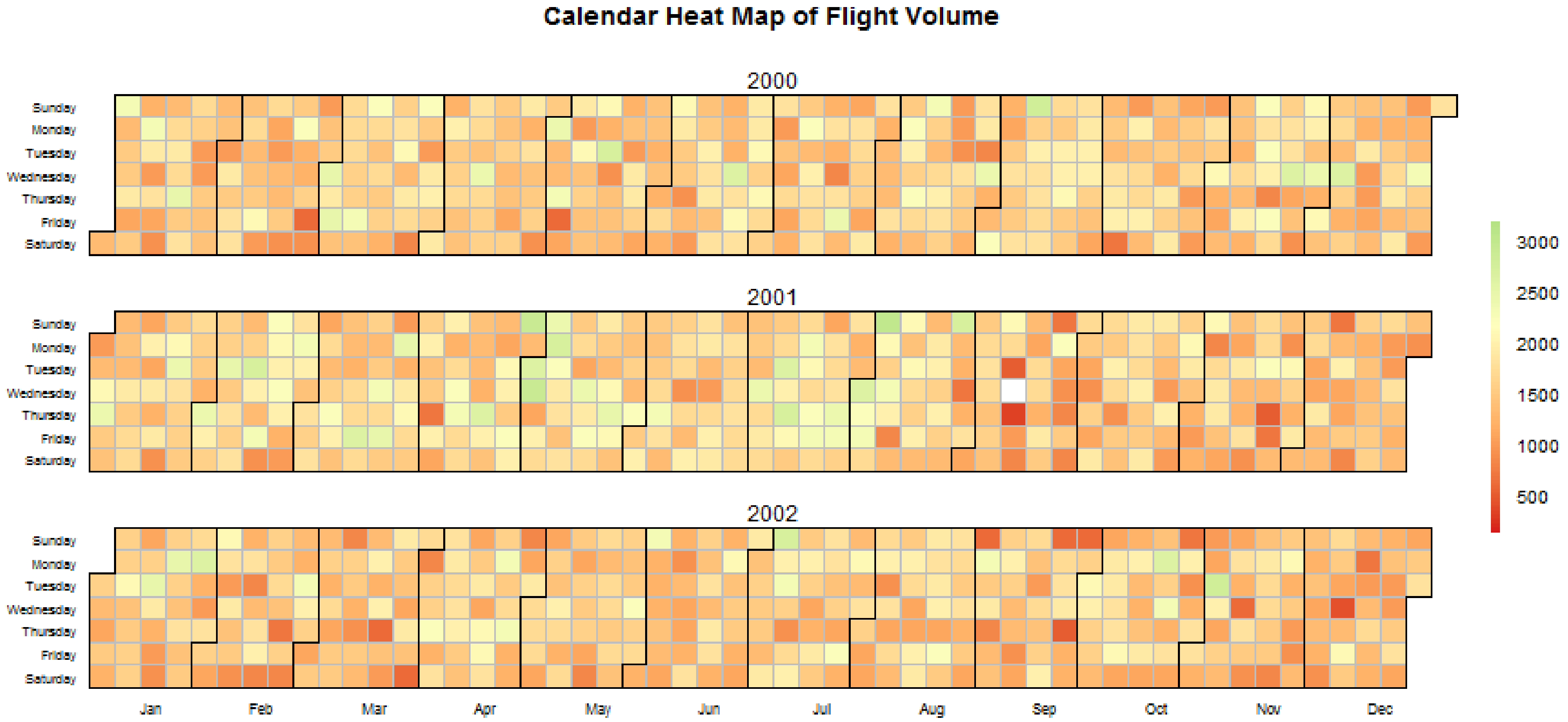


BigSheets | Collection: Employees(1) - Mozilla Firefox

