Troubleshooting hardware resource usage

Sveta Smirnova
Principal Technical Services Engineer
May, 26, 2016

Table of Contents

Introduction

What this session is about?

- MySQL does not run in isolated environment
- It communicates with OS and HW
- We will study how HW and MySQL
  - Communicate
  - Affect each other
- We would not discuss how to fix HW issues
  - If HW is broken just replace it
  - Easy if you cared about backups!

What can we find if study HW metrics?

- Which kind of activity MySQL is doing
- If we need to optimize queries
- If our machines are good for current workload
- How to tune MySQL, so it performs better

Common issues with hardware

- Resource over-usage
  - Server ”hangs”
  - Queries work slow
  - Server got killed by OOM killer
- Resource under-usage
  - Server ”hangs”
  - Queries are slow
  - Crashes
  - This is pretty good HW and you paid a lot for it!

Common issues with hardware

- Resource over-usage
  - Server ”hangs”
  - Queries work slow
  - Server got killed by OOM killer
- Resource under-usage
  - Your load is smaller than HW can handle

Which hardware will we discuss?

- Memory
- CPU
- Disk
- Network

Memory

How MySQL Server uses memory?

- Global buffers
  - Allocated once at server startup
  - Never freed after
- Thread-specific buffers
- Operation-specific buffers
- ”Internal” buffers

How MySQL Server uses memory?

- Global buffers
- Thread-specific buffers
  - Allocated for each connection
  - Freed after connection closes
- Operation-specific buffers
- ”Internal” buffers

How MySQL Server uses memory?

- Global buffers
- Thread-specific buffers
- Operation-specific buffers
  - Allocated for an operation
    - join_buffer_size - for each table in JOIN
    - tmp_table_size - for each temporary table
    - ...
  - Freed when operaiton finishes
- ”Internal” buffers

How MySQL Server uses memory?

- Global buffers
- Thread-specific buffers
- Operation-specific buffers
- ”Internal” buffers
  - Out of user control

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r
- vmstat
- numactl
- Investigation
- There was no way to know how exactly memory was allocated

Diagnostic tools before 5.7

- free

```
$free
             total       used       free     shared    buffers     cached
Mem:      16149184    6223916    9925268     317536       1048    3655160
-/+ buffers/cache:    2567708   13581476
Swap:      2110460          0    2110460
```

- top, atop -m, htop, pidstat -r
- vmstat
- numactl
- Investigation

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r

```
$top
Tasks: 295 total,   3 running, 292 sleeping,   0 stopped,   0 zombie
%Cpu(s):  3.0 us,  0.8 sy,  0.1 ni, 95.4 id,  0.8 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:  16149184 total,  6231688 used,  9917496 free,     1048 buffers
KiB Swap:  2110460 total,        0 used,  2110460 free.  3670752 cached Mem

PID  USER  PR  NI VIRT    RES    SHR S %CPU  %MEM     TIME+  COMMAND
1914 mysql 20   0 670m    95m   1296 S  0.7   1.2   2:42.14  mysqld
```

- vmstat
- numactl
- Investigation

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r

```
sveta@Thinkie:~$ pidstat -r -p 4704
Linux 4.2.0-36-generic (Thinkie)  23-05-2016  _x86_64_ (8 CPU)

17:27:23      UID       PID  minflt/s  majflt/s     VSZ    RSS   %MEM  Command
17:27:23     1000      4704      3,53      0,22 1715116 496668   3,08  mysqld
```

- vmstat
- numactl
- Investigation

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r
- vmstat
  - Repeatable output

```
sveta@Thinkie:~$ vmstat 5 5
procs -----------memory---------- ---swap-- -----io---- -system-- ------cpu-----
 r  b   swpd   free   buff  cache   si   so    bi    bo   in   cs us sy id wa st
 1  0      0 203992 240048 7140992    0    0    37   278   82  110 18  3 77  2  0
 0  0      0 204876 240048 7138176    0    0     0    30 1481 8291  4  1 94  1  0
 0  0      0 201884 240048 7138176    0    0     0    10 1059 7954  5  1 94  1  0
 0  0      0 203248 240048 7135864    0    0     0    53 1414 8622  5  1 93  1  0
 1  0      0 202816 240048 7135708    0    0     0   174 1393 8226  5  1 93  1  0
```

