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Tracking SQL statistics with ExtSQL

KEEPING SCORE

ExtSQL provides detailed usage statistics for MySQL and PostgreSQL database systems. **BY JOHN MURTARI**

MySQL and PostgreSQL have become standard open source databases on the basis of their active developer communities, solid performance, and reliable operation.

Despite the power and flexibility of these SQL variants, the options for obtaining historical data on database usage are relatively limited. SQL monitoring tools typically focus on gross monitoring at the server level. The Extended Usage Statistics for SQL (ExtSQL) project is an effort to make a much wider range of statistical information available to database admins through simple commands at the SQL command line. In fact, ExtSQL provides advanced admin features for MySQL and PostgreSQL that are not even available in the “big brother” SQL vendors. Database admins can now use ExtSQL to monitor and account for server usage down to the individual database, user, or even connecting client.

Almost any variable available through the *SHOW STATUS* command can be tracked. For instance, To see a display of all user activity in hourly increments for the last 24 hours showing the number of queries of each type, enter:

```
SHOW STATISTICS Z
Com_select, Com_update, Com_insert Z
FROM user WHERE
Com_select > 100 HISTORY LIMIT 24
```

My company, Software Workshop Inc., developed ExtSQL and currently makes it available as open source software under the GPL. Our hope is that the features implemented through ExtSQL will eventually be implemented by other databases such as Oracle and DB2 and will become part of the SQL standard. In the meantime, ExtSQL takes the form of drop-in replacements for the server daemons used with MySQL and PostgreSQL.

In this article, I describe how to install and configure ExtSQL for a typical MySQL installation. The process for setting up ExtSQL for PostgreSQL is similar.

Building a New mysql

The ExtSQL website [1] has compiled binaries for various OS/hardware platforms available for evaluation and licensing. The most current instructions for installing and using ExtSQL are also available at the ExtSQL website.

First, download the ExtSQL patches for your version of the MySQL server

Table 1: db – A Database	
Class	Entity
<i>user</i>	A user
<i>host</i>	The connection host machine
<i>conuser</i>	User–host connection combo
<i>condb</i>	Db–host connection combo
<i>server</i>	The server

and put the .gz file at the top of your MySQL distribution. Type *make distclean* at the top of your distribution tree to remove all prior build products then enter

```
tar -zxvf ?
extsql-my-src-5.0.45-rhel4-?
x86-2-1a-2.0b.tar.gz
```

to unpack. The result should be files similar to these four:

```
patch-5.0.2.0b
compat-5.0.1a
do_conf-5.2
README.source_extsql
```

The first two files are patch files. The *patch-* file contains the bulk of the changes that make up ExtSQL. The second file (*compat-*) contains unique fixes for the specific version of MySQL.

The *do_conf-* file contains the exact configure commands used for the source build, so merge this list with any selections you've made. As always, view the README for the latest information.

The next step is to apply the patches, but apply the *compat-* file first

```
patch -V t -p0 -lNu ?
< compat-5.0.1a
patch -V t -p0 -lNu ?
< patch-5.0.2.0b
```

then run the same *configure* command you used to create your current build of MySQL with the options you desire.

For ExtSQL 5.0.x, you must add the following option to the current list of *CXXFLAGS* used in the definition for your configure (e.g., *-DEXTSQL_50=1*):

```
'CXXFLAGS=-O2 -DEXTSQL_50=1 ?
-pipe -m32 -march=i386 ?
-mtune=pentium4'.
```

Then type *make* as usual to build *mysqld*. A new *mysqld* binary in the build directory *sql* should be the result.

Install the ExtSQL Server

Instead of *make install*, you manually replace *mysqld*. I recommend the following procedure. (I assume the base install directory for MySQL is */usr/local/mysql*.)

Start by backing up your databases and making a backup of your current *mysqld*:

```
cp -a mysqld mysqld.sav
```

ExtSQL prints status information to the MySQL error file. In another window, monitor the server with the following (use the correct path for your system):

```
tail -f /usr/local/mysql/var/?
your-hostname.err &
```

Now you are ready to install and activate the new server with the basic commands available in MySQL to stop and start the server. If your installation uses other wrapper programs, use them as well:

```
/usr/local/mysql/bin/mysqladmin ?
-u root -p"password" shutdown
```

Listing 1: Usage Examples

The examples below show a cross section of ExtSQL commands and output.

```
## Show number of selects and inserts given by all users:
```

```
sql> SHOW STATISTICS Com_select, Com_insert, Questions FROM user;
```

```
+-----+-----+-----+-----+
| user      | Com_select | Com_insert | Questions |
+-----+-----+-----+-----+
| bandala   | 8302675    | 95973      | 23153940  |
| sandymao  | 1702812    | 6205       | 3829023   |
| ponnetli  | 24909      | 4784       | 95646     |
```

```
## Show number of selects, total queries, and updates made by all
## client hosts:
```

```
sql> SHOW STATISTICS Com_select, Questions, Com_update FROM host;
```

```
+-----+-----+-----+-----+
| host              | Com_select | Questions | Com_update |
+-----+-----+-----+-----+
| db2.adomain.com   | 17715223   | 44224076  | 4143634981 |
| lathe.adomain.com | 2738061    | 9743215   | 3913397495 |
| telkomads1.co.za  | 195        | 5390      | 539604     |
```

```
## Show number of selects, total queries, and updates made by all
## users@client host with more than 10,000 queries:
```

```
sql> SHOW STATISTICS Com_select, Questions, Com_update FROM conuser
WHERE Questions > 10000;
```

```
+-----+-----+-----+-----+
| conuser (user@host) | Com_select | Questions | Com_update |
+-----+-----+-----+-----+
| bandala@db2.adomain.com | 8306726    | 23163320  | 3439850933 |
| sandymao@db2.adomain.com | 1704040    | 3831803   | 3365501841 |
| ponnetli@taro.adomain.com | 24920      | 95662     | 156529077  |
```

```
## Show number of selects, total queries, and updates to DB allison for
## the last three minutes with activity:
```

```
sql> SHOW STATISTICS Com_select, Questions, Com_update FROM db
```

```
LIKE 'allison' HISTORY LIMIT 3;
+-----+-----+-----+-----+
| db | minutes      | Com_select | Questions | Com_update |
+-----+-----+-----+-----+
| allison | 11/20 13:56 | 216        | 382        | 318343     |
| allison | 11/20 13:55 | 642        | 1618       | 1386347    |
| allison | 11/20 13:54 | 280        | 699        | 646855     |
```

```
060612 07:58:08 [Note]
/usr/local/mysql/bin/mysqld:
Shutdown complete
```

Note: The path in the logfile *shutdown* command should be the same path to which you previously backed up *mysqld*. Copy the new *mysqld* into place

```
cp -a /path/to/your/
source-installation/sql/
mysqld mysqld
```

and start the new server:

```
/usr/local/mysql/bin/mysqld_safe
--user=$mysql_user $other_args &

071121 7:42:47 [Note]
ExtSQL build: ExtSQL version:
```

```
extsql-my-bin-5.0.45-
rhel4-x86-2-1a-2.0b
060612 7:58:38 [Note]
ExtSQL disabled by user,
no extsql_class_list defined
```

Now take a breather. The preceding lines confirm the server was built with the ExtSQL subsystem, and it is currently disabled because no statistics were requested. We recommend you run the server for at least a day and convince yourself things are operating normally. Server performance should not be affected.

If an error occurs, it could indicate a problem with the build. To get back to a known good configuration, just restore your version of *mysqld* and restart the server. To start recording statistical data,

open */etc/my.cnf* and add the following line, which must be in the *[mysqld]* section of the config file:

```
extsql_class_list=
"user, max-100, time-120,
units-h, (Com_insert, Com_select,
Com_update, Com_delete,
Com_replace, Qcache_hits,
Questions, Slow_queries)"
```

The command above should be on one physical line in the file. If you change */etc/my.cnf*, be sure to remove this line if you revert to a standard *mysqld*.

On restart of your server, you should see the following entries in the error log:

```
060612 8:26:12 [Note]
ExtSQL build: ExtSQL version:
extsql-my-bin-5.0.45-rhel4-
x86-2-5a-3.0b
060612 8:26:12 [Note]
ExtSQL ACTIVE tracking memory:
435600 bytes for 1
class
```

Errors during initialization or operation will be noted in the error log, and the subsystem will disable itself, leaving MySQL operations intact.

Terminology

In ExtSQL, the entities that interact with the server are called *classes* (Table 1). Within a class, specific instantiations are called *instances*. An instance of a user could be *domenic* or *christina*, for example. The *server* class is unique in that the only instance is the server itself.

For each instance, you can track individual data items called *vars*. Vars include almost all of the values displayed in the present *SHOW STATUS* command. Use the name of the var as displayed by *SHOW STATUS*; for example, *Com_select* tracks *select* statements.

Configuration Options

More than 100 vars (data items) are available. Configure the ExtSQL server by describing which vars you are interested in tracking and how you want to collect data. For a more complete example, consider this string, which must be one line in the configuration file:

```
extsql_class_list="
user, max-50, time-60, units-m,
```

Listing 2: INFORMATION_SCHEMA

```
mysql> use INFORMATION_SCHEMA;
mysql> SHOW TABLES;
## Note: the additional tables configured by the DBA for ExtSQL are
## prefaced with 'EXTSTATS_'
| EXTSTATS_condb          |
| EXTSTATS_conuser       |
| EXTSTATS_db            |
| EXTSTATS_host          |
| EXTSTATS_server        |
| EXTSTATS_user          |
## End of added tables

mysql> SELECT user, minutes, Com_select, Questions FROM EXTSTATS_user
WHERE TIMEDIFF(now(), minutes) < '10:00';
+-----+-----+-----+-----+
| user   | minutes          | Com_select | Questions |
+-----+-----+-----+-----+
| thebook | 2008-07-19 09:28:00 | 2          | 4         |
| thebook | 2008-07-19 09:27:00 | 3          | 3         |
| matt   | 2008-07-19 09:53:00 | 4          | 4         |
| matt   | 2008-07-19 09:52:00 | 0          | 1         |

## This makes the full syntax of the SQL parser available, BUT... it
## exposes that data is recorded in a circular buffer by time interval
## (minutes in our example), with the time '0000-00-00' containing
## totals since server start.

mysql> SELECT user, minutes, Com_select, Questions FROM EXTSTATS_user
WHERE user='thebook' LIMIT 5;
+-----+-----+-----+-----+
| user   | minutes          | Com_select | Questions |
+-----+-----+-----+-----+
| thebook | 2008-07-19 09:27:00 | 3          | 3         |
| thebook | 2008-07-19 09:25:00 | 2          | 73        |
| thebook | 2008-07-18 16:44:00 | 0          | 14        |
```

```
(Com_select, Com_update), ↗
db, max-50, time-10, units-h, ↗
(Com_insert, Com_select, ↗
Com_update, Qcache_hits), ↗
host, max-5, time-3, units-d, ↗
(Com_select, Com_update, ↗
Slow_queries), server, max-5, ↗
time-3, units-d, ↗
(Questions, Qcache_hits)"
```

As with *SHOW STATUS* (in this case with historical data), the server will track information on four different classes: *user*, *db*, *host*, and cumulative server stats.

For each class, *max-* precedes the maximum number of instances of that class. *time-* precedes the number of historical time units to store, and *units-* designates the period of interest (*m*, minutes; *h*, hours; *d*, days). After the limits for each class, a comma-separated list of vars is included. The line starting with *db* is a directive to track a maximum of 50 *db*s and record historical data for each of the last 10 hours. The vars addressed in the preceding command are inserts, selects, updates, and query cache hits.

SHOW STATISTICS Syntax

The goal for command syntax was to stay as close to standard SQL as possible. The syntax described here should look familiar, especially if you replace *SHOW STATISTICS* with *SELECT*. Listing 1 shows some ExtSQL usage examples.

Significantly different are *LIKE*, to match specific instances, and the new keyword *HISTORY*, to produce historical output. *LIMIT* operates differently if *HISTORY* is specified. Without *HISTORY*, it limits the number of results displayed. With *HISTORY*, it functions as a time limit.

```
SHOW STATISTICS ( * | Var list) ↗
FROM Class [LIKE 'Instance pattern']
[WHERE Var ( '<' | '>' | '=' ) num] ↗
[ORDER BY Var] [HISTORY] ↗
[LIMIT num]
```

Information Schema Syntax

Many of you are aware that *INFORMATION SCHEMA* is already part of the SQL standard, and its purpose is to make SQL databases more “self describing.” The ExtSQL project already has an example working implementation for MySQL 5.0.x (see Listing 2).

Command	Action
<i>STATISTICS (ON OFF)</i>	Set data collection on or off. Historical data are not lost.
<i>STATISTICS RESET [conf_file]</i>	Clear any old data. Start collecting using the existing Class definitions, or use those in <i>conf_file</i> .
<i>STATISTICS WRITE reload_file</i>	Save a snapshot of current data to a file. Useful in storing data from an anomalous event for later analysis.
<i>STATISTICS READ reload_file</i>	Load statistics data from the specified file.

For example, you can ask:

```
SHOW STATISTICS * ↗
FROM user LIKE '%joe%' ↗
WHERE Com_select > 500
```

In standard SQL, that would be:

```
SHOW STATISTICS * ↗
FROM user WHERE user ↗
LIKE '%joe%' AND Com_select > 500
```

LIKE is a separate clause in the syntax that matched just *Class* instances. For now, the syntax is limited in the *WHERE* clause, and *ORDER BY* is available if *INFORMATION SCHEMA* is supported in your base version of the ExtSQL server.

Server Performance

Performance was a primary design constraint on ExtSQL. With more and more memory available on servers, it made sense to store data in RAM while giving the database administrator complete control over how much memory would be allocated. This resulted in an average performance effect of about 5% – an acceptable number on most servers.

For a better understanding of performance statistics, consider how ExtSQL records and reports time. With the class definition *user*, *max-50*, *time-10*, *units-h*, ExtSQL will create a buffer that holds 11 time periods. The 0 buffer always holds cumulative numbers since server start and is the number displayed in the command *SHOW STATISTICS * FROM user*.

Historical activity is captured for 10-hour periods in a circular manner and only when activity occurs (e.g., start the server and 20 hours later enter):

```
SHOW STATISTICS * ↗
FROM user HISTORY
```

Assume user activity was recorded in each of the first 10 hours of server operation, and then only in the last five hours

(i.e., a five-hour gap with no activity). Activity that occurred between server operation hours 5 and 10 is reported by the hour, then the last five hours. Each row is timestamped to the hour. With the command *SHOW STATISTICS * FROM user*, you would see just one line of cumulative totals for all 20 hours.

Security

Because you might not want to share ExtSQL information with every user, the configuration file lets you specify the users who will have access:

```
extsql_users=↗
"john, domenico, phil, mary"
```

The root user is always allowed access.

Controlling ExtSQL

Additional commands (Table 2) allow the database administrator to temporarily suspend data collection, store data, and even change what data is being collected – without a server restart.

A configuration option called *extsql_reload_file* allows you to store collected data, which is automatically saved and restored during a restart.

Future Directions

Development with ExtSQL should be strong, and we plan to provide a focal point for community discussion, bug reports, fixes, and enhancements. ■

INFO

[1] ExtSQL: <http://www.ExtSQL.com/>

THE AUTHOR

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