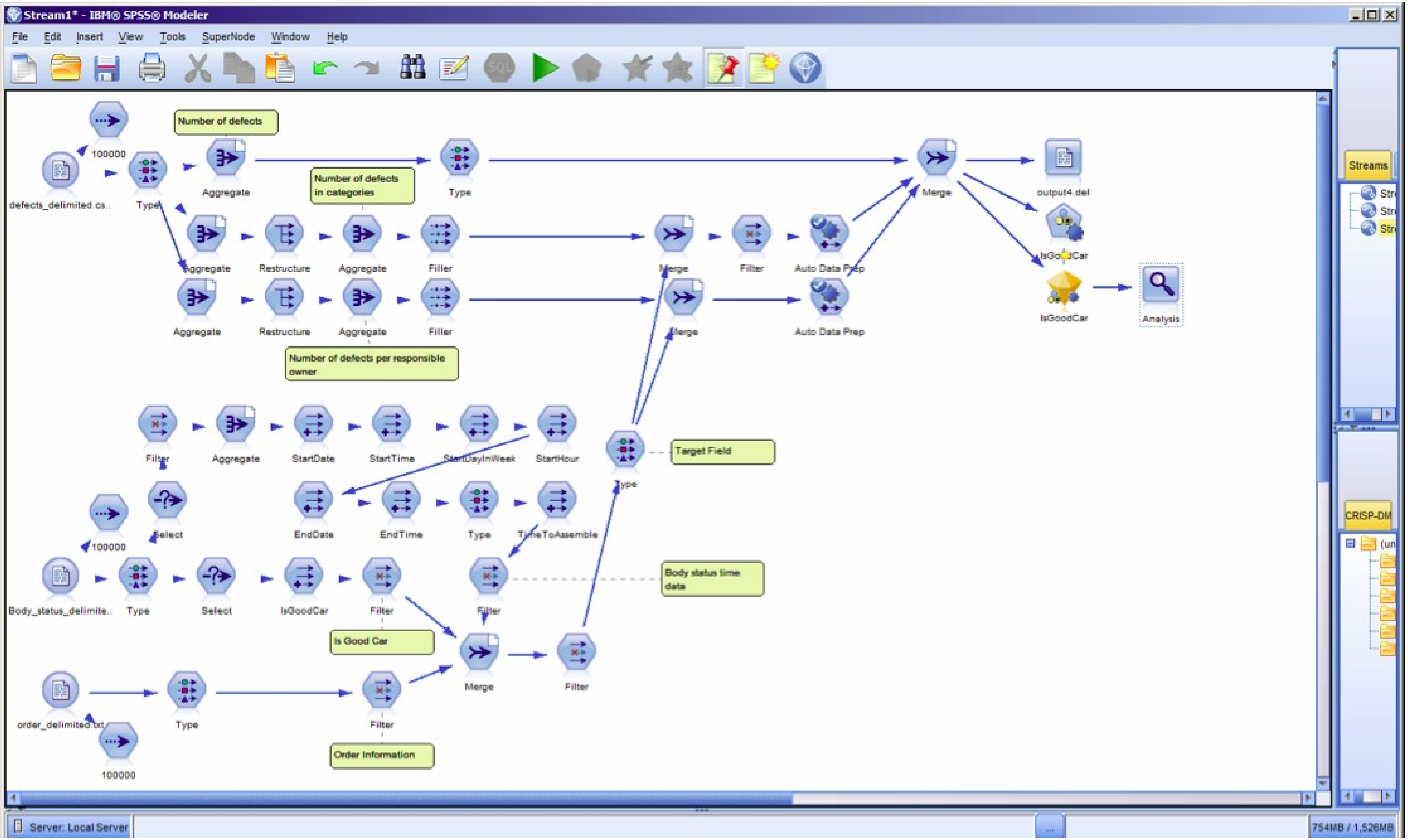
http://localhost:8080/bigsheets/client/collection/create?id=2

#SALARY + #BONUS + #CO

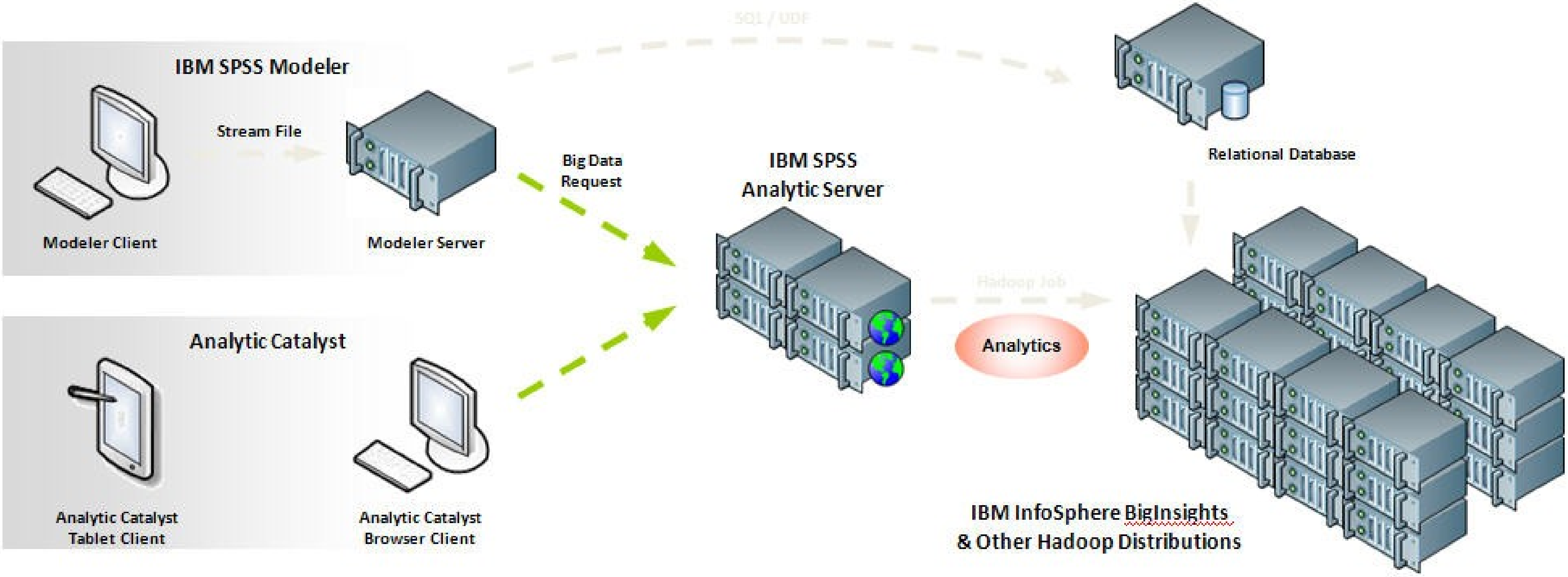
BigR


Calendar Heat Map of Flight Volume
2000
2001
2002
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
3000
2500
2000
1500
1000
500

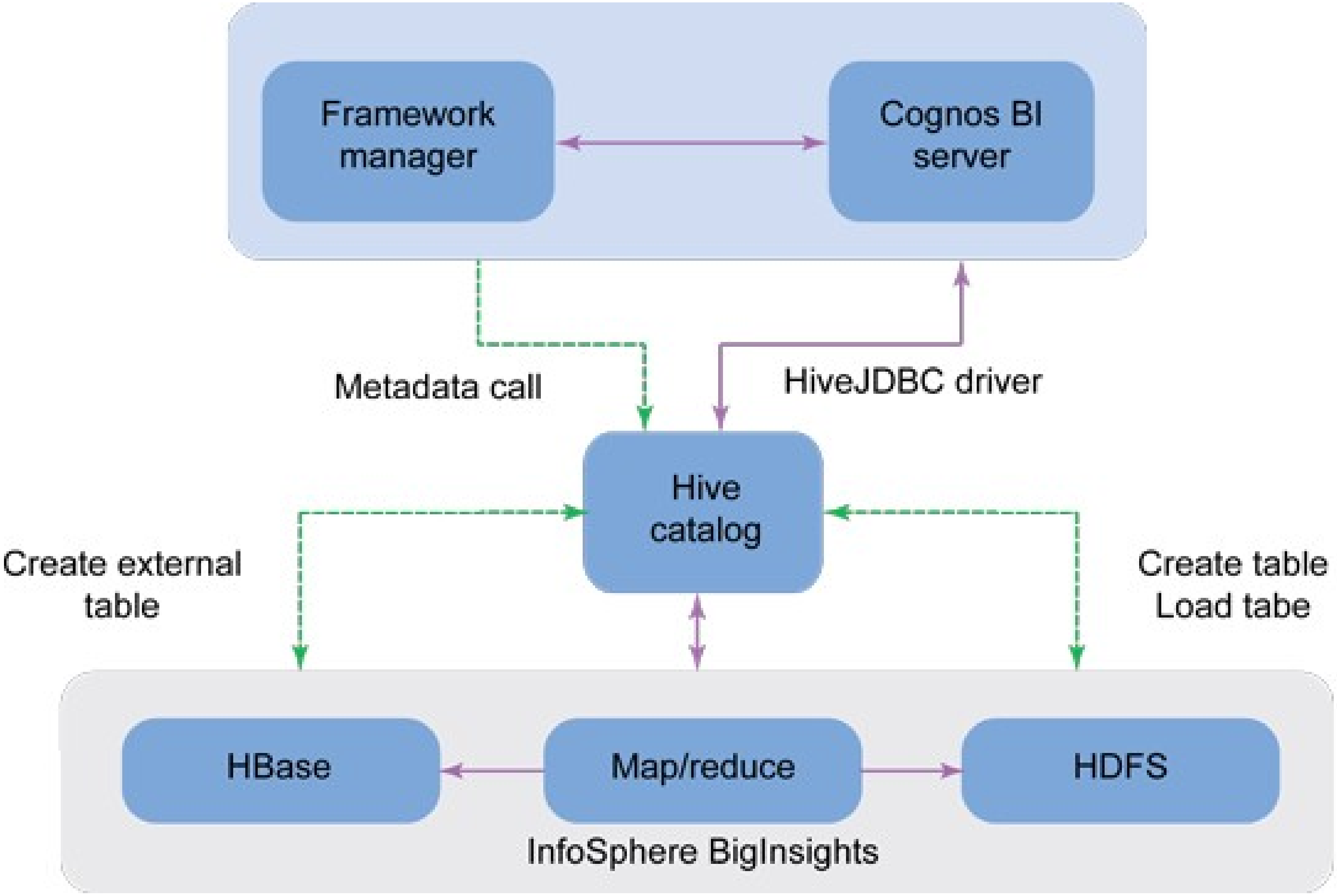
SPSS


Stream1* - IBM® SPSS® Modeler
File
Edit
Insert
View
Tools
SuperNode
Window
Help
Number of defects
100000
defects_delimited.cs..
Type
Aggregate
Type
Merge
output4.del
Number of defects in categories
Aggregate
Restructure
Aggregate
Filler
Merge
Filter
Auto Data Prep
IsGoodCar
Aggregate
Restructure
Aggregate
Filler
Merge
Auto Data Prep
IsGoodCar
Analysis
Number of defects per responsible owner
Filter
Aggregate
StartDate
StartTime
StartDayInWeek
StartHour
Type
Target Field
100000
Select
EndDate
EndTime
Type
TimeToAssemble
Body_status_delimite..
Type
Select
IsGoodCar
Filter
Filter
Body status time data
Is Good Car
Merge
Filter
order_delimited.txt
Type
Filter
100000
Order Information
Streams
CRISP-DM
Server: Local Server
754MB / 1,526MB

SPSS


SQL / UDF
IBM SPSS Modeler
Stream File
Modeler Client
Modeler Server
Big Data
Request
IBM SPSS
Analytic Server
Relational Database
Analytic Catalyst
Hadoop Job
Analytics
Analytic Catalyst
Tablet Client
Analytic Catalyst
Browser Client
IBM InfoSphere BigInsights
& Other Hadoop Distributions

Business Intelligence



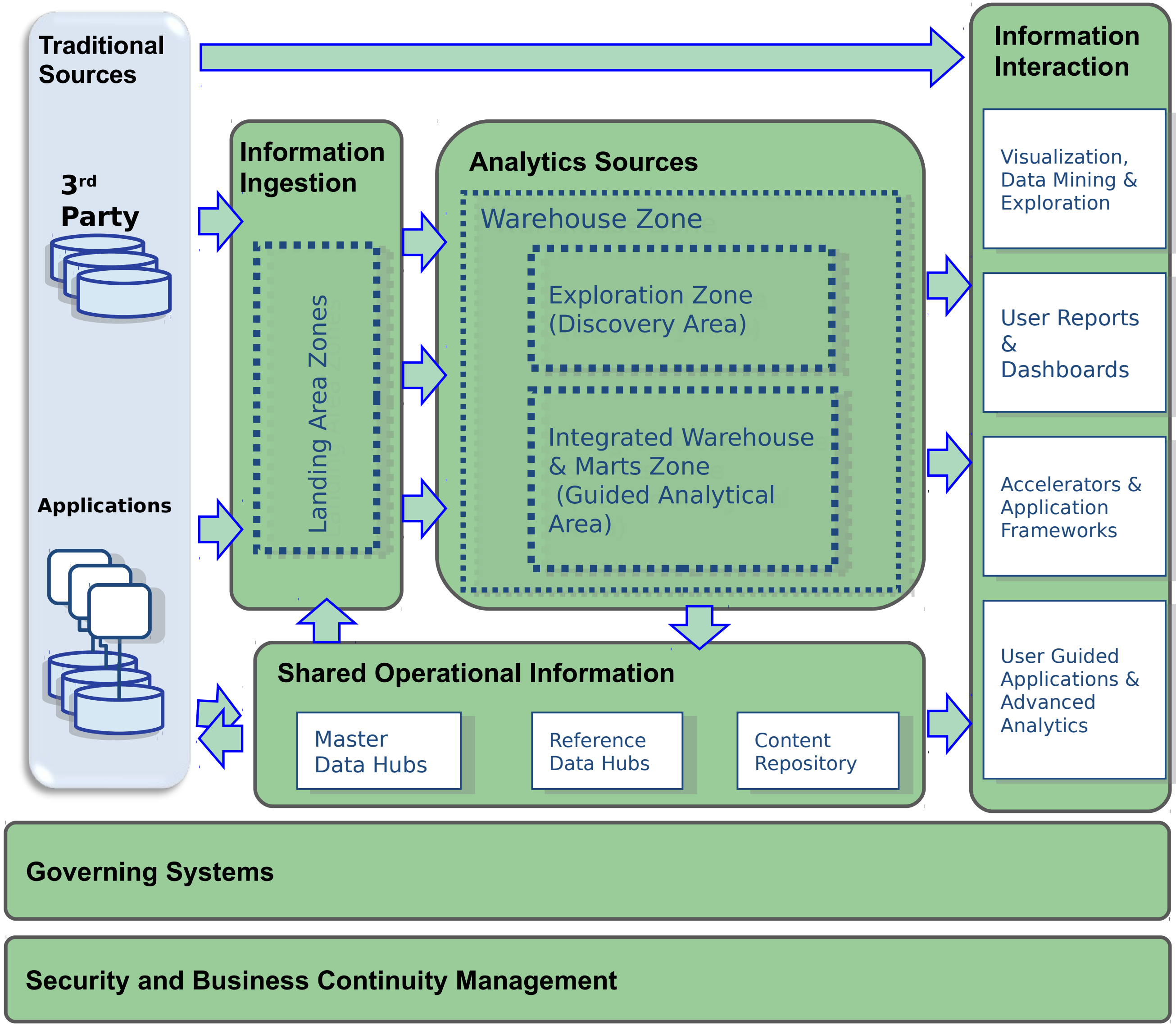
Requirements Summary

- Fault tolerance
- Dynamic and elastic scale-in and out
- Processing data of all types
- Use familiar ways of working with data

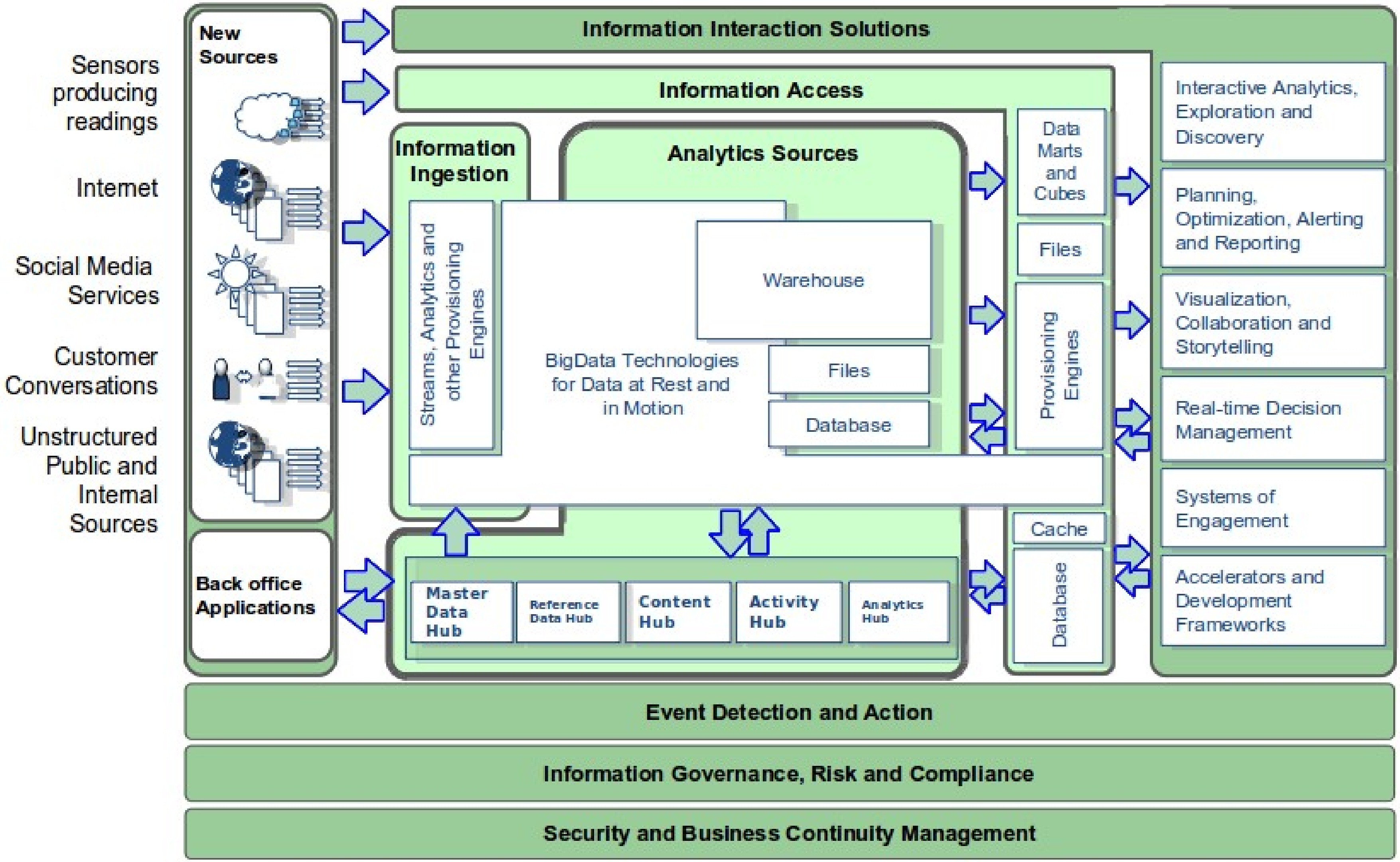
Ingredients

- NoSQL DB
- Cloud
- Push-back from Business Applications

IBM Reference Architecture (current)


Traditional Sources
3rd Party
Applications
Information Ingestion
Landing Area Zones
Analytics Sources
Warehouse Zone
Exploration Zone (Discovery Area)
Integrated Warehouse & Marts Zone (Guided Analytical Area)
Shared Operational Information
Master Data Hubs
Reference Data Hubs
Content Repository
Information Interaction
Visualization, Data Mining & Exploration
User Reports & Dashboards
Accelerators & Application Frameworks
User Guided Applications & Advanced Analytics
Governing Systems
Security and Business Continuity Management

IBM Reference Architecture (transition)


Sensors producing readings
Internet
Social Media Services
Customer Conversations
Unstructured Public and Internal Sources
New Sources
Back office Applications
Information Interaction Solutions
Information Access
Information Ingestion
Streams, Analytics and other Provisioning Engines
Analytics Sources
BigData Technologies for Data at Rest and in Motion
Warehouse
Files
Database
Master Data Hub
Reference Data Hub
Content Hub
Activity Hub
Analytics Hub
Data Marts and Cubes
Files
Provisioning Engines
Cache
Database
Interactive Analytics, Exploration and Discovery
Planning, Optimization, Alerting and Reporting
Visualization, Collaboration and Storytelling
Real-time Decision Management
Systems of Engagement
Accelerators and Development Frameworks
Event Detection and Action
Information Governance, Risk and Compliance
Security and Business Continuity Management

15 minutes Discussion

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