- numactl
- Investigation

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r
- vmstat
  - Swapping!

```
sveta@Thinkie:~$ vmstat 5 4
procs -----------memory---------- ---swap-- -----io---- -system-- ------cpu-----
 r  b   swpd   free   buff  cache   si   so    bi    bo   in   cs us sy id wa
 1  0   1936 296828   7524 5045340    4   11   860     0  470  440  4  2 75 18
 0  0   1936 295928   7532 5046432   36   40   860   768  471  455  3  3 75 19
 0  1   1936 294840   7532 5047564    4   12   868     0  466  441  3  3 75 19
 0  1   1936 293752   7532 5048664    0    0   848     0  461  434  5  2 75 18
```

- numactl
- Investigation

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r
- vmstat
- numactl

```
sveta.smirnova@support:~$ sudo numastat -czs mysqld
Per-node process memory usage (in MBs)
PID              Node 0 Node 1 Total
---------------  ------ ------ -----
4233 (mysqld)      1551    161  1713
33301 (mysqld)      719    142   860
23196 (mysqld)      116    158   274
...
---------------  ------ ------ -----
Total              2438    465  2903
```

- Investigation

Diagnostic tools before 5.7

- free
- top, atop -m, htop, pidstat -r
- vmstat
- numactl
- Investigation
  - Total size of buffers
  - Number of temporary tables
  - Number of parallel connections

Memory diagnostic in 5.7

```
mysql> select thread_id tid, user, current_allocated ca, total_allocated
    -> from sys.memory_by_thread_by_current_bytes;
+-----+-------------------------+-------------+-----------------+
| tid | user                    |          ca | total_allocated |
+-----+-------------------------+-------------+-----------------+
|   1 | sql/main                | 2.53 GiB    | 2.69 GiB        |
| 150 | root@127.0.0.1          | 4.06 MiB    | 32.17 MiB       |
| 146 | sql/slave_sql           | 1.31 MiB    | 1.44 MiB        |
| 145 | sql/slave_io            | 1.08 MiB    | 2.79 MiB        |
...
|  60 | innodb/io_read_thread   | 0 bytes     | 384 bytes       |
| 139 | innodb/srv_purge_thread | -328 bytes  | 754.21 KiB      |
|  69 | innodb/io_write_thread  | -1008 bytes | 34.28 KiB       |
|  68 | innodb/io_write_thread  | -1440 bytes | 298.05 KiB      |
|  74 | innodb/io_write_thread  | -1656 bytes | 103.55 KiB      |
|   4 | innodb/io_log_thread    | -2880 bytes | 132.38 KiB      |
|  72 | innodb/io_write_thread  | -7632 bytes | 1.10 MiB        |
+-----+-------------------------+-------------+-----------------+
145 rows in set (2.65 sec)
```

Threads Statistics

```
mysql> select * from sys.memory_by_thread_by_current_bytes
    -> order by current_allocated desc\G
*************************** 1. row ***************************
         thread_id: 152
              user: lj@127.0.0.1
current_count_used: 325
 current_allocated: 36.00 GiB
 current_avg_alloc: 113.43 MiB
 current_max_alloc: 36.00 GiB
   total_allocated: 37.95 GiB
...
```

- Finding connections, using too much memory, now is matter of seconds!

RAW Performance Schema tables

- memory_summary_by_account_by_event_name
- memory_summary_by_host_by_event_name
- memory_summary_by_thread_by_event_name
- memory_summary_by_user_by_event_name
- memory_summary_global_by_event_name
- sys schema also includes information about user name

Users in sys.memory_* tables

- NAME@HOST - regular user
- System users
  - sql/main
  - innodb/*
  - ...
- Data comes from table THREADS

CPU

How MySQL Server uses CPU?

- Parallel threads
  - Connections
  - InnoDB threads
- IO

Diagnostic

- top, atop, htop

```
$top
Tasks: 295 total,   3 running, 292 sleeping,   0 stopped,   0 zombie
%Cpu(s):  3.0 us,  0.8 sy,  0.1 ni, 95.4 id,  0.8 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:  16149184 total,  6231688 used,  9917496 free,     1048 buffers
KiB Swap:  2110460 total,        0 used,  2110460 free.  3670752 cached Mem

PID  USER  PR  NI VIRT    RES    SHR S %CPU  %MEM     TIME+  COMMAND
1914 mysql 20   0 670m    95m   1296 S  0.7   1.2   2:42.14  mysqld
```

- ps, pidstat
- mpstat
- iostat
- P_S.THREADS table

Diagnostic

- top, atop, htop
- ps, pidstat

```
sveta@Thinkie:~$ ps -eo pid,user,comm,pcpu,pmem,vsz | grep mysqld
16565 sveta    mysqld           0.1  0.6 1249880

sveta@Thinkie:~$ pidstat -p 4704
Linux 4.2.0-36-generic (Thinkie)  23-05-2016  _x86_64_ (8 CPU)

17:26:45      UID       PID    %usr %system  %guest    %CPU   CPU  Command
17:26:45     1000      4704    0,01    0,01    0,00    0,01     7  mysqld
```

- mpstat
- iostat
- P_S.THREADS table

Diagnostic

- top, atop, htop
- ps, pidstat
- mpstat

```
sveta@Thinkie:~$ mpstat -P ALL
Linux 4.2.0-36-generic (Thinkie)  24-05-2016  _x86_64_ (8 CPU)

02:16:48     CPU    %usr   %nice    %sys %iowait    %irq   %soft  %steal  %guest  %gnice   %idle
02:16:48     all    3,09    0,06    0,50    0,73    0,00    0,01    0,00    0,00    0,00   95,63
02:16:48       0    2,22    0,03    0,69    3,11    0,00    0,02    0,00    0,00    0,00   93,94
02:16:48       1    3,70    0,13    0,49    0,04    0,00    0,00    0,00    0,00    0,00   95,64
02:16:48       2    3,88    0,05    0,64    0,52    0,00    0,00    0,00    0,00    0,00   94,91
02:16:48       3    2,67    0,02    0,26    0,03    0,00    0,00    0,00    0,00    0,00   97,02
02:16:48       4    3,74    0,03    0,59    0,24    0,00    0,00    0,00    0,00    0,00   95,40
...
```

- iostat
- P_S.THREADS table

Diagnostic

- top, atop, htop
- ps, pidstat
- mpstat
- iostat

```
sveta@Thinkie:~$ iostat -x 5

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           4,71    0,05    1,05   12,63    0,00   81,56

Device: rrqm/s wrqm/s r/s    w/s  rkB/s wkB/s avgrq-sz avgqu-sz await r_await w_await  svctm  %util
sda      0,00    61,60 3,80  85,60 49,60 612,00   14,80     1,13 12,45   32,21   11,57  11,03  98,64
sdb      0,00     0,00 0,00   0,00 0,00    0,00    0,00     0,00  0,00    0,00    0,00   0,00   0,00
mmcblk0 0,00     0,00 0,00   0,00 0,00    0,00    0,00     0,00  0,00    0,00    0,00   0,00   0,00
```

- P_S.THREADS table

Diagnostic

- top, atop, htop
- ps, pidstat
- mpstat
- iostat
- P_S.THREADS table

```
mysql> select thread_id, processlist_id, thread_os_id, type, name from threads;
+-----------+----------------+--------------+------------+---------------------------------------+
| thread_id | processlist_id | thread_os_id | type       | name                                  |
+-----------+----------------+--------------+------------+---------------------------------------+
|         1 |           NULL |        17983 | BACKGROUND | thread/sql/main                       |
|         2 |           NULL |        17984 | BACKGROUND | thread/sql/thread_timer_notifier      |
|         3 |           NULL |        17985 | BACKGROUND | thread/innodb/io_ibuf_thread          |
...
|        23 |              2 |        18009 | FOREGROUND | thread/sql/one_connection             |
|        24 |              3 |        18011 | FOREGROUND | thread/sql/one_connection             |
+-----------+----------------+--------------+------------+---------------------------------------+
```

How to fix?

- Low load
  - Check if mysqld is really active
  - Check OS limits
    - ulimit
    - User options
    - Kernel options
  - Increase number of parallel threads
    - innodb_thread_concurrency
- High load

How to fix?

- Low load
- High load
  - Move job to memory: increase buffers
  - Tune queries

Disk

What is written to disk?

- Data in your tables
- Log files
  - Binary
  - Engine
    - InnoDB Redo Log Files
  - General, Audit
- Temporary tables which cannot fit in memory

Diagnostics: OS tools

- df

```
sveta@Thinkie:$ df
Filesystem           1K-blocks      Used Available Use% Mounted on
udev                   8042480         4   8042476   1% /dev
tmpfs                  1611760      1612   1610148   1% /run
/dev/sda5            679369552 108352296 536484240  17% /
none                         4         0         4   0% /sys/fs/cgroup
none                      5120         0      5120   0% /run/lock
none                   8058788     64756   7994032   1% /run/shm
none                    102400       100    102300   1% /run/user
/home/sveta/.Private 679369552 108352296 536484240  17% /home/sveta
```

- iostat
- ls -l /proc/{PID_OF_MYSQLD}/fd
- iotop
- blktrace

Diagnostics: OS tools

- df
- iostat
  - Low activity

```
$ iostat -x 5
...
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           1.83    0.00    6.03    0.01    0.00   92.14

Device: rrqm/s wrqm/s  r/s   w/s  rkB/s   wkB/s avgrq-sz avgqu-sz await r_await w_await svctm
sda       0.00   0.80 0.00  1.20   0.00    6.40    10.67     0.00  0.00    0.00    0.00  0.00
sdb       0.40  38.60 6.80 62.00 102.20 1305.60    40.92     0.03  0.45    1.88    0.30  0.17
...
sdc       0.00   0.00 0.00  0.00   0.00    0.00     0.00     0.00  0.00    0.00    0.00  0.00
```

  - High activity
- ls -l /proc/{PID_OF_MYSQLD}/fd

Diagnostics: OS tools

- df
- iostat
  - Low activity
  - High activity

```
$ iostat -x 5
...
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           4.09    0.00    7.31    0.53    0.00   88.06

Device: rrqm/s wrqm/s  r/s     w/s rkB/s    wkB/s avgrq-sz avgqu-sz await r_await w_await...
sda       0.00    2.40 6.80    2.20 28.00    16.80     9.96     0.04  4.09    5.41    0.00...
sdb       0.00   28.80 4.40   40.40 22.50   490.40    22.90     0.01  0.23    2.18    0.02...
...
sdc       0.00 1139.40 0.00 6136.60  0.00 36490.40    11.89     0.23  0.04    0.00    0.04...
```

- ls -l /proc/{PID_OF_MYSQLD}/fd

Diagnostics: OS tools

- df
- iostat
- ls -l /proc/{PID_OF_MYSQLD}/fd

```
sveta.smirnova@support:~$ ls -la /proc/27702/fd
total 0
dr-x------ 2 sveta.smirnova percona  0 May 18 08:08 .
dr-xr-xr-x 9 sveta.smirnova percona  0 May 18 07:58 ..
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 0 -> /dev/pts/145
l-wx------ 1 sveta.smirnova percona 64 May 18 08:08 1 -> /mysql/mysqld.1.err
...
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 36 -> /mysql/mysql/innodb_index_stats.ibd
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 4 -> /mysql/tmp/mysqld.1/ibBWXOTU (deleted)
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 5 -> /mysql/tmp/mysqld.1/ib71WRZV (deleted)
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 6 -> /mysql/tmp/mysqld.1/ibPIhJ5W (deleted)
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 7 -> /mysql/tmp/mysqld.1/ibXvtfiZ (deleted)
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 8 -> /mysql/ib_logfile0
lrwx------ 1 sveta.smirnova percona 64 May 18 08:08 9 -> /mysql/ib_logfile1
```

Diagnostics: OS tools

- df
- iostat
- ls -l /proc/{PID_OF_MYSQLD}/fd
- iotop

```
sveta@Thinkie:~$ sudo iotop -ob
...
  TID  PRIO  USER     DISK READ  DISK WRITE  SWAPIN      IO    COMMAND
Total DISK READ :    1002.77 K/s | Total DISK WRITE :    1660.84 K/s
Actual DISK READ:    1002.77 K/s | Actual DISK WRITE:     744.24 K/s
  TID  PRIO  USER     DISK READ  DISK WRITE  SWAPIN      IO    COMMAND
 7118 be/4 sveta       0.00 B/s  630.65 K/s  0.00 %  0.17 % mysqld --defaults-...
 7116 be/4 sveta       0.00 B/s    0.00 B/s  0.00 %  0.06 % mysqld --defaults-...
 8081 be/4 sveta       0.00 B/s 1030.19 K/s  0.00 %  0.03 % mysqld --defaults-...
 8080 be/4 sveta    1002.77 K/s    0.00 B/s  0.00 %  0.00 % mysql -h127.0.0.1 -P13000 -uroot
Total DISK READ :       0.00 B/s | Total DISK WRITE :    1130.16 K/s
Actual DISK READ:       0.00 B/s | Actual DISK WRITE:     915.08 K/s
```

Diagnostics: OS tools

- df
- iostat
- ls -l /proc/{PID_OF_MYSQLD}/fd
- blktrace
  - With innodb_write_io_threads = 4

```
sveta@Thinkie:~$ sudo blktrace -d /dev/sda
^C=== sda ===
  CPU  0:                 1658 events,       78 KiB data
  CPU  1:                    0 events,        0 KiB data
  CPU  2:                 1465 events,       69 KiB data
  CPU  3:                    0 events,        0 KiB data
  CPU  4:                  761 events,       36 KiB data
  CPU  5:                    0 events,        0 KiB data
  CPU  6:                  337 events,       16 KiB data
  CPU  7:                    0 events,        0 KiB data
  Total:                  4221 events (dropped 0),      198 KiB data
```

Diagnostics: OS tools

- df
- iostat
- ls -l /proc/{PID_OF_MYSQLD}/fd
- blktrace
  - With innodb_write_io_threads = 8

```
sveta@Thinkie:~$ sudo blktrace -d /dev/sda
^C=== sda ===
  CPU  0:                  575 events,       27 KiB data
  CPU  1:                 1761 events,       83 KiB data
  CPU  2:                 1803 events,       85 KiB data
  CPU  3:                 1439 events,       68 KiB data
  CPU  4:                 1568 events,       74 KiB data
  CPU  5:                   32 events,        2 KiB data
  CPU  6:                  730 events,       35 KiB data
  CPU  7:                   12 events,        1 KiB data
  Total:                  7920 events (dropped 0),      372 KiB data
```

Diagnostics: status variables

- Temporary tables and files
  - Created_tmp_disk_tables
  - Created_tmp_files
- Data traffic
- Open files and tables
- InnoDB IO

Diagnostics: status variables

- Temporary tables and files
- Data traffic
  - Binlog_[stmt_]cache_disk_use
  - Bytes_[received|sent]
  - Handler_write
- Open files and tables
- InnoDB IO

Diagnostics: status variables

- Temporary tables and files
- Data traffic
- Open files and tables
  - Open[ed]_files
  - Open[ed]_tables
  - Open[ed]_table_definitions
- InnoDB IO

Diagnostics: status variables

- Temporary tables and files
- Data traffic
- Open files and tables
- InnoDB IO
  - Innodb_..._fsyncs
  - Innodb_..._reads
  - Innodb_..._writes
  - Innodb_..._written

Diagnostic: Performance Schema

- file_instances

```
mysql> select * from file_instances where OPEN_COUNT > 0\G
*************************** 1. row ***************************
 FILE_NAME: /home/sveta/build/mysql-5.7/mysql-test/var/mysqld.1/data/ibdata1
EVENT_NAME: wait/io/file/innodb/innodb_data_file
OPEN_COUNT: 3
*************************** 2. row ***************************
 FILE_NAME: /home/sveta/build/mysql-5.7/mysql-test/var/mysqld.1/data/ib_logfile0
EVENT_NAME: wait/io/file/innodb/innodb_log_file
OPEN_COUNT: 2
*************************** 3. row ***************************
 FILE_NAME: /home/sveta/build/mysql-5.7/mysql-test/var/mysqld.1/data/ib_logfile1
EVENT_NAME: wait/io/file/innodb/innodb_log_file
OPEN_COUNT: 2
...
```

- table_handles
- events_statements_*, prepared_statements_instances

Diagnostic: Performance Schema

- file_instances
- table_handles

```
mysql> select OBJECT_TYPE, OBJECT_SCHEMA, OBJECT_NAME from table_handles\G
*************************** 1. row ***************************
          OBJECT_TYPE: TABLE
        OBJECT_SCHEMA: employees
          OBJECT_NAME: dept_emp
*************************** 2. row ***************************
          OBJECT_TYPE: TABLE
        OBJECT_SCHEMA: employees
          OBJECT_NAME: dept_emp
...
```

- events_statements_*, prepared_statements_instances

Diagnostic: Performance Schema

- file_instances
- table_handles
- events_statements_*, prepared_statements_instances
  - CREATED_TMP_DISK_TABLES

How to fix?

- Optimize queries if number of tmp tables is high
- Trade writes with safety
  - sync_binlog - Read-only slave!
  - innodb_doublewrite - Read-only slave!
  - innodb_flush_log_at_trx_commit - PXC!
- Write less
- Use engine-specific optimizations
- Move job to memory

How to fix?

- Optimize queries if number of tmp tables is high
- Trade writes with safety
- Write less
  - binlog_row_image
- Use engine-specific optimizations
- Move job to memory

How to fix?

- Optimize queries if number of tmp tables is high
- Trade writes with safety
- Write less
- Use engine-specific optimizations
  - innodb_io_capacity
  - innodb_adaptive_flushing
  - innodb_flush_method
  - innodb_max_dirty_pages_pct
- Move job to memory

How to fix?

- Optimize queries if number of tmp tables is high
- Trade writes with safety
- Write less
- Use engine-specific optimizations
- Move job to memory
  - Increase buffers and in-memory temporary table size

Network

What uses network in MySQL?

- Communication between client and server
  - Regular client
  - Application
  - Replication IO thread
  - Traffic between PXC nodes

What is important about network?

- Stability
  - TCP re-sends missed packets, but more packets re-sent, longer wait time is
- Bandwidth
- Speed

What is important about network?

- Stability
- Bandwidth
  - You don’t want to send 1,000,000 packets when you can send 1
- Speed

What is important about network?

- Stability
- Bandwidth
- Speed
  - RTT

```
sveta@Thinkie:~$ ping www.percona.com -c 2
PING www.percona.com (74.121.199.234) 56(84) bytes of data.
64 bytes from www.percona.com (74.121.199.234): icmp_seq=1 ttl=47 time=212 ms
64 bytes from www.percona.com (74.121.199.234): icmp_seq=2 ttl=47 time=214 ms

--- www.percona.com ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 999ms
rtt min/avg/max/mdev = 212.283/213.308/214.333/1.025 ms
```

Network diagnostic

- –log-warnings=2
- Status variables
- nicstat
- netstat
- tcpdump

Network diagnostic

- –log-warnings=2
  - Not as much information as we want to
  - Reports failed connections
- Status variables
- nicstat
- netstat
- tcpdump

Network diagnostic

- –log-warnings=2
- Status variables
  - Aborted_clients
  - Aborted_connects
- nicstat
- netstat
- tcpdump

Network diagnostic

- –log-warnings=2
- Status variables
- nicstat

```
sveta@Thinkie:~$ nicstat -x -t
02:57:00    InKB   OutKB   InSeg  OutSeg Reset  AttF %ReTX InConn OutCon Drops
TCP         0.00    0.00    4.97    4.13  0.04  0.00 0.000    0.00    0.07  0.00
02:57:00      RdKB    WrKB   RdPkt   WrPkt   IErr  OErr  Coll  NoCP Defer  %Util
wlan0         4.78    0.60    2.91    2.35   0.00  0.00  0.00  0.00  0.00   0.00
lo            8.27    8.27    1.08    1.08   0.00  0.00  0.00  0.00  0.00   0.00
```

- netstat
- tcpdump

Network diagnostic

- –log-warnings=2
- Status variables
- nicstat
- netstat
  - Watch your established and closed connections
- tcpdump

Network diagnostic

- tcpdump
  - Send huge file (1G or greater)
  - Watch how it is transferring using tcpdump

```
sveta@Thinkie:~$ sudo tcpdump -i wlan0 host customers.percona.com and port 443
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on wlan0, link-type EN10MB (Ethernet), capture size 65535 bytes
02:36:15.897535 IP 192.168.0.4.50370 > customers.percona.com.https: Flags [S], seq 2306918552,
02:36:16.098193 IP customers.percona.com.https > 192.168.0.4.50370: Flags [S.], seq 3101265933
02:36:16.098232 IP 192.168.0.4.50370 > customers.percona.com.https: Flags [.], ack 1, win 229,
...
02:36:36.891383 IP customers.percona.com.https > 192.168.0.4.50370: Flags [P.], seq 1586:1926,
02:36:36.891397 IP 192.168.0.4.50370 > customers.percona.com.https: Flags [.], ack 1926, win 2
^C
1943 packets captured
1947 packets received by filter
0 packets dropped by kernel
15 packets dropped by interface
```

Performance Schema for network diagnostic

- Tables accounts, users, hosts

```
mysql> select user, host, current_connections as cur,
    -> total_connections as total from accounts;
+------+-----------+-----+-------+
| user | host      | cur | total |
+------+-----------+-----+-------+
| foo  | localhost | 0   | 3     |
| root | localhost | 1   | 3     |
| NULL | NULL      | 14  | 17    |
+------+-----------+-----+-------+
3 rows in set (0.01 sec)
```

- Connection attributes
- Host Cache

Performance Schema for network diagnostic

- Tables accounts, users, hosts
- Connection attributes

```
mysql> SELECT ATTR_NAME, ATTR_VALUE FROM session_account_connect_attrs
    -> WHERE processlist_id != @@pseudo_thread_id;
+-----------------+----------------------------------------+
| ATTR_NAME       | ATTR_VALUE                             |
+-----------------+----------------------------------------+
| _os             | Linux                                  |
| _client_name    | libmysql                               |
| _pid            | 4729                                   |
| program_name    | Troubleshooting webinars               |
| _platform       | x86_64                                 |
| session         | Troubleshooting hardware resource usage |
| author          | Sveta Smirnova                         |
| _client_version | 5.7.12                                 |
+-----------------+----------------------------------------+
```

- Host Cache

Performance Schema for network diagnostic

- Tables accounts, users, hosts
- Connection attributes
- Host Cache
  - Content of DNS cache
  - Errors from:
    - Name Server
    - Connection
    - Authentication
    - max_connect_errors, max_user_errors, etc.

How to fix?

- Long-term fix: make network fast
  - Replace hardware
  - Fix topology
  - Switch vendor
- