



SQL for Hadoop: Introducing Big SQL for BigInsights



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Executive Summary



- **Why SQL?**
 - Easy on-ramp to Hadoop for SQL professionals
 - Support familiar SQL tools / applications (via JDBC and ODBC drivers)
- **What SQL operations are supported?**
 - Create tables / views (and, optionally, HBase indexes)
 - Load data into tables (from local files, distributed files, RDBMSs)
 - Query data (project, restrict, join, union, sub-queries . . .)
- **What Hadoop-based storage mechanisms are supported?**
 - Hive
 - HBase
 - Distributed file system

Agenda

- **Big SQL: motivation and architecture**
- **Using Big SQL**
 - Invocation options
 - Creating tables
 - Populating tables with data
 - Querying data
 - Developing applications and working with tools
 - . . . And a peek at some additional topics
- **What RDBMS professionals should know about Big SQL**



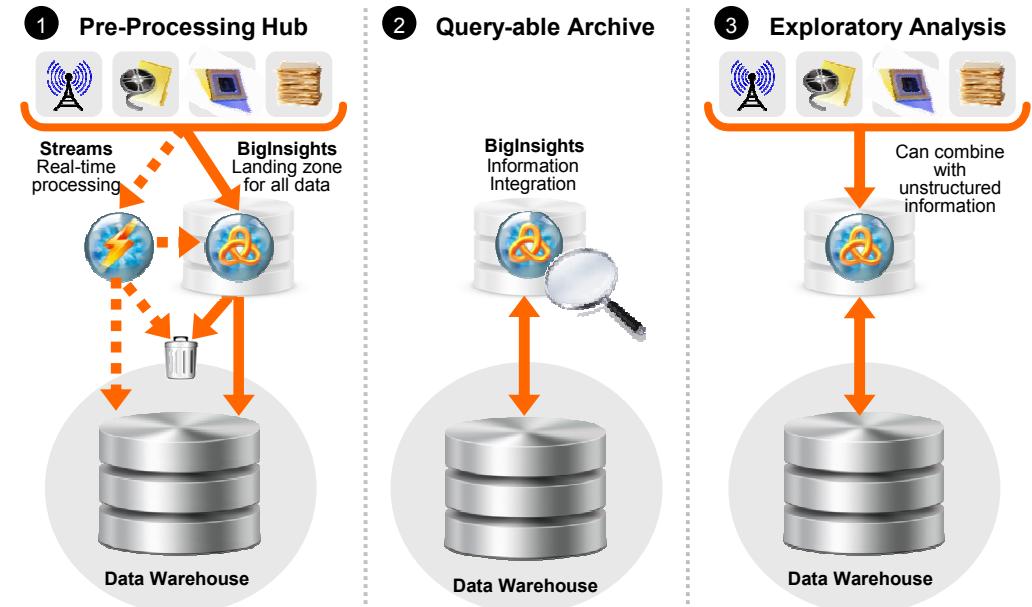
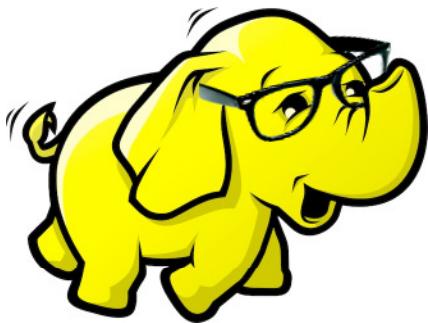
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SQL Access for Hadoop: Why?

- Data warehouse augmentation is a leading Hadoop use case



- Hadoop often perceived as difficult
 - MapReduce Java API requires programming expertise
 - Unfamiliar languages (such as Pig) also require special skills
- SQL support opens the data to a much wider audience
 - Familiar, widely known syntax
 - Common catalog for identifying data and structure

Big SQL Architecture and Feature Overview

- **Standard SQL syntax and data types**

- Joins, unions, aggregates . . .
- VARCHAR, decimal, TIMESTAMP, . . .

- **JDBC/ODBC drivers**

- Prepared statements
- Cancel support
- Database metadata API support
- Secure socket connections (SSL)

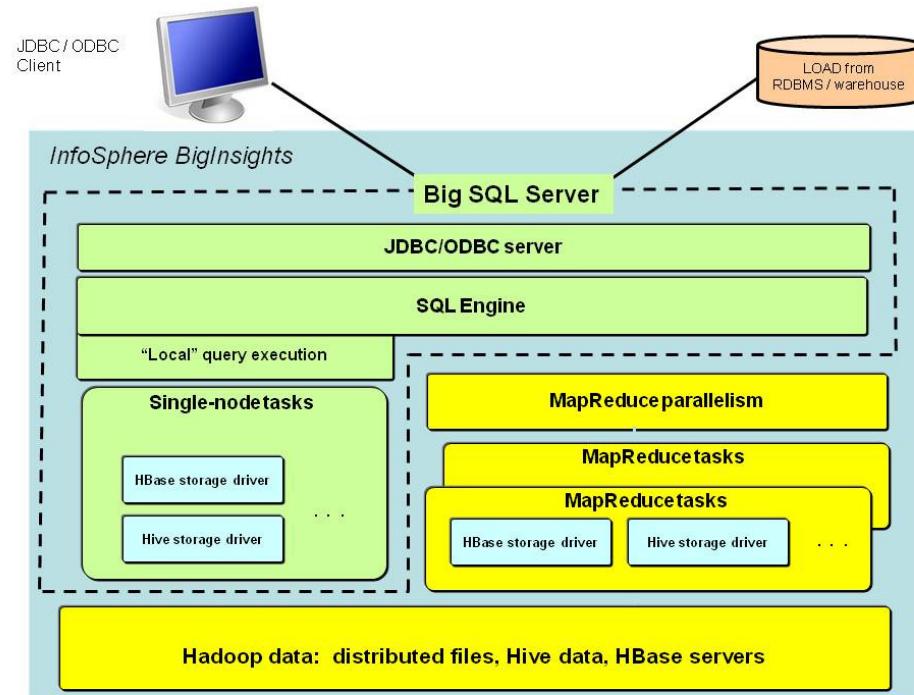
- **Optimization**

- MapReduce parallelism
or...
- “Local” access for low-latency queries

- **Varied storage mechanisms appropriate for Hadoop ecosystem**

- **Integration**

- Eclipse tools
- DB2, Netezza, Teradata, Oracle*, MS-SQL*, Informix *(via LOAD)
- Cognos Business Intelligence
- , , ,



* In beta

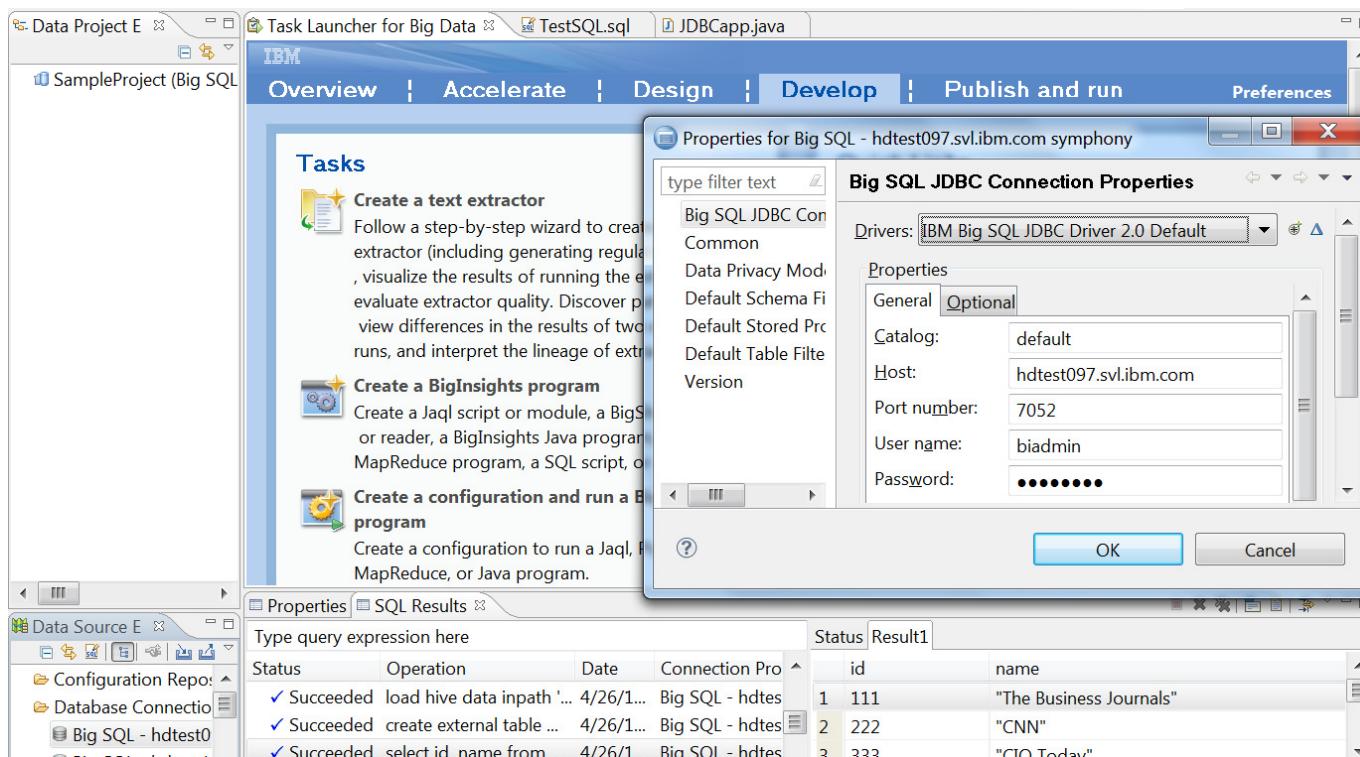
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Invocation options provided with BigInsights

- **Command-line interface (JSqsh shell)**
 - **Web-based interface (BigInsights web console)**
 - **Eclipse (BigInsights plug-in)**



Creating a Big SQL Table

- **BigSQL supports CREATE TABLE and many data types including varchar, decimals, etc. Non-ISO standard clauses leverage Hadoop ecosystem**

```
CREATE TABLE TPCH.CUSTOMER ( C_CUSTKEY INTEGER, C_NAME VARCHAR(25),  
C_ADDRESS VARCHAR(40), C_NATIONKEY INTEGER, C_PHONE CHAR(15), C_ACCTBAL  
FLOAT, C_MKTSEGMENT CHAR(10), C_COMMENT VARCHAR(117) )  
row format delimited fields terminated by '|'  
stored as textfile;
```

- **Big SQL supports CREATE VIEW***

```
CREATE VIEW IF NOT EXISTS myschema.cust_view (key, name)  
AS SELECT c_custkey, c_name  
FROM TPCH.CUSTOMER;
```

* In beta

Results from CREATE TABLE . . .

- **Table**

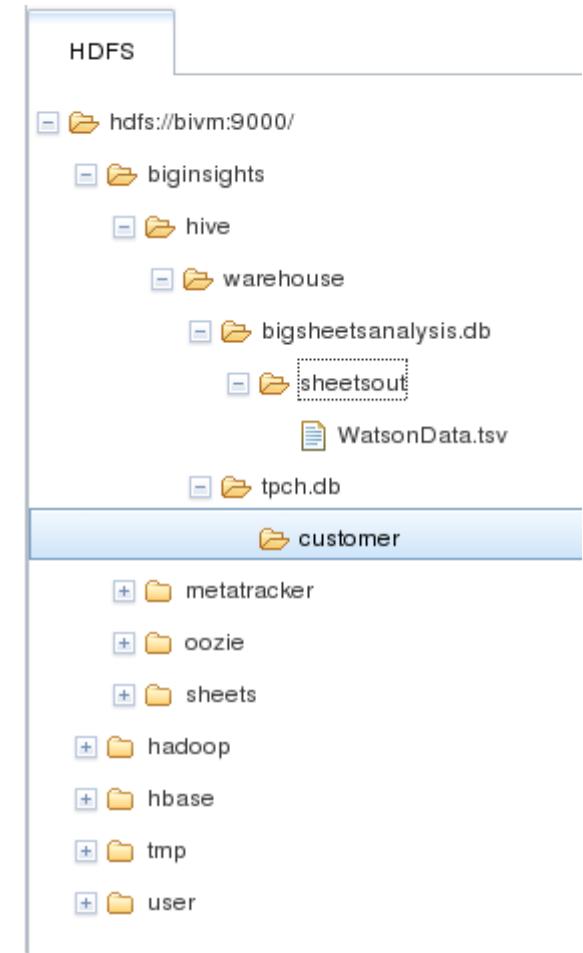
- Subdirectory created in warehouse directory
`/biginsights/hive/warehouse/tablename/`
- **External tables** may have their data stored anywhere in the DFS
- Populated tables contain 1 or more data files

- **Schema (or database)**

- Tables may be organized by schemas
- Schema is just a collection of tables
- Creating a schema creates a subdirectory in the warehouse to hold the tables

`/biginsights/hive/warehouse/schema.db/table
name/`

- **Catalog data (more later)**



Big SQL Extensions to CREATE TABLE

- Additional data types: **BINARY(N), VARCHAR(N), DECIMAL(P,S)**
- **NULL/NOT NULL indicators**
 - These are advisory only – not enforced
 - Big SQL query re-write software takes advantage of this info
- **Table hints**
 - Certain optimizer hints can be attached to tables
 - Hint will automatically apply when the table is used in a query

```
create table offices
(
    office_id int          not null,
    name      string        not null
)
...
with hints (tablesize='small')
```

- **Explicit syntax for HBase tables (column mappings, column family options, . . .)**

Populating Tables

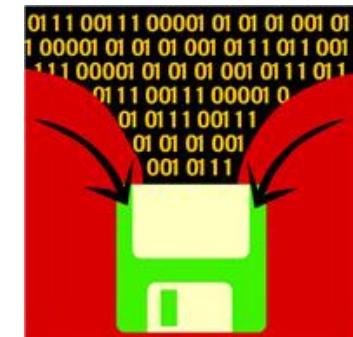
- **Data can be LOADED from . . .**

- Local file system
 - Distributed file system
 - Netezza, DB2, Oracle, Informix, MS-SQL, Teradata
 - Example

```
CREATE TABLE EMPLOYEE (EMPNO INT, NAME STRING, AGE INT) . . . ;
```

```
// Overwrite any existing data with new data from a local file
LOAD HIVE DATA LOCAL INPATH '/home/user1/employee.data' OVERWRITE INTO TABLE EMPLOYEE;

// Append new data from a file in HDFS to the table
LOAD HIVE DATA INPATH '/user/biadmin/employee.data' INTO TABLE EMPLOYEE;
```



- **What LOAD does:**

- Copies or moves the data, but doesn't manipulate it
 - Format of the input file must match the format of the table

- **HBase notes:**

- Similar LOAD syntax (LOAD HBASE). Composite keys, indexes, column encoding handled.
 - A single row INSERT may be used against HBase table

Querying data: Overview of SQL Support

■ Projection

```
SELECT col1, col2 FROM t1
```

■ Restriction

```
SELECT * FROM t1 WHERE col1 > 5
```

■ Union

```
SELECT EMPNO FROM EMPLOYEE WHERE WORKDEPT LIKE 'E%'  
UNION  
SELECT EMPNO FROM ACTIVITIES WHERE PROJNO IN('MA2100', 'MA2110', 'MA2112')
```

■ Difference (EXCEPT)

```
(SELECT * FROM T1) EXCEPT ALL (SELECT * FROM T2)
```

■ Intersection

```
(SELECT * FROM T1) INTERSECT (SELECT * FROM T2)
```

■ Joins

■ Subqueries

■ Built-in functions

SQL Support - Joins

- **Big SQL supports both common and ANSI / ISO join syntax**



```
select ... from tpch.orders,  
tpch.lineitem  
where o_orderkey = l_orderkey
```



```
select ... from tpch.orders  
join tpch.lineitem  
on o_orderkey = l_orderkey
```

SQL Support – Subqueries

- Big SQL supports subqueries in SELECT and WHERE clauses



```
select c1, (select  
    count(*) from t2)  
from t1  
where ...
```



```
select c1  
from t1  
where c2 > (select ...)
```

SQL Support – Aggregates

- Big SQL supports windowed aggregates



```
SELECT EXTRACT(YEAR FROM CAST(CAST (order_day_key AS  
varchar(100)) AS timestamp)) AS year,  
SUM (sale_total) AS total_sales,  
RANK () OVER (ORDER BY SUM (sale_total) DESC) AS ranked_sales  
FROM gosalesdw.sls_sales_fact  
GROUP BY EXTRACT(YEAR FROM CAST(CAST (order_day_key AS  
varchar(100)) AS timestamp))
```

year	total_sales	ranked_sales
2006	1495891100.90	1
2005	1159195590.16	2
2007	1117336274.07	3
2004	914352803.72	4

SQL Support – Functions (partial list)

- **Numeric**

abs	ceil	floor	ln	log10
mod	power	sqrt	sign	width_bucket

- **Trigonometric**

cos	sin	tan	acos	asin
atan	cosh	sinh	tanh	

- **String**

char_length	bit_length	octet_length	upper	lower
substring	position	index	translate	trim
json_get_object				

- **Aggregates, etc.**

Catalog Tables (HCatalog)

```
[localhost] [foo] 1> select * from syscat.tables where tablename='users' ;
+-----+-----+
| schemaname | tablename |
+-----+-----+
| default    | users      |
+-----+-----+
1 row in results(first row: 0.14s; total: 0.15s)
```

```
[localhost] [foo] 1> select * from syscat.columns where tablename='users' ;
+-----+-----+-----+-----+-----+-----+
| schemaname | tablename | name   | type   | precision | scale |
+-----+-----+-----+-----+-----+-----+
| default    | users     | id     | INT    | 10        | 0      |
| default    | users     | office_id | INT    | 10        | 0      |
| default    | users     | name   | STRING | 0         | 0      |
| default    | users     | children | ARRAY  | 0         | 0      |
+-----+-----+-----+-----+-----+-----+
4 rows in results(first row: 0.19s; total: 0.21s)
```

Other BigInsights catalog tables track index and schema information

BigSheets and Big SQL

IBM InfoSphere BigInsights Quick Start Edition (for Non-Production Environment)

Welcome biadmin | Log out | About | Help IBM.

Welcome | Dashboard | Cluster Status | Files | Applications | Application Status | BigSheets

WatsonBlogs-Revised

Edit Delete Add chart Refresh Fit column(s) Create Table Export data Run Stop 100%

Ready

	Country	FeedInfo	Language	SubjectHtml
1		{"Title": "Fern Halper's data makes English		Are you ready for <Keyw
2		{"Title": "", "Id": "27788189", "ExtKey": English		<Keyword>IBM Watson<
3		{"Title": "Medical Quack", "Id": "2336 English		<Keyword>IBM Watson<
4		{"Title": "Flying like a banana blog", "Id": "2336 English		<Keyword>IBM Watson<
5		{"Title": "iMasters -", "Id": "3230361", "Portuguese": Portuguese		Processamento de lingu
6	DE	{"Title": "Rudiwu2019s ruk Blog", "Id": "German		Citi Bank prüft Einsatz v
7		{"Title": "Medical Quack", "Id": "2336 English		

Task Launcher for Big Data *Test.sql

Connection: Big SQL JDBC

```
... test script
create view myview
as select feedinfo from sheets.blogs;
select * from myview limit 10;
```

DFS File Catalog Table

Table: sheets.blogs

sheets.blogs HCatalog Reader Save as Master Workbook

Ready

country	feedinfo	language	postsize	published	subject
1	{"Title": "Fern H English	1018	2012-02-13 14: Are yo		
2	{"Title": "", "Id": "English	10628	2012-03-22 15: <Keyw		

Problems Console SQL Results

Type query expression here

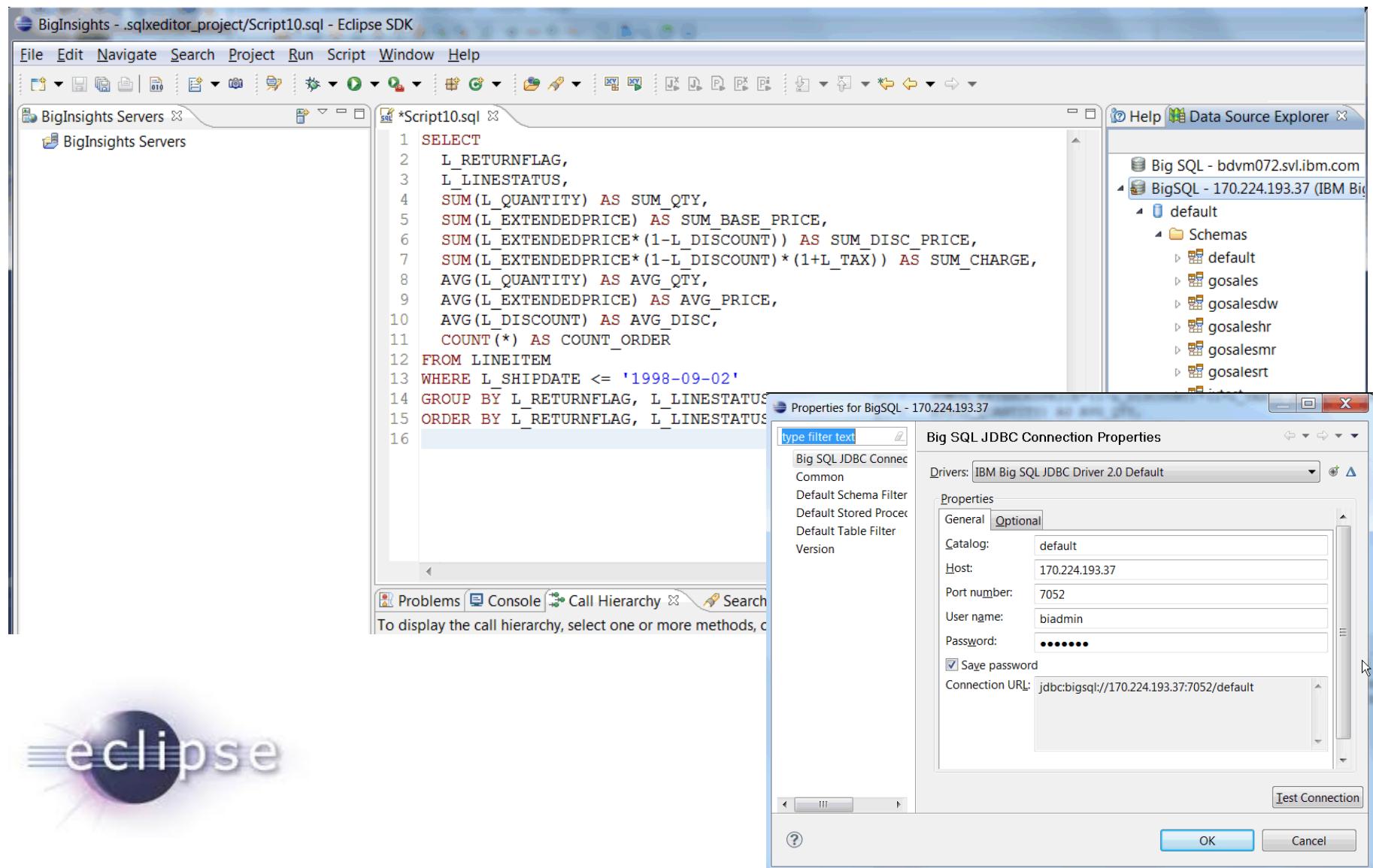
Status	Operation	Date	Connection Profile
✓ Success	create view	2/7/14 3:32 F	Big SQL JDBC
✓ Success	Success select * from	2/7/14 3:32 F	Big SQL JDBC
✓ Success	drop view my	2/7/14 3:34 F	Big SQL JDBC
✓ Success	create view r	2/7/14 4:31 F	Big SQL JDBC
✓ Success	select * from	2/7/14 4:31 F	Big SQL JDBC

feedinfo

1	{"Title": "Fern Halper's data makes the world go round", "Id": "26441ca88258772333b0", "ExtKey": "26441ca88258772333b0", "Published": "2012-02-13T14:00:00Z", "Language": "English", "PostSize": 1018}
2	{"Title": "", "Id": "27788189", "ExtKey": "41b844757", "Published": "2012-03-22T15:00:00Z", "Language": "English", "PostSize": 10628}
3	{"Title": "Medical Quack", "Id": "23369637", "ExtKey": "d4abe748d", "Published": "2012-02-13T14:00:00Z", "Language": "English", "PostSize": 1018}
4	{"Title": "Flying like a banana blog", "Id": "41b844757", "ExtKey": "d4abe748d", "Published": "2012-02-13T14:00:00Z", "Language": "English", "PostSize": 1018}
5	{"Title": "iMasters -", "Id": "32303613", "ExtKey": "aebc21dbf716", "Published": "2012-03-22T15:00:00Z", "Language": "Portuguese", "PostSize": 10628}
6	{"Title": "Rudiwu2019s ruk Blog", "Id": "39980009", "ExtKey": "e8", "Published": "2012-03-22T15:00:00Z", "Language": "German", "PostSize": 10628}
7	{"Title": "Medical Quack", "Id": "23369637", "ExtKey": "d4abe748d", "Published": "2012-02-13T14:00:00Z", "Language": "English", "PostSize": 1018}

Total 10 records shown

Using Existing Standard SQL Tools: Eclipse



Using Existing Standard SQL Tools: SQuirreL SQL

The screenshot shows the SQuirreL SQL Client interface. The main window has a toolbar at the top with various icons for file operations, session management, and database navigation. Below the toolbar is a menu bar with File, Drivers, Aliases, Plugins, Session, Windows, and Help. A 'Connect to:' dropdown is set to 'BigSQL vm072'. The 'Active Session' dropdown shows '1 - BigSQL vm072 () as biadmin'. The left sidebar has tabs for Aliases and Drivers, with 'Aliases' currently selected. The main area contains a query editor with the following SQL code:

```
SELECT L_RETURNFLAG, L_LINESTATUS, SUM(L_QUANTITY) AS SUM_QTY, SUM(L_EXTENDEDPRICE) AS SUM_BASE_PRICE, SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT)) AS SUM_DISC_PRICE,  
SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT)*(1+L_TAX)) AS SUM_CHARGE,  
AVG(L_QUANTITY) AS AVG_QTY,  
AVG(L_EXTENDEDPRICE) AS AVG_PRICE,  
AVG(L_DISCOUNT) AS AVG_DISC,  
COUNT(*) AS COUNT_ORDER  
FROM tpch.LINEITEM  
WHERE L_SHIPDATE <= '1998-09-02'  
GROUP BY L_RETURNFLAG, L_LINESTATUS  
ORDER BY L_RETURNFLAG, L_LINESTATUS;
```

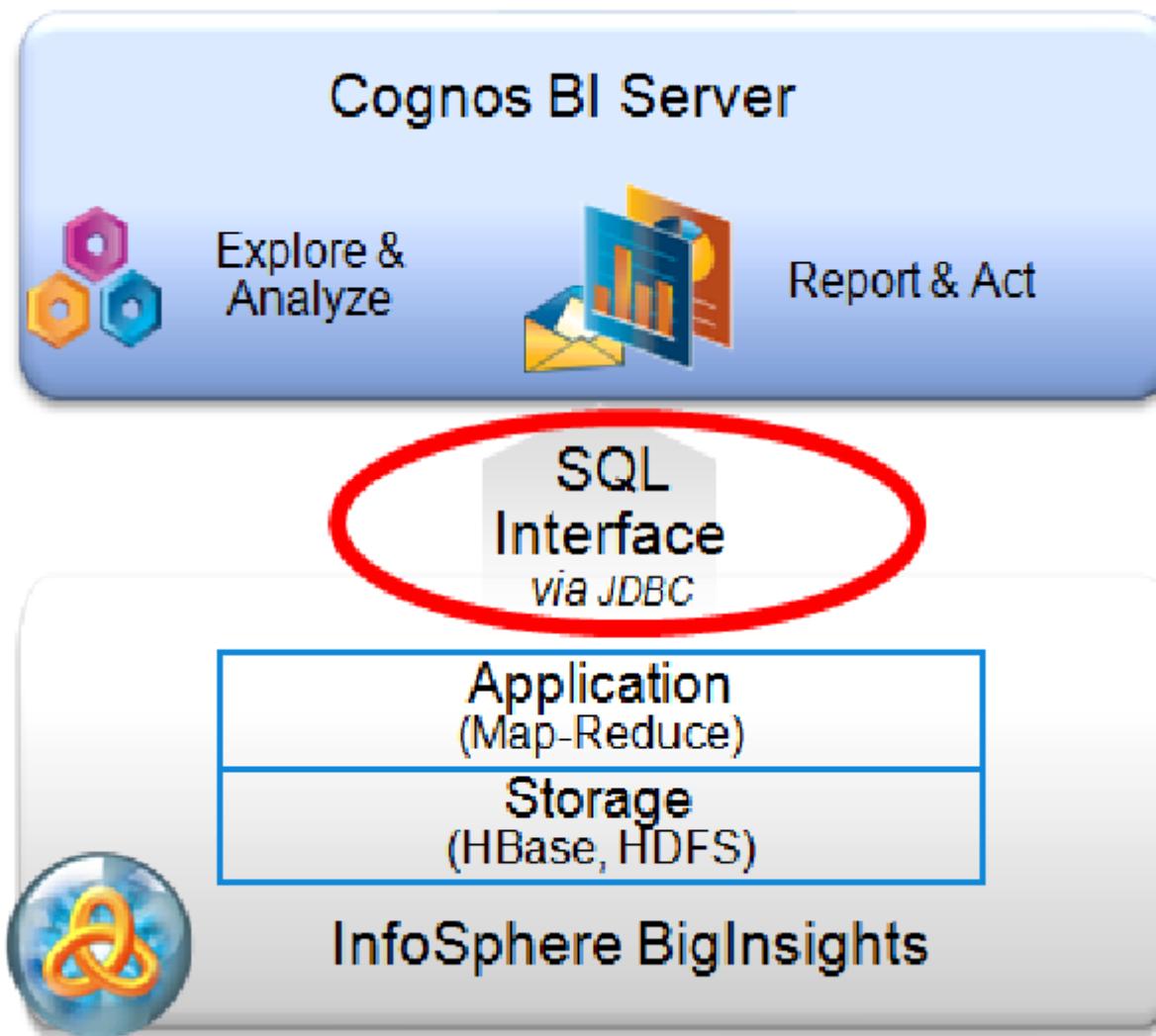
Below the query editor is a results pane showing the output of the query. The results table has columns: L_RETURNFLAG, L_LINESTATUS, SUM_QTY, SUM_BASE_PRICE, and SUM_CHARGE. The data is as follows:

L_RETURNFLAG	L_LINESTATUS	SUM_QTY	SUM_BASE_PRICE	SUM_CHARGE
A	F	380,456	532,348,211.54083	505,82
N	F	8,971	12,384,801.3941	11,798
N	O	742,802	1,041,502,841.74463	989,73
R	F	381,449	534,594,445.51434	507,99

To the right of the main window, a modal dialog box titled 'Add Alias' is open. It contains fields for Name (set to 'BigSQL on bdvm072.svl.ibm.com'), Driver (set to 'IBM Big SQL JDBC Driver 2.0 Default'), URL (set to 'jdbc:bigsqll://bdvm072.svl.ibm.com:7052/default'), User Name (set to 'biadmin'), and Password (represented by a series of dots). There are also checkboxes for Auto logon and Connect at Startup, and a 'Properties' button. A warning message at the bottom states 'Warning - Passwords are saved in clear text'. At the bottom of the dialog are OK, Close, and Test buttons.

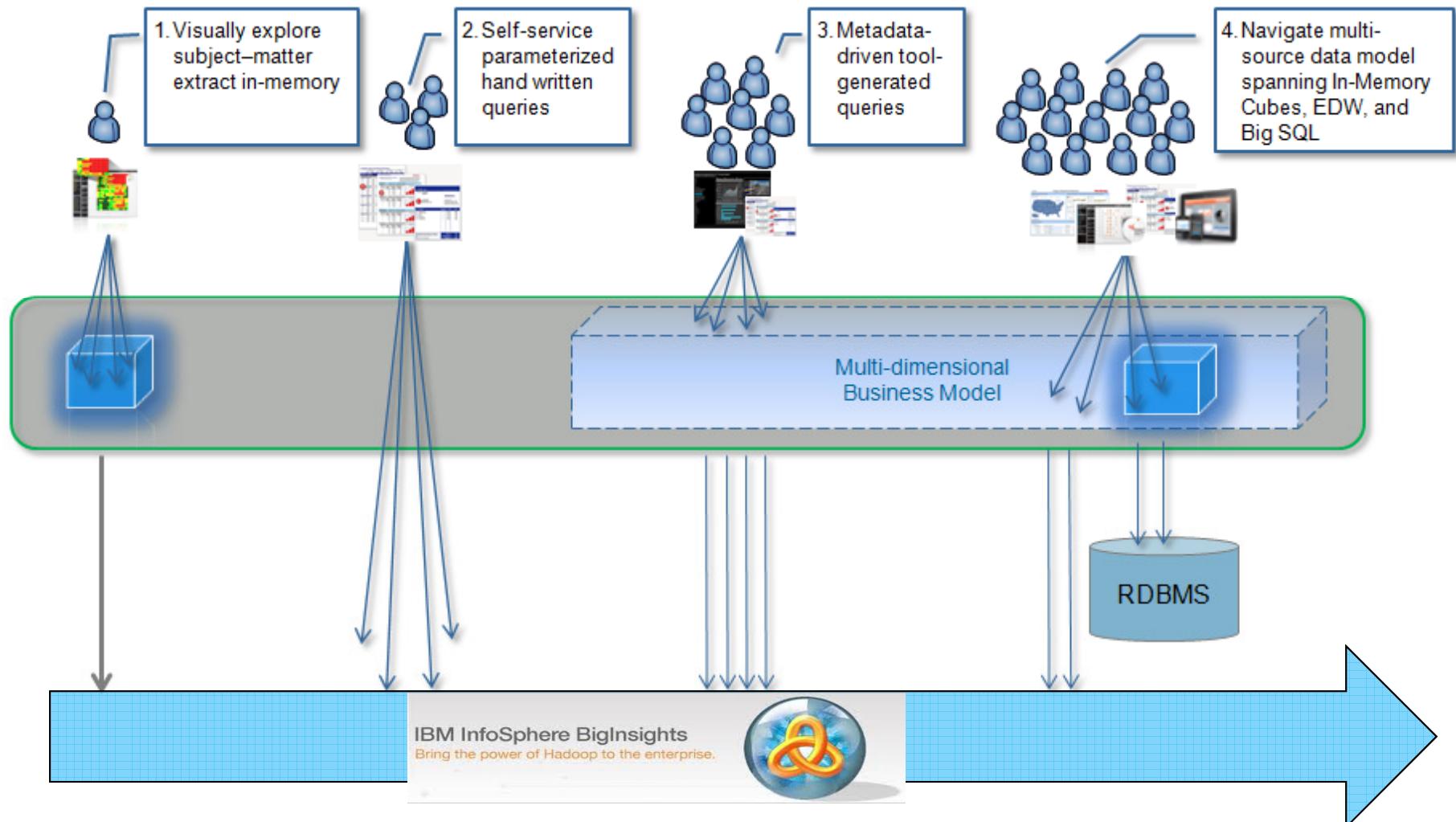


Cognos Business Intelligence



MicroStrategy use of Big SQL

MicroStrategy



MS Excel: Big SQL integration via ODBC

IBM Big SQL ODBC Client Setup

Big SQL Server configuration

Please enter the myBigSQL DSN's information

Database: default

Host: sdsvm691013.svl.ibm.com

Port: 7052

User ID: biadmin

Password: [REDACTED]

InstallShield

Data Connection Wizard

Connect to ODBC Data Source

Choose the ODBC data source you want to connect to.

ODBC data sources:

- BI_DSN_1
- dBASE Files
- Excel Files
- MS Access Database
- myBigSQL**
- MyDSN55

Data **Window** **Help**

A1

Sort... Filter Form... Subtotals... Validation... Table... Text to Columns... Consolidate... Group and Outline PivotTable and PivotChart Report... Import External Data... Import Data... List New Web Query... Base Query... Properties...

Default

Select Database and Table

Select the Database and Table/Cube which contains the data you want.

Select the database that contains the data you want:

default

Connect to a specific table:

Name	Schema	Description	Modified	Created	Type
go_org_name_lookup	gosalesdw				TABLE
go_region_dim	gosalesdw				TABLE
go_satisfaction_dim	gosalesdw				TABLE
go_time_dim	gosalesdw				TABLE
go_time_quarter_lookup	gosalesdw				TABLE
media_test	gosalesdw				TABLE
media_vert_3	gosalesdw				TABLE
media_ts	gosalesdw				TABLE
mrk_activity_status_dim	gosalesdw				TABLE
mrk_adv_fact	gosalesdw				TABLE
mrk_bundle_group_lookup	gosalesdw				TABLE
mrk_campaign_lookup	gosalesdw				TABLE
mrk_prod_survey_targ_fact	gosalesdw				TABLE
mrk_product_survey_dim	gosalesdw				TABLE
mrk_product_survey_fact	gosalesdw				TABLE
mrk_promotion_dim	gosalesdw				TABLE
mrk_promotion_fact	gosalesdw				TABLE
mrk_promotion_plan_fact	gosalesdw				TABLE
mrk_rt_survey_dim	gosalesdw				TABLE
mrk_rt_survey_fact	gosalesdw				TABLE
mrk_rt_survey_targ_fact	gosalesdw				TABLE
myprod_brand	gosalesdw				TABLE
mvord.brand1	gosalesdw				TABLE

Cancel < Back Next >

Cancel < Back Next > Finish



A word about . . . SerDes

- **Custom serializers / deserializers (SerDes)**
 - Read / write complex or “unusual” data formats (e.g., JSON)
 - Commonly used with Hive, HBase
 - Developed by user or available from open source community
- **Using SerDes with Big SQL**
 - Add the SerDe .jar file to \$BIGSQL_HOME/userlib and \$HIVE_HOME/lib
 - Stop / restart Big SQL service
 - Specify SerDe class name (not .jar file name) when creating table

▪ Example

```
-- Create a table for JSON data. Use open source hive-json-serde-0.2.jar SerDe
create table socialmedia-json (Country String, FeedInfo String, . . . )
row format serde 'org.apache.hadoop.hive.contrib.serde2.JsonSerde'
stored as textfile;

load hive data inpath '</hdfs_path>/WatsonBlogsData.json' overwrite into table
socialmedia-json;

select * from socialmedia-json;
```

Sample JSON input for previous example

```
[biadmin@bdvm327 twitter]$ cat WatsonNewsBlogsData.json|more
```

```
{"PostSize":5775,"ThreadId":"4f129a8be","Crawled":"2012-01-15 09:21:15","FeedInfo":{"\n    \"Title\":\"www.ibm.comnews\", \"Id\":\"44032787\", \"ExtKey\":\"879cd3257c296614160914c3d96f9b85\", \"Url\":\"http://www-03.ibm.com\"}, \"Published\":\"2012-01-15 09:21:15\", \"Url\":\"http://www.ibm.com/innovation/us/watson/?lnk=ftpl\", \"Country\":\"US\", \"SubjectHtml\":\"<Keyword>IBM</Keyword> - <Keyword>Watson</Keyword>\", \"Inserted\":\"2012-05-29 00:52:57\", \"Language\":\"English\", \"TextHtml\":\"<! [CDATA[<Keyword>IBM</Keyword> - <Keyword>Watson</Keyword>\nCall to find\nout how Watson's capabilities could benefit your business.\n1-800-426-7630\nRelated content\nDesigning the Computer for a Smarter Planet\nThere\u2019s an enormous amount\nof science included when <Keyword>Watson</Keyword> answers a single Jeopardy! question,\nhow does it all work together?\nExplore <Keyword>Watson</Keyword>\nBeyond Jeopardy! The Business Implications of <Keyword>Watson</Keyword>\n<Keyword>IBM</Keyword> <Keyword>Watson</Keyword> passed its first test on Jeopardy! in February 2011, but the real test will be in\napplying the underlying systems, data management and analytics technology in business and across different industries. Watch the webcast now and learn about the present and future business implications of Deep QA and the other technologies behind <Keyword>Watson</Keyword> from David Ferrucci and other <Keyword>IBM</Keyword> executives.\nRegister now\nBetter Bu
```

JSON-based social media data to load into Big SQL Table *socialmedia-json* defined with SerDe

Sample Big SQL query output for JSON data

authorinfo	country	crawled	feedinfo	id	inserted	published
{"Nick":"" , "Id":"" , "Name":"" , "Url":""}	US	2012-04-11 03:31:47	{"Title":"www.ibm.comnews","Id":4403278,"ExtKey":7,"ExtKey2":879cd32,"ExtKey3":57c2966141,"ExtKey4":60914c3d96,"ExtKey5":f9b85,"Url": "http://www-03.ibm.com"}	31859312	2012-05-23 20:18:08	2012-04-11 03:31:47
{"Nick":"" , "Id":"" , "Name":"" , "Url":""}	US	2012-02-22 23:50:14	{"Title":"www.ibm.comnews","Id":4403278,"ExtKey":7,"ExtKey2":879cd32,"ExtKey3":57c2966141,"ExtKey4":60914c3d96,"ExtKey5":f9b85,"Url": "http://www-03.ibm.com"}	32535948	2012-05-26 05:21:06	2012-02-22 23:50:14

Sample output: Select * from socialmedia-json

A word about . . . performance

- **Tuning options**

- Table design (e.g., storage formats for Hive, key & column family definitions for HBase)
- Hints in queries, table definitions
- ANALYZE TABLE ... COMPUTE STATISTICS command
- Secondary indexes (HBase tables only)
- MapReduce job properties
- ...

- **Query hints provided in comments:** /*+ name=value [, ...] */
select * from foo /*+ accessmode='local' */ where c1 < 1000;

- **Access mode hint**

- Causes query to be executed in the Big SQL server
- HBase indexed queries can return extremely rapidly
- Local access can be forced on for your entire session



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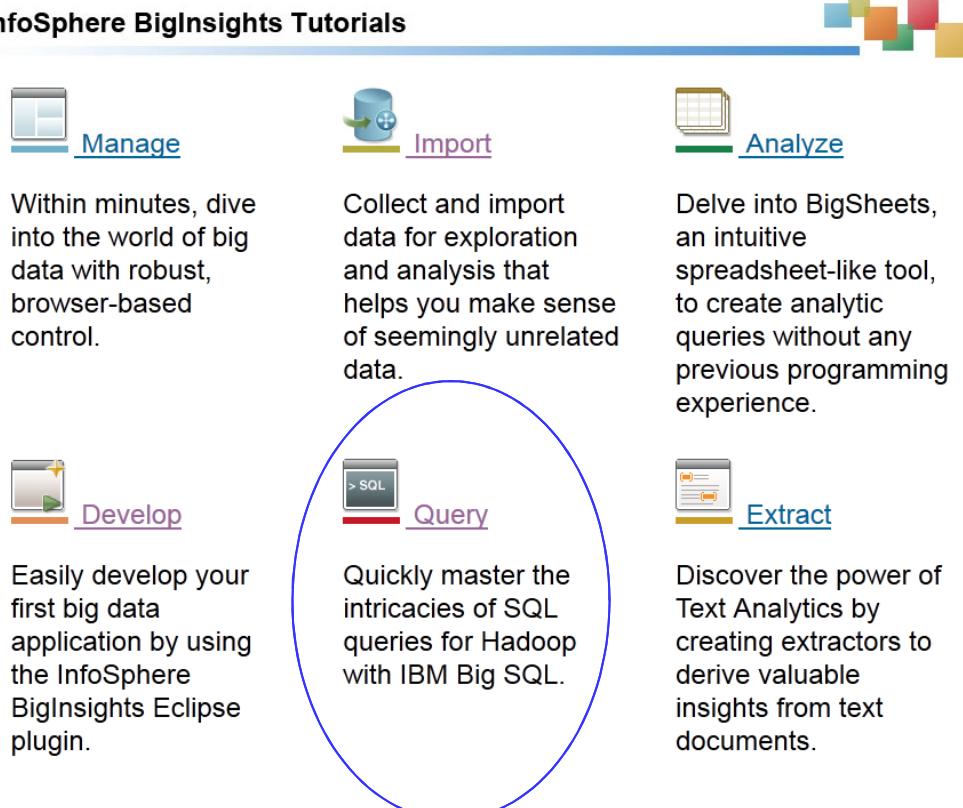
Big SQL – what RDBMS experts should know

- **Big SQL provides industry-standard query support for Hadoop-based storage managers**
 - Exploits Hadoop environment
 - Includes Hadoop-specific extensions
 - Introduces Hadoop-specific concepts
 - Copes with “unconventional” data structures and formats (e.g., JSON) via SerDes, other features
- **RDBMS = more than query & storage management**
 - Transaction management
 - Stored procedures
 - INSERT / UPDATE / DELETE
 - GRANT / REVOKE
 - 3GL language support (e.g., COBOL)
 - Rich catalog statistics and decades of cost-based optimization development
- **Bottom line: Big SQL provides SQL experts with on-ramp to Hadoop, but doesn't turn Hadoop into one big relational database**

Want to learn more?

- **Big SQL tutorial (product Information Center)**
- **Videos , articles, downloads, etc.**
 - Technical portal at <http://tinyurl.com/biginsights>

InfoSphere BigInsights Tutorials




BigInsights Technical Enablement Wiki