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MySQL

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MySQL Query Tracing And Profiling

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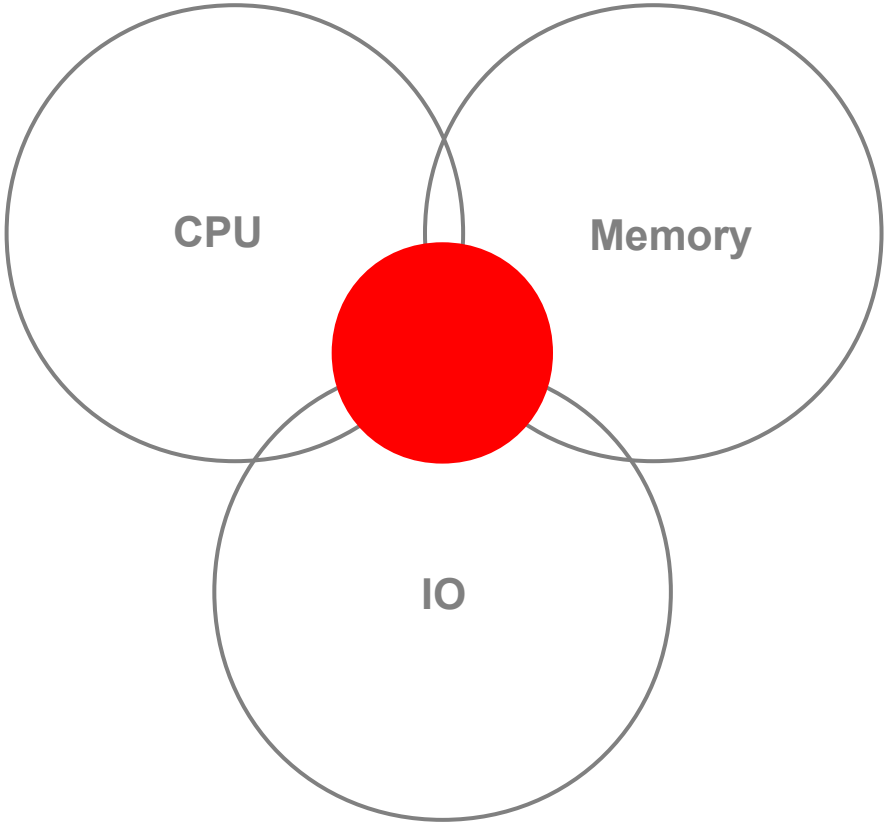
MySQL Engineering Connectors And Client Connectivity

- Performance
- Scalability

Performance Limiters

At least a few of them

- Frequency
- Scale
- ...



- Amount
- Speed
- CPU-Architecture (NUMA?)
- ...

- Disc
- Network
- ...

- If I …
  - Use a more CPU efficient algorithm
    - I might need more memory (and vice versa)
  - Add compression to save IO
    - I need more CPU
  - Offload work from the database
    - I need a bigger app/web server

→ Improving one piece might have bad impact on others

We're talking about the Web …

Measure What Matters!

- Goal has to be to server more users and/or serve faster
- Some tools:
  - Apache httpd's ab
  - Apache JMeter
  - Siege
- Measure the base line
- Decide what to focus on
  - Latency, throughput, ...

We're talking about the Web …

… don't forget the Frontend!

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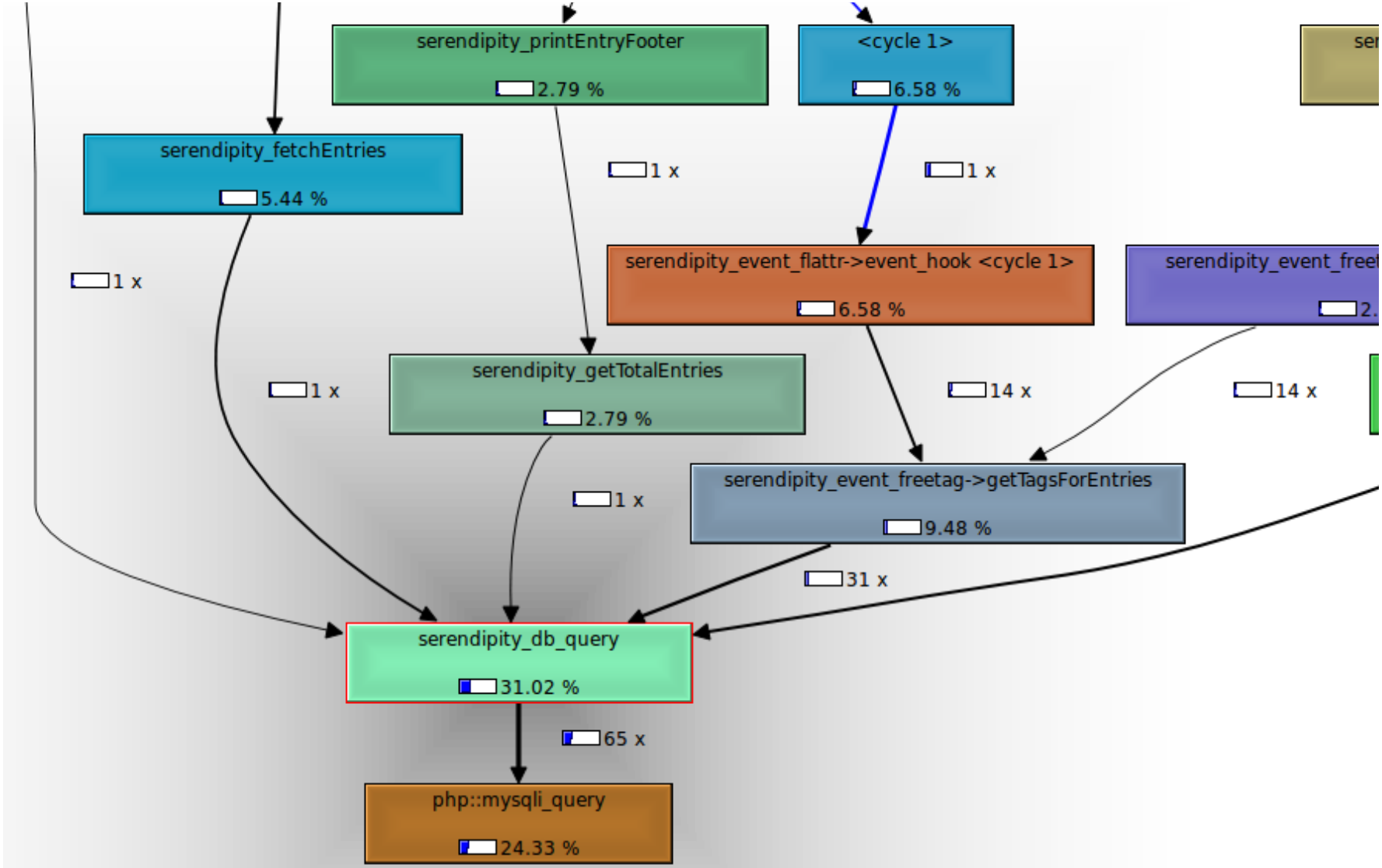

serendipity_printEntryFooter
2.79 %
<cycle 1>
6.58 %
serendipity_fetchEntries
5.44 %
1 x
1 x
1 x
serendipity_event_flattr->event_hook <cycle 1>
6.58 %
1 x
serendipity_getTotalEntries
2.79 %
14 x
14 x
1 x
serendipity_event_freetag->getTagsForEntries
9.48 %
31 x
serendipity_db_query
31.02 %
65 x
php::mysqli_query
24.33 %

PHP Profiling

- Xdebug
  - Free / OpenSource
  - $ pecl install xdebug
  - $ php -d xdebug.profiler_enale=1 script.php
  - KCacheGrind, WinCacheGrind, WebGrind
  - http://xdebug.org
- Zend Platform/Studio
  - commercial


MySQL

Finding the Slow/Expensive Queries

PHP-Based Database Wrapper

```
class MyPDO extends PDO {
    private $data = array();
    public function query($stmt) {
        $stats_before = mysqli_get_client_stats();
        $start = microtime(true);

        $retval = parent::query($stmt);

        $end = microtime(true);
        $stats_after = mysqli_get_client_stats();

        $this->data[] = array(
            'stmt' => $stmt,
            'time' => $end - $start,
            'bytes_sent' => $stats_after['bytes_sent'] - $stats_before['bytes_sent']
        );
        return $retval;
    }
}
```

mysqlnd Statistics

Client statistics	
bytes_sent	5381679
bytes_received	39375881
packets_sent	16117
packets_received	469633
protocol_overhead_in	1878532
protocol_overhead_out	64468
bytes_received_ok_packet	18436
bytes_received_eof_packet	67682
bytes_received_rset_header_packet	68915
bytes_received_rset_field_meta_packet	8416202
bytes_received_rset_row_packet	30690198
bytes_received_prepare_response_packet	0
bytes_received_change_user_packet	0
packets_sent_command	15279
packets_received_ok	1676
packets_received_eof	13522

- Around 150 statistic values collected
- mysqli_get_client_stats (), mysqli_get_connection_stats()

PHP-Based Database Wrapper

- ✔ Aware of the application
- ✔ Requires no changes to the Server

- ✗ Application changes needed
- ✗ Probably notable performance impact

PHP mysqlnd_uh

```
// php.ini
auto_prepend_file=autoprepend.php
```

```
// autoprepend.php
class ConnProxy extends MysqlndUHConnection {
    public function query($conn, $stmt) {
        // Same code as before ...
    }
}

mysqlnd_uh_set_connection_proxy(new ConnProxy());
```

PHP mysqlnd_uh

- ✔ Aware of the application
- ✔ Requires no changes to the server

- • Very little application change needed

- ✗ Probably notable performance impact
- ✗ No stable version

MySQL Proxy

- “MySQL Proxy is a simple program that sits between your client and MySQL server(s) that can monitor, analyze or transform their communication.“
- Can be programmed using LUA

```
function read_query( packet )
    if string.byte(packet) == proxy.COM_QUERY then
        local query = string.sub(packet, 2)
        print("we got a normal query: " .. query)
    end
end
```

MySQL Proxy

- ✔ Requires only changes to the configuration, not the code
- ✔ Can be placed on app server, database server or dedicated machine
- ✔ No actual code changes needed
- ✔ No server admin changes needed

- ✗ Requires knowledge of LUA and the MySQL protocol
- ✗ Not application-aware
- ✗ No GA version

Slow Query Log

- --slow_query_log=1

```
$ mysqldumpslow

Reading mysql slow query log from /usr/local/mysql/data/mysqld51-slow.log
Count: 1  Time=4.32s (4s)  Lock=0.00s (0s)  Rows=0.0 (0), root[root]@localhost
 insert into t2 select * from t1

Count: 3  Time=2.53s (7s)  Lock=0.00s (0s)  Rows=0.0 (0), root[root]@localhost
 insert into t2 select * from t1 limit N

Count: 3  Time=2.13s (6s)  Lock=0.00s (0s)  Rows=0.0 (0), root[root]@localhost
 insert into t1 select * from t1
```

DTrace

```
#!/usr/sbin/dtrace -qs

mysql*:mysqld::query-start {
  this->query = copyinstr(arg0);
  this->start = timestamp;
  this->in_filesort = 0;
}

mysql*:mysqld::filesort-start {
  this->in_filesort = 1;
}

mysql*:mysqld::query-done
/ this->in_filesort / {
  printf("%u: %s\n",
          timestamp – this->start,
          this->query);
}
```

DTrace

- ✔ Low impact on system
- ✔ No changes to the system
- ✔ Can be attached while running
- ✔ Access to all information on the system

- • Oracle Solaris Kernel feature (ported to BSD, MacOS)

- ✗ Deep system knowledge required
- ✗ System user with the needed rights required

Can the query be avoided?

Can it be cached?

Can it be simplified?

Can it be optimized?

Explain

```
mysql> EXPLAIN SELECT first_name, last_name, salary
            FROM employees e
            LEFT JOIN salaries s ON e.emp_no = s.emp_no
            WHERE salary > 67000
            AND e.last_name LIKE '%fg%'
            AND s.to_date = '9999-01-01';
+----+-------------+-------+------+----------------+
| id | select_type | table | type | possible_keys  |
+----+-------------+-------+------+----------------+
|  1 | SIMPLE      | e     | ALL  | PRIMARY        |
|  1 | SIMPLE      | s     | ref  | PRIMARY,emp_no |
+----+-------------+-------+------+----------------+
```

```
 +--------+---------+---------------------+--------+-------------+
 | key    | key_len | ref                 | rows   | Extra       |
 +--------+---------+---------------------+--------+-------------+
 | NULL   | NULL    | NULL                | 300363 | Using where |
 | emp_no | 4       | employees.e.emp_no |      4 | Using where |
 +--------+---------+---------------------+--------+-------------+
```

SHOW PROFILES;

```
mysql> SET profiling = 1;
mysql> SELECT first_name, last_name, salary
           FROM employees e
           LEFT JOIN salaries s ON e.emp_no = s.emp_no
           WHERE salary > 67000
           AND last_name LIKE '%fg%' AND to_date = '9999-01-01';
mysql> SHOW PROFILES;
+----------+------------------------------------------------+
| Query_ID | Duration   | Query                             |
+----------+------------+-----------------------------------+
|        1 | 0.33801275 | SELECT first_name, last_name, ...
                                ...  to_date = '9999-01-01'|
+----------+------------+-----------------------------------+
```

SHOW PROFILE;

```
mysql> SHOW PROFILE CPU FOR QUERY 1;
+--------------------+----------+----------+------------+
| Status             | Duration | CPU_user | CPU_system |
+--------------------+----------+----------+------------+
| starting           | 0.000101 | 0.000089 |   0.000011 |
| Opening tables     | 0.000015 | 0.000014 |   0.000002 |
| System lock        | 0.000006 | 0.000005 |   0.000001 |
| Table lock         | 0.000009 | 0.000008 |   0.000001 |
| init               | 0.000033 | 0.000032 |   0.000001 |
| optimizing         | 0.000016 | 0.000015 |   0.000001 |
| statistics         | 0.000024 | 0.000023 |   0.000001 |
| preparing          | 0.000017 | 0.000015 |   0.000001 |
| executing          | 0.000004 | 0.000003 |   0.000001 |
| Sending data       | 0.337715 | 0.382104 |   0.013387 |
| end                | 0.000014 | 0.000006 |   0.000006 |
| query end          | 0.000005 | 0.000004 |   0.000001 |
| freeing items      | 0.000046 | 0.000024 |   0.000022 |
| logging slow query | 0.000004 | 0.000002 |   0.000001 |
| cleaning up        | 0.000005 | 0.000005 |   0.000001 |
+--------------------+----------+----------+------------+
```

MySQL 5.5 Performance Schema

- **PERFORMANCE_SCHEMA** presents low level MySQL performance information
- Data can be cleared
- Filters with **WHERE** are allowed
- Must be enabled with **--performance_schema**

```
mysql> SELECT EVENT_ID, EVENT_NAME, TIMER_WAIT
-> FROM EVENTS_WAITS_HISTORY WHERE THREAD_ID = 13
-> ORDER BY EVENT_ID;
+----------+----------------------------------------+------------+
| EVENT_ID | EVENT_NAME                             | TIMER_WAIT |
+----------+----------------------------------------+------------+
|       86 | wait/synch/mutex/mysys/THR_LOCK::mutex |     686322 |
|       87 | wait/synch/mutex/mysys/THR_LOCK_malloc |     320535 |
|       88 | wait/synch/mutex/mysys/THR_LOCK_malloc |     339390 |
|       89 | wait/synch/mutex/mysys/THR_LOCK_malloc |     377100 |
|       90 | wait/synch/mutex/sql/LOCK_plugin       |     614673 |
|       91 | wait/synch/mutex/sql/LOCK_open         |     659925 |
|       92 | wait/synch/mutex/sql/THD::LOCK_thd_data |     494001 |
|       93 | wait/synch/mutex/mysys/THR_LOCK_malloc |     222489 |
|       94 | wait/synch/mutex/mysys/THR_LOCK_malloc |     214947 |
|       95 | wait/synch/mutex/mysys/LOCK_alarm      |     312993 |
+----------+----------------------------------------+------------+


mysql> UPDATE SETUP_INSTRUMENTS
-> SET ENABLED = 'NO'
-> WHERE NAME = 'wait/synch/mutex/myisammrg/MYRG_INFO::mutex';
mysql> UPDATE SETUP_CONSUMERS
-> SET ENABLED = 'NO' WHERE NAME = 'file_summary_by_instance';
```

Performance Schema

```
mysql> SHOW TABLES FROM performance_schema;
+----------------------------------------------+
| Tables_in_performance_schema                 |
+----------------------------------------------+
| COND_INSTANCES                               |
| EVENTS_WAITS_CURRENT                         |
| EVENTS_WAITS_HISTORY                         |
| EVENTS_WAITS_HISTORY_LONG                    |
| EVENTS_WAITS_SUMMARY_BY_INSTANCE             |
| EVENTS_WAITS_SUMMARY_BY_THREAD_BY_EVENT_NAME |
| EVENTS_WAITS_SUMMARY_GLOBAL_BY_EVENT_NAME    |
| FILE_INSTANCES                               |
| FILE_SUMMARY_BY_EVENT_NAME                   |
| FILE_SUMMARY_BY_INSTANCE                     |
| MUTEX_INSTANCES                              |
| PERFORMANCE_TIMERS                           |
| RWLOCK_INSTANCES                             |
| SETUP_CONSUMERS                              |
| SETUP_INSTRUMENTS                            |
| SETUP_TIMERS                                 |
| THREADS                                      |
+----------------------------------------------+
```

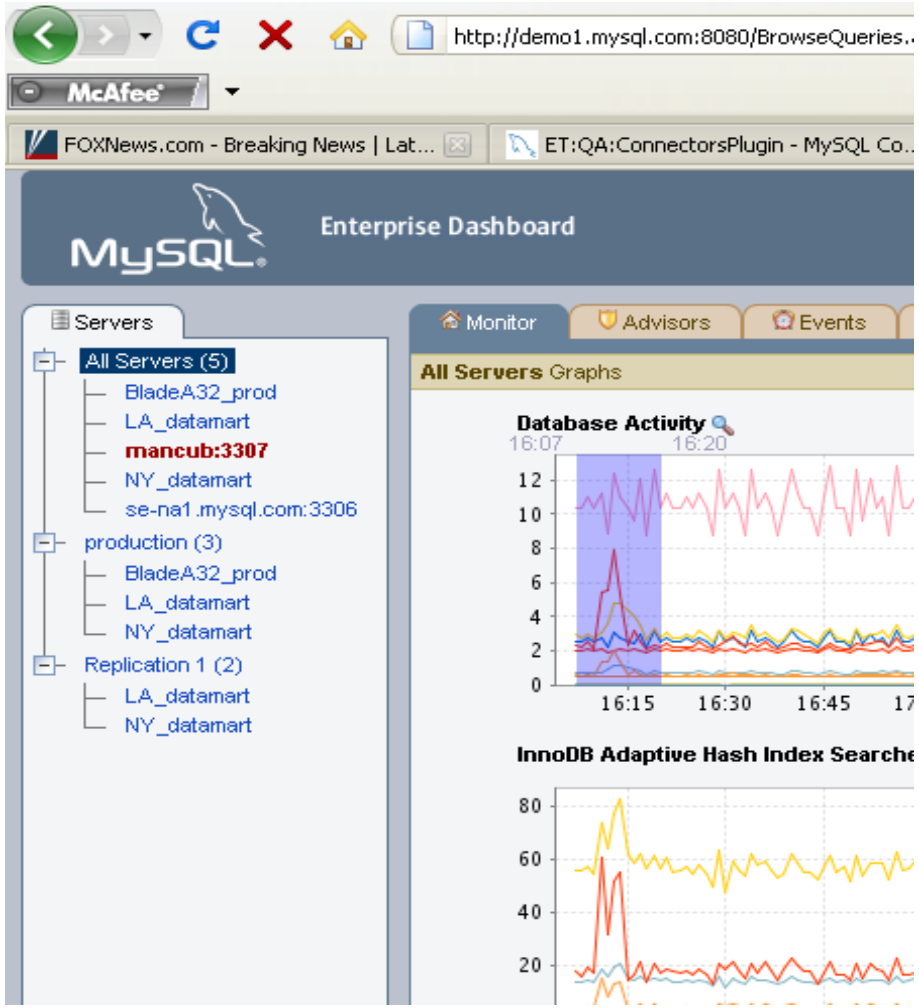
Performance Schema

```
mysql> SELECT EVENT_ID, EVENT_NAME, TIMER_WAIT AS WAIT
    -> FROM EVENTS_WAITS_HISTORY WHERE THREAD_ID = 13
    -> ORDER BY EVENT_ID;
+----------+-----------------------------------------+--------+
| EVENT_ID | EVENT_NAME                              | WAIT   |
+----------+-----------------------------------------+--------+
|       86 | wait/synch/mutex/mysys/THR_LOCK::mutex  | 686322 |
|       87 | wait/synch/mutex/mysys/THR_LOCK_malloc  | 320535 |
|       88 | wait/synch/mutex/mysys/THR_LOCK_malloc  | 339390 |
|       89 | wait/synch/mutex/mysys/THR_LOCK_malloc  | 377100 |
|       90 | wait/synch/mutex/sql/LOCK_plugin        | 614673 |
|       91 | wait/synch/mutex/sql/LOCK_open          | 659925 |
|       92 | wait/synch/mutex/sql/THD::LOCK_thd_data | 494001 |
|       93 | wait/synch/mutex/mysys/THR_LOCK_malloc  | 222489 |
|       94 | wait/synch/mutex/mysys/THR_LOCK_malloc  | 214947 |
|       95 | wait/synch/mutex/mysys/LOCK_alarm       | 312993 |
+----------+-----------------------------------------+--------+
```

```
mysql> SELECT * FROM EVENTS_WAITS_CURRENT\G
*************************** 1. row ***************************
            THREAD_ID: 0
             EVENT_ID: 5523
           EVENT_NAME: wait/synch/mutex/mysys/THR_LOCK::mutex
               SOURCE: thr_lock.c:525
          TIMER_START: 201660494489586
            TIMER_END: 201660494576112
           TIMER_WAIT: 86526
                SPINS: NULL
        OBJECT_SCHEMA: NULL
          OBJECT_NAME: NULL
          OBJECT_TYPE: NULL
OBJECT_INSTANCE_BEGIN: 142270668
     NESTING_EVENT_ID: NULL
            OPERATION: lock
     NUMBER_OF_BYTES: NULL
                FLAGS: 0
```

MySQL Enterprise Monitor

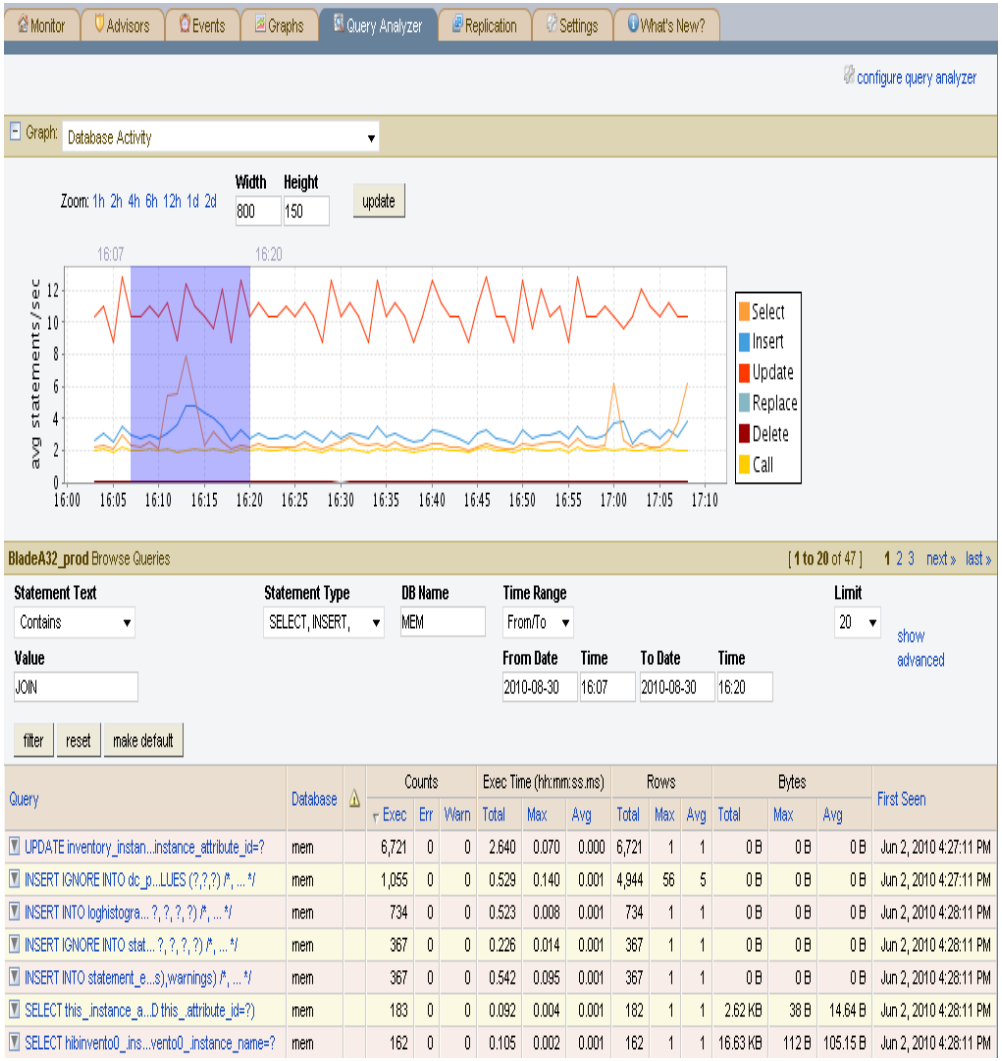
- Single, consolidated view into entire MySQL environment
- Automated, rules-based monitoring and alerts (SMTP, SNMP enabled)
- Query capture, monitoring, analysis and tuning, correlated with Monitor graphs
- Visual monitoring of “hot” applications and servers
- Real-time Replication Monitor with auto-discovery of master-slave topologies
- Integrated with MySQL Support



A Virtual MySQL DBA Assistant!

MySQL Query Analyzer

- Centralized monitoring of Queries across all servers
- No reliance on Slow Query Logs, SHOW PROCESSLIST;, VMSTAT, etc.
- Aggregated view of query execution counts, time, and rows
- Saves time parsing atomic executions for total query expense
- Visual “grab and go” correlation with Monitor graphs



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