STREAM HORIZON
DataProcessingPlatform

StreamHorizon – Test Demo deployment Guide

Version 3.3.x

StreamHorizon - Test Demo Deployment Guide

TABLE OF CONTENTS

INTRODUCTION

INSTALLATION REQUIREMENTS

Thank you for downloading StreamHorizon test demo!

We will refer to directory where you have installed the demo software as $ENGINE_HOME.

There are few requirements that need to be met in order to run StreamHorizon.

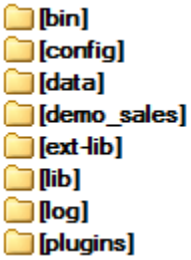
1. Mainstream operating system (Linux, Windows, Solaris)
2. JDK 1.7+ (we recommend Oracle HotSpot)
3. Database (if you use it) must support JDBC interface.

NOTE: Even if you intend to run multiple (clustered) StreamHorizon instances there is no need to install binaries more than once per single (physical) server.

NOTE: 64-bit Java deployment is desirable (but not mandatory) for performance reasons.

DEMO DIRECTORY STRUCTURE

Demo you have downloaded comes in two flavours, Oracle and MySQL. Demo is located in $ENGINE_HOME/demo_sales/ directory as shown below.



Directory name	Purpose
$ENGINE_HOME/bin/	All startup scripts should be placed in this directory. There are two default scripts (start.bat and start.sh) that can be utilised for starting single instance

	(default). If you are customizing new startup scripts always place them in this directory.
$ENGINE_HOME/config/	All configuration files are placed in this directory: • engine-config.xml is single most important configuration file which describes database connectivity, directory structures and your database (demo database model).
$ENGINE_HOME/data/	This is engine's private directory used for housekeeping. You should not add, delete or modify content of this folder.
$ENGINE_HOME/demo_sales/	Demo feature demonstrating capabilities of StreamHorizon engine (performance and functionality).
$ENGINE_HOME/ext-lib/	Additional dependencies required by your custom plugins. All jar files needed by your plugins and containing your StreamHorizon plugins.
$ENGINE_HOME/lib/	External dependencies needed by engine are placed here. You should not add, delete or modify anything within this directory.
$ENGINE_HOME/log/	Engine log files can be found here.
$ENGINE_HOME/plugins/	Java plugins. Plain java (*.java) files can be placed in this directory. Engine will compile and load them (when configured to do so in engine-config.xml file).

CONFIGURING STREAMHORIZON DEMO

ORACLE DEMO

Oracle deployment comes in three flavours: JDBC, external tables and named pipes. JDBC performs slower than external tables generally, however setup script for external tables requires you to create Oracle directories (as instructed in execution script).

TO TEST ORACLE JDBC DEPLOYMENT

1. Move $ENGINE_HOME/demo_sales/oracle/jdbc_deploy/engine-config.xml file into $ENGINE_HOME/config/ folder.
2. Open engine-config.xml file and change parameters commented out with string "SET ME!". The engine-config-example.xml is provided as an arbitrary example of correctly configured file.
3. Execute Oracle script StreamHorizon/demo_sales/oracle/jdbc_deploy/oracle_create_schema.sql. Please read NOTE's at the beginning of the script prior to execution
4. Copy sample file $ENGINE_HOME /demo_sales/sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file_multiplier script in order to create 500 files.
5. NOTE: by default data in fact table (sales_fact) will be stored in your default tablespace. This tablespace (if not big enough) may be filled up during processing and that will cause errors in StreamHorizon logs ($ENGINE_HOME/log/sh-engine*log). To avoid this either edit file multiplier script file_multiplier to create less than 500 copies of the feed files or extend your default tablespace. Alternatively, change create table statement for sales_fact table to point to tablespace of your choice.
6. Please skip to section RUNING STREAMHORIZON DEMO

TO TEST ORACLE IN EXTERNAL TABLE (BULK LOAD) MODE

1. Move $ENGINE_HOME/demo_sales/oracle/ext_table_deploy/engine-config.xml into $ENGINE_HOME/config/ folder.
2. Open engine-config.xml and change parameters commented out with string "SET ME!". The engine-config-example.xml is provided as an arbitrary example of correctly configured file.
3. If you have already executed $ENGINE_HOME/demo_sales/oracle/jdbc_deploy/oracle_create_schema.sql as part of install of JDBC setup please skip next step.
4. Execute Oracle script $ENGINE_HOME/demo_sales/oracle/jdbc_deploy/oracle_create_schema.sql. Please read NOTE's at the beginning of the script prior to execution.
5. Execute Oracle script $ENGINE_HOME/demo_sales/oracle/ext_table_deploy/externalTableCreate.sql. Please read NOTE's at the beginning of the script prior to execution
6. Copy sample file $ENGINE_HOME/demo_sales/sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file multiplier script in order to create 500 files.
7. NOTE: by default data in fact table (sales_fact) will be stored in your default tablespace. This tablespace (if not big enough) may be filled up during processing and that will cause errors in StreamHorizon logs ($ENGINE_HOME/log/sh-engine*log). To avoid this either edit file multiplier script file_multiplier to create less than 500 copies of the feed files or extend your default tablespace. Alternatively, change create table statement for sales_fact table to point to tablespace of your choice.
8. Please skip to section RUNING STREAMHORIZON DEMO

NOTE: On some I/O systems you may get better performance if you remove following setting from engine-config.xml:

<property name="bulk.file.acceptance.timeout.millis">2000</property>

Note that in that case in some (less performant) I/O systems you may get the following error:

java.nio.file.DirectoryIteratorException: java.nio.file.AccessDeniedException

This occurs as DB loader threads start consuming files before ETL threads finishes writing them. If you see this error please set property "bulk.file.acceptance.timeout.millis" to adequate value which will give enough time to ETL threads to persist bulk files before DB threads try to consume them. This setting is subject to performance of your I/O system and need be tuned on every deployment.

ORACLE SUBSECOND QUERY LATENCY AND AGGREGATIONS

StreamHorizon enables you to achieve data throughput of 1+ million records per second on single commodity server. In most deployments throughput of 1million+ records/second exceeds the rate at which data is produced. If your data source produces much less (for example only 300K) records per second (rather than 1 million records per second) it may be beneficial that you create indexes and aggregations. StreamHorizon load speed should match the rate at which data is produced, if this is true, StreamHorizon is working in Real Time processing mode.

Indexing fact table heavily will enable Oracle to return majority of user queries within 0-2 seconds. Creating indexes (bitmap indexes & join bitmap indexes) and aggregations will reduce throughput of StreamHorizon, however, as long as throughput of StreamHorizon is higher than the rate of production of your source data this is desirable design approach. By indexing and aggregating fact tables you will achieve low query latency which outperforms most of MOLAP (OLAP) cube deployments.

Testing indexes and aggregation features:

1. Note that Aggregation and Indexing demo is available only in external table operation mode. With few small adjustments you can alter JDBC deployment to create aggregations and perform indexing as well if required.

2. Truncate fact table sales_fact “truncate table sales_fact”

3. Execute $ENGINE_HOME/demo_sales/oracle/ext_table_deploy/oracleCreateAggregations.sql script. Script will create required indexes

4. Update engine-config.xml by changing aggregation flag from value 0 to value 1:

   <command type="sql">

   CALL p_sh_external_table_load(${ffn[2]}, ${bulkProcessingThreadID},'${bulkFileName}', 1)

   </command>

5. Run StreamHorizon demo. Note that you may need to ensure that feeds are copied from archive to source directory before you execute demo.

6. After load has finished execute statistics for database schema. Statistics script is located in $ENGINE_HOME/demo_sales/oracle/ext_table_deploy/oracleStatistics.sql file

7. Run queries against fact and aggregated fact table in order to analyse low latency of sql queries, sample queries are supplied in $ENGINE_HOME/demo_sales/oracle/ext_table_deploy/oracleQueries.sql

TO TEST ORACLE IN PIPE LOAD MODE

Pipe deployment mode can be tuned to be the fastest mode of loading data using StreamHorizon into the database. This is because there are no intermediate persistence steps (no I/O) between StreamHorizon and database in which external table load mode with Oracle is used. Before considering deployment in this mode make sure that your Unix/Linux system administrator and Infrastructure team can provide you adequate support in tuning size of Unix/Linux pipes (pipe buffer size). Default size for pipe buffers is usually 5KB and thereby much smaller than required (much smaller than the ideal size of the largest data file). This reduces out of the box throughput significantly for untuned systems to circa 400K records per second.

1. Move $ENGINE_HOME/demo_sales/oracle/pipe_deploy/engine-config.xml into $ENGINE_HOME/config/ folder.
2. Open engine-config.xml and change parameters commented out with string "SET ME!". The engine-config-example.xml is provided as an arbitrary example of correctly configured file.

3. If you have already executed $ENGINE_HOME/demo_sales/oracle/jdbc_deploy/oracle_create_schema.sql as part of install of JDBC setup please skip the next step.
4. Execute Oracle script $ENGINE_HOME/demo_sales/oracle/jdbc_deploy/oracle_create_schema.sql. Please read NOTE's at the beginning of the script prior to execution.
5. Copy sample file $ENGINE_HOME/demo_sales/sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file multiplier script in order to create 500 files.
6. NOTE: by default data in fact table (sales_fact) will be stored in your default tablespace. This tablespace (if not big enough) may be filled up during processing and that will cause errors in StreamHorizon logs ($ENGINE_HOME/log/sh-engine*log). To avoid this either edit file multiplier script file_multiplier to create less than 500 copies of the feed files or extend your default tablespace. Alternatively, change create table statement for sales_fact table to point to tablespace of your choice.
7. Copy directory sqlldr located in $ENGINE_HOME/demo_sales/oracle/pipe_deploy into your $ENGINE_HOME/bin directory. Ensure that StreamHorizon has required privileges for sqlldr directory.
8. Change following parameters in $ENGINE_HOME/bin/sqlldr/pipe_invoke.sh file:
    a. Enter your valid SID: export ORACLE_SID=orcl
    b. Enter your Oracle install path: export PATH=${PATH}:/db/oracle/product/11.2.0/bin
    c. Enter your logging credentials and Oracle SID: userid=sh/sh@orcl
    d. Enter path to sqlldr directory: control=$ENGINE_HOME/bin/sqlldr/
9. Note that all t*.ctl files located in $ENGINE_HOME/bin/sqlldr directory have hardcoded values for table subpartition name, sub attribute, booking_date attribute and file_id attribute. They need not be changed. In case that you wish to run more than 10 parallel ETL threads (<etlProcessingThreadCount>) you will need to create more t*.ctl files. Demo example runs with maximum of 10 ETL threads.
10. For simplicity reasons, logs generated by *ctl files will be located in your $ENGINE_HOME/bin directory this should be changed for strategic deployments as you see fit.
11. If StreamHorizon in pipe mode appears ‘stuck’ after startup that is probably because there is nothing to drain the pipes created by StreamHorizon. This means that pipe_invoke.sh and/or t*.ctl aren’t configured properly (data is not being inserted into Oracle database). To verify that this is the case you can output the content of the pipes to your terminal. If you see the data (coming out of pipe files) this implies that StreamHorizon is processing data correctly and that Oracle isn’t accepting the data. Most likely, this is the issue with pipe_invoke.sh file. StreamHorizon pipes are located in $ENGINE_HOME/data/instance_0 directory. One ‘bulkFile#.pipe’ file is created for every ETL thread. Draining pipe files of data can be achieved by issuing command: cat $ENGINE_HOME/data/instance_0/bulkFile0.pipe
12. Please skip to section RUNING STREAMHORIZON DEMO

The following throughput can be achieved on I/O & network ‘out of the box’ (not optimized) systems utilising SAN Tier 2 (non SSD) storage, 32 core Unix server. Note that single Unix server hosts Oracle instance as well as StreamHorizon instance(s):

Load Method	Indexes	Number of ETL threads	Number of DB loader threads	Throughput per second
Bulk insert	no indexes / db loader mode*	0	50	2.4 million
Bulk insert	no indexes	24	50	1.1 million
Bulk insert	4 indexes + simultaneous aggregated and transactional fact table load (in parallel)	24	50	750K
JDBC insert	no indexes	24	0	750K
JDBC insert	no indexes (or indexes disabled)	3 instances** x 16	0	1.1 million
PIPE insert	pipes not tuned (excessively small buffers!)	10	0	400K

- - db loader mode – fastest way for persisting data into the database. This architecture employs any number of StreamHorizon instance which run in ETL mode only (number of db threads is zero for ETL mode of operation). ETL instance simply produces bulk file from source file (and performs dimensional maintenance on the fly). Number of ETL instances should be enough to keep single DB instance 100% utilized. DB instance which runs in db loader mode (it has number of ETL threads equal to zero) simply loads bulk files into the target database.
- ** - instance – Implies ETL instance, meaning that StreamHorizon runs in 'local cluster mode', three separate processes located on a single or multiple servers which run with ETL thread count greater than zero and DB thread count equal to zero. ETL instances essentially simply process input feeds and either:
    - Insert data directly into the database (if you use JDBC mode)
    - Create bulk files if you use BULK operation mode

Description of dataset used for benchmarks:

• 200 million loaded records

• Individual file size of 100K records

• Each record has minimum 200 bytes length (20 attributes)

• Data generated by Quant Library (meaning partially sorted)

• Target schema is Data Mart (Kimball design methodology)

• Fact table contains 6 Dimensions & 3 Measures. Highest cardinality of single dimension is 1200

• StreamHorizon was performing housekeeping tasks during execution (moving and deleting files) and logging performance metrics which downgrade performance between 7% and 13% (depending on mode of operation)

MSSQL DEMO

MSSQL demo achieves loads of 1 million records per second by utilizing partitioned heap table (table with no references or indexes). Note that fact table (sales_fact) is partitioned and is utilizing non PRIMARY data and log files. This is in order to achieve higher I/O parallelism/throughput. You can achieve similar throughput (1million per second) into MSSQL table if sales_fact wasn't partitioned. Supplied demo is using partitioned table (sales_fact).

INSTALLING JDBC DRIVERS FOR MSSQL

Installing JTDS Drivers:

StreamHorizon supports official Microsoft JDBC driver for MSSQL and also JTDS (http://jtds.sourceforge.net/). When using JTDS be aware that connection URL format is slightly different than the one for Microsoft driver (examples are given in section below). JTDS is shipped with StreamHorizon distribution and you can find it in $ENGINE_HOME/lib/ directory.

Installing Microsoft Drivers:

1. Please install MSSQL JDBC driver of your choice
2. If installing Microsoft JDBC drivers:
    - Microsoft driver (at the time of writing) is named sqljdbc_4.0.2206.100_enu.exe and can be found online at: http://www.microsoft.com/en-us/download/details.aspx?displaylang=en&id=11774
    - Place adequate sqljdbc_auth.dll file into $ENGINE_HOME\lib directory
    - Change PATH system variable to contain path to sqljdbc_auth.dll file
    - Copy sqljdbc4.jar file into $ENGINE_HOME\lib\directory.
3. Ensure that your MSSQL instance runs in mixed authentication rather than Windows authentication mode (alternatively you can alter script provided to work in Windows authentication mode, script: $ENGINE_HOME\demo_sales\mssql\mssql_create_db.sql)
4. Note that JDBC connectivity connection string <jdbcUrl> located in ($ENGINE_HOME\demo_sales\mssql\engine-config_JDBC.xml) contains following tuned parameters:
    - Maximum packet size (PacketSize=-1)
    - Set implicit transaction mode (TransactionMode=implicit)
    - Uses NCALRPC protocol (protocol=ncalrpc). NCALRPC setting should be used only if database and StreamHorizon instances are hosted on a single server. Alternatively it should be removed from <jdbcUrl> element ($ENGINE_HOME\demo_sales\mssql\engine-config_JDBC.xml)

TO TEST MSSQL JDBC DEPLOYMENT

1. Move $ENGINE_HOME\demo_sales\mssql\engine-config_JDBC.xml into StreamHorizon\config\ folder. After move file should be renamed from engine-config-JDBC.xml to engine-config.xml
2. Open engine-config.xml and change parameters commented out with string "SET ME!". The engine-config-JDBC-example.xml is provided as an arbitrary example of correctly configured file.
3. If required change default server:port setting from engine-config.xml (element <jdbcUrl>) from “localhost:1433” to adequate values
4. Ensure that your MSSQL instance runs in mixed authentication rather than Windows authentication mode (alternatively you can alter script provided to work in Windows authentication mode, script: $ENGINE_HOME\demo_sales\mssql\mssql_create_db.sql)
5. Execute MSSQL script $ENGINE_HOME\demo_sales\mssql\mssql_create_db.sql. Please read NOTE's at the beginning of the script prior to execution.
6. Copy sample file $ENGINE_HOME\demo_sales\sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file multiplier script in order to create 500 files.
7. Please skip to section RUNING STREAMHORIZON DEMO
8. NOTE: majority of systems run with JDBC batch size of 2000 records. In order to tune your throughput feel free to default batch size:

<property name="jdbc.bulk.loading.batch.size">2000</property>

TO TEST MSSQL BULK INSERT DEPLOYMENT

1. Move $ENGINE_HOME\demo_sales\mssql\engine-config-BULK-INSERT.xml into StreamHorizon\config\ folder. After move file should be renamed from engine-config-BULK-INSERT.xml into engine-config.xml
2. Open engine-config.xml and change parameters commented out with string "SET ME!". The engine-config-BULK-INSERT-example.xml is provided as an arbitrary example of correctly configured file.
3. If required change default server:port setting from engine-config.xml (element <jdbcUrl>) from “localhost:1433” to adequate values

4. Ensure that your MSSQL instance runs in mixed authentication rather than Windows authentication mode (alternatively you can alter script provided to work in Windows authentication mode, script: $ENGINE_HOME\demo_sales\mssql\mssql_create_db.sql)
5. Execute MSSQL script $ENGINE_HOME\demo_sales\mssql\mssql_create_db.sql. Please read NOTE's at the beginning of the script prior to execution. This step needs to be omitted if database has already been created.
6. Copy sample file $ENGINE_HOME\demo_sales\sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file multiplier script in order to create 500 files.
7. Change following values from $ENGINE_HOME\demo_sales\mssql\bulk_loader.bat file:
8. Change “server\myInstance” into adequate “server[\instance]” value
9. Change “G:\Data\StreamHorizon\bulk\” into path to your bulk directory as configured in <bulkOutputDirectory> element of engine-config.xml. Note that “%1” needs to remain as is in order for parameters to be adequately passed to the bulk insert routine.
10. Change “G:\Data\StreamHorizon\error\” into path to your error directory as configured in < errorDirectory> element of engine-config.xml. Note that “%1” needs to remain as is in order for parameters to be adequately passed to the bulk insert routine.
11. You may want to alter batch size setting ROWS_PER_BATCH=11000 of bulk_loader.bat file. However, in most cases default setting will deliver highest throughput.
12. Please skip to section RUNING STREAMHORIZON DEMO

NOTE: On some I/O systems you may get better performance if you remove following setting from engine-config.xml:

<property name="bulk.file.acceptance.timeout.millis">2000</property>

Note that in that case in some (less performant) I/O systems you may get the following error:

java.nio.file.DirectoryIteratorException: java.nio.file.AccessDeniedException

This occurs as DB loader threads start consuming files before ETL threads finishes writing them. If you see this error please set property "bulk.file.acceptance.timeout.millis” to adequate value which will give enough time to ETL threads to persist bulk files before DB threads try to consume them. This setting is subject to performance of your I/O system and need be tuned on every deployment.

INDEXING WITH MSSQL

MSSQL delivers query latency of 0-2 seconds if fact table is adequately indexed. This eliminates need to deliver MOLAP(OLAP) as a part of Data Warehousing solution. Load throughput into MSSQL heap table is approximately 1 million records per second, if fact table is indexed (to deliver low latency SQL queries by end users) load performance is reduced to ~333K records per second. This still provides throughput of 1.2 billion records per hour (running out of the box (systems which aren’t I/O tuned)).

- If your application requires 1million records per second throughput indexes should be disabled before data load and rebuilt after the loading has finished.
- If your data sources supply your target database with data at pace less than 28K-50K records per second you may want to leave indexes online during your data load. This eliminates need to disable and rebuild indexes.

Note: Performance of database load throughput doesn't linearly depend on number of indexes created on the fact table. Our findings are that fact table with one and three indexes has negligible different data load throughput.

Note: All given throughput metrics do not assume SSD but rather Tier 2 SAN storage. These figures are for systems which aren't tuned but are rather utilized with their default configuration 'out of the box'. Tuning MSSQL I/O may deliver throughput figures higher than those listed in this document.

Script containing create, drop, rebuild index statements and test sql queries is located in $ENGINE_HOME\demo_sales\mssql\mssql_IndexesAndQueries.sql file.

Conducted tests (on I/O & network 'out of the box' (not optimized) systems utilising SAN Tier 2 (non SSD) storage following throughput can be achieved (42 core server):

Load Method	Indexes	Number of ETL threads	Number of DB loader threads	Throughput per second
Bulk insert	no indexes (or indexes disabled)	40	40	1.05 million
Bulk insert	3 indexes	40	40	333K
JDBC insert	no indexes (or indexes disabled)	48	0	141K
JDBC insert	3 indexes	48	0	133K

Description of dataset used for benchmarks:

•200 million loaded records

•Individual file size of 100K records

•Each record has minimum 200 bytes length (20 attributes)

•Data generated by Quant Library (meaning partially sorted)

•Target schema is Data Mart (Kimball design methodology)

•Fact table contains 6 Dimensions & 3 Measures. Highest cardinality of single dimension is 1200

•StreamHorizon was performing housekeeping tasks during execution (moving and deleting files) and logging performance metrics which downgrade performance between 7% and 13% (depending on mode of operation)

MYSQL DEMO

MySQL deployment comes in two flavours, JDBC and reading rows from a text file (LOAD DATA INFILE).

Note: Unlike Oracle and MSSQL examples, MySQL example gives full working example of StreamHorizon integration; however, it does not contain partitioning for JDBC and Bulk loading examples. By partitioning tables and ensuring that writes are optimized and locks are avoided between parallel conections to same target table throughput can be dramatically increased to become of order of million records per second. Please look at Oracle (or MSSQL) examples to see how partitioning is achieved with those databases. In Oracle for example, JDBC insert statement contains StreamHorizon variable feedProcessingThreadID which gives unique id to every active ETL thread, we also ensure that every thread targets its own subpartition by using 'subpartition…' keyword in a query. Bulk load example with oracle is based on parallel load of 50 external tables dedicated to their own respective subpartitions of the table. Each process gains unique identifier by

utilizing bulkProcessingThreadID StreamHorizon variable (please see invocation of p_sh_external_table_load procedure).

It is very important to understand how to tune MySQL database engine for high throughput and bulk loading. Please refer to official MySQL documentation.

TO TEST MYSQL JDBC DEPLOYMENT

1. Move $ENGINE_HOME/demo_sales/mysql/engine-config.xml file into $ENGINE_HOME/config/ folder.
2. Open engine-config.xml file and change parameters commented out with string "SET ME!"
3. Execute script $ENGINE_HOME/demo_sales/mysql_create_schema.sql.
4. Make sure that element of engine-config.xml is set to <bulkLoadDefinition outputType="jdbc">
5. Make sure that <bulkLoadInsert> element has <command> tag uncommented. Value starting with 'insert into sales_fact….' Should be uncommented if you run in JDBC mode.
6. Copy sample file $ENGINE_HOME/demo_sales/sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file multiplier script in order to create 500 files.
7. Please skip to section RUNNING STREAMHORIZON DEMO

TO TEST MYSQL IN BULK LOAD MODE

1. Execute first four steps needed for running MySQL JDBC demo (see above)
2. In $ENGINE_HOME/config/engine-config.xml change <bulkLoadInsert> so that it uses first command (with LOAD DATA INFILE syntax)
3. Make sure that element of engine-config.xml is set to <bulkLoadDefinition outputType="file">
4. Make sure that <bulkLoadInsert> element has appropriate <command> tag uncommented. Value starting with 'LOAD DATA INFILE….' Should be uncommented if you run in JDBC mode.
5. Copy sample file $ENGINE_HOME/demo_sales/sales_20140107_data.csv and file multiplier script file_multiplier.sh (or .bat) to your <property name="directoryPath"> as configured in engine-config.xml. Execute file multiplier script in order to create 500 files.
6. Please skip to section RUNNING STREAM HORIZON DEMO

NOTE: On some I/O systems you may get better performance if you remove following setting from engine-config.xml:

<property name="bulk.file.acceptance.timeout.millis">2000</property>

Note that in that case in some (less performant) I/O systems you may get the following error:

java.nio.file.DirectoryIteratorException: java.nio.file.AccessDeniedException

This occurs as DB loader threads start consuming files before ETL threads finishes writing them. If you see this error please set property "bulk.file.acceptance.timeout.millis" to adequate value which will give enough time to ETL threads to persist bulk files before DB threads try to consume them. This setting is subject to performance of your I/O system and need be tuned on every deployment.

RUNNING STREAMHORIZON DEMO

Before we run StreamHorizon we need to set StreamHorizon threadpools. StreamHorizon has two threadpools, ETL and DB threadpools.

- If you run test via JDBC (for Oracle, MSSQL and MYSQL) your ETL threadpool needs to be greater than zero while DB threadpool needs to be set to zero.
- If you run in BULK MODE (BULK for MYSQL or EXTERNAL TABLES for Oracle or BULK INSERT for MSSQL) both, ETL and DB threadpools would be set as advised in engine-config.xml.
- ETL threadpool (number of threads) is set by assigning number to element <etlProcessingThreadCount> of $ENGINE_HOME/config/engine-config.xml
- DB threadpool (number of threads) is set by assigning number to element <databaseProcessingThreadCount> of $ENGINE_HOME/config/engine-config.xml NOTE: for JDBC deployment this number should be set to zero.

WHAT IS DESIRED THREADPOOL SIZE?

Rough estimate is that (assuming that your server is not under heavy load) you should set threadpool size to number of cores of your server. So, for 24 core server for JDBC following settings should be used:

- <etlProcessingThreadCount>24</etlProcessingThreadCount>
- <databaseProcessingThreadCount>0</databaseProcessingThreadCount>

For BULK LOAD deployment following should be used:

- <etlProcessingThreadCount>24</etlProcessingThreadCount>
- <databaseProcessingThreadCount>24</databaseProcessingThreadCount>

Please modify your threadpool sizes and save changes in engine-config.xml file.

Maximum database load parallelism <databaseProcessingThreadCount> element for Oracle is 50 as fact table has 50 subpartions, for MSSQL it is 40 as fact table has 40 partitions. These limitations are due to data model provided by StreamHorizon, you can as per your needs alter provided create table statements to increase parallelism (number of partitions).

For JDBC mode may want to test tuning of JDBC batch size <property name="jdbc.bulk.loading.batch.size"> property. Oracle usually delivers best performance with setting of 10000 while MSSQL usually performs best with the setting of 2000.

Other parameters critical for tuning are:

- <property name="read.buffer.size.mb">10.0</property> This parameter should ideally be set to value (in MB) which is bigger or equal to the size of your largest data file size. If I/O system is saturated due to high number of etl threads <etlProcessingThreadCount> it may be beneficial to set "read.buffer.size.mb" to

value less than average file size (approximately 1/10 of average file size). Most suitable buffer size is determined by testing of different buffer sizes

- <property name="write.buffer.size.mb">10.0</property> This parameter should be set to be just over size (in MB) of largest bulk file generated by StreamHorizon. If I/O system is saturated due to high number of etl threads <etlProcessingThreadCount> it may be beneficial to set "write.buffer.size.mb" to value less than average file size (approximately 1/10 of average file size). Most suitable buffer size is determined by testing of different buffer sizes

STARTING STREAMHORIZON INSTANCE

Please start StreamHorizon instance by executing $ENGINE_HOME/bin/start.sh (or .bat)

Please read "REALISTIC TESTING" section below

CHECKING THROUGHPUT OF YOUR SERVER FOR ORACLE & MSSQL DATABASES

- Use select * from sh_dashboard to view statistics/throughput of JDBC or file/feed processing (case when output feeds (files) are created without being loaded into the database)
- Use select * from sh_dashboard_bulk to view statistics/throughput of load via external tables or SQL*Loader

Views return statistics of total number of data records loaded, time window and achieved throughput per second of StreamHorizon instance(s). You will notice that throughput of StreamHorizon increases as batch progresses.

Note that views sh_dashboard* will only show throughput metrics for data loaded for latest start of StreamHorizon engine instance. This is because $ENGINE_HOME/config/engine-config.xml has '<OnStartupCommands> SQL call to truncate metrics table (<command type="sql">truncate table sh_metrics</command>). If you wish to see metrics over many runs of StreamHorizon instance uncomment or remove this setting.

OTHER METRICS & VIEWS

sh_* views return statistics of total number of data records loaded, time window and achieved throughput per second of StreamHorizon instance(s) and other useful statistics.

- Use **sh_dashboard_jdbc** to view query statistics/throughput of JDBC (or file to file) processing (case when output feeds (bulk or ordinary text files) are created without being loaded into the database). This view is used when only ETL threadpool is operational (DB threadpool size is zero), for example ETL (single instance) or ETL (clustered instance) mode or any other mode without DB threadpool.
- Use **sh_dashboard_bulk** to view statistics/throughput of load via bulk inserts. Note that this view can only be used if your StreamHorizon instance runs in both ETL & DB mode (if number of ETL threads and number of DB threads is higher than zero).
- View **sh_dashboard_db_loader_mode** to view statistics/throughput of load via bulk inserts. Note that this view can only be used if your StreamHorizon instance runs in exclusive DB Loader mode only (if number of ETL threads is set to be zero) see figure "Dedicated ETL & Dedicated DB Loader Instances".
- View **sh_dashboard_pipe** shows throughput figures when StreamHorizon is running in pipe mode. Note that for this mode number of DB threads is set to zero. This mode is available only for Oracle database running on Unix/Linux platforms.

- View **sh_dashboard_file_2_file** shows throughput figures when StreamHorizon is running in file to file mode. This means that DB threadpool has size zero and that only ETL threadpool is used. In this mode ETL threads read feed files as an input and produce ordinary or bulk files as output.
- View **sh_dashboard_file_2_file** shows throughput figures when StreamHorizon is running in file to file mode. This means that DB threadpool has size zero and that only ETL threadpool is used. In this mode ETL threads read feed files as an input and produce ordinary or bulk files as output.
- View **sh_all_sales_fact** selects all data from sales_fact table
- View **sh_all_sales_fact_agg** selects all data from sales_fact_agg table. This table is only populated for Oracle external table demo when Aggregation feature is switched on; please see "Copy of StreamHorizon Test Demo Deployment Guide" for more information.
- View **sh_all_sales_fact_count** returns number of records loaded in sales_fact table
- View **sh_all_erros** will show all feeds which have had errors during processing. Errors are flagged either by error flag attributes having 'F' value (etlCompletionFlag = 'F' or bulkCompletionFlag = 'F') or/and by error description attributes being not null (etlerrordescription IS NOT NULL OR bulkerrordescription IS NOT NULL).
- To see detailed performance & activity logs look at **sh_metrics** table (or view **sh_all_metrics**). This table contains one record for every file processed if you run in JDBC mode and two records (one created by ETL thread and one created by DB thread) if you run in Oracle external table mode. To troubleshoot please look at $ENGINE_HOME/log/sh-engine*log
- Use **sh_etl_bulk** view to analyze time delays introduced by ETL or DB threads. This view is intended to work only for bulk load modes of operation for single instance monitoring. View shows only events for a last startup of the StreamHorizon engine.
- Other **sh_etl_*** views are advanced views used in monitoring of ETL and database load performance, please see source code if you wish to understand potential usage.
- View **sh_all_db_loader_proc_time** returns processing window and number of files processed for StreamHorizon running in DB loader mode (either exclusive or not).
- View **sh_dashboard** is view is utilised by views sh_dashboard_jdbc, sh_dashboard_pipe and other mode specific views.

ANALYZING DELAYS IN ETL AND DB LOAD

Use select * from sh_etl_bulk to analyse time delays introduced by ETL or DB threads. This view is intended to work only for bulk load modes of operation for single instance monitoring. View shows only events for a last startup of the StreamHorizon engine.

CUSTOMIZE METRICS & LOGGING

You may customize all above tables & views to your liking by changing calls <afterFeedProcessingCompletion> & <onBulkLoadCompletion> of default $ENGINE_HOME/config/engine-config.xml configuration.

CHECKING THROUGHPUT OF YOUR SERVER FOR MYSQL DATABASE

Use *select * from sh_metrics* to see throughput of StreamHorizon instance when using MySQL database.

REALISTIC TESTING

As first run of StreamHorizon will form all cardinalities of the all dimensions from scratch average throughput will be ~3 times slower than actual.

After first successful run, after dimensions have been repopulated, kill the StreamHorizon instance. Then copy files back from <archiveDirectory> to location specified in <property name="directoryPath">. Start instance of StreamHorizon again and observe the throughput. To avoid repeating this every time you run StreamHorizon write a script which moves files from archive to source directory and change engine-config.xml to invoke it on every startup of StreamHorizon engine instance:

```
<onStartupCommands>

      <command type="shell">/yourMoveScriptComesHere.sh (or .bat)</command>

      <command type="sql">truncate table sales_fact</command>

      <command type="sql">truncate table sh_metrics</command>

</onStartupCommands>
```

NOTE: if you run one set of files, than pause let's say an hour (you do not kill StreamHorizon instance) and then run another batch of files, view sh_dashboard will show very low throughput. This is because view calculates time window of first file processed by instance after startup and last file processed since instance startup. If batch was loaded in 1 minute, if idle time of server was 98 minutes, and if second batch was running for 1 minute, throughput shown by sh_dashboard will be 2% of actual throughput of the StreamHorizon.

To avoid this simply observe throughput during the batch immediately after all files are loaded and make sure you restart StreamHorizon before the next test.

StreamHorizon increases data throughput as batch progresses!

THROUGHPUT GUIDELINES

In our testing environments we have used commodity Windows, Linux and Solaris servers.

StreamHorizon performs better if deployed on the same server as database server. As StreamHorizon is resource lightweight and can efficiently coexist/operate with database instance this is our recommended deployment.

We have used 24 core servers and have achieved throughput above 800K per second for Oracle External Tables (running with 24 ETL and 24 DB threads) and throughput above 600K for JDBC Oracle setup running with 26 ETL and zero DB threads.

If you deploy StreamHorizon on the same server as database server and if your server has 32 cores then number of ETL threads should be around 26. These, of course, are rough guidelines; you should perform multiple tests by adjusting ETL and DB thread count in order to determine optimal settings for your hardware configuration.

REALISTIC DATA

Our tests utilize data typical for Time Series Analysis, Credit Risk, Market Risk and PnL datasets.

File sizes are large (but realistic), data is partially 'sorted' because of the way Tick and Risk data is produced. Such nature of data increases throughput of the StreamHorizon (or any other data processing & ETL platform).

If you are happy with StreamHorizon next step would be to configure it to work with your data model and data feeds.

We are happy to help you in setting up, deploying and delivering your StreamHorizon instance.

TUNING STREAMHORIZON

Note that extensive sample xml configuration which presents more detailed ability of the platform is available in $ENGINE_HOME/config/streamHorizonQuickXMLTutorial_engine_config.xml file. XML file is full of descriptive comments about some useful features of the platform of which many are not included in this demo due to simplicity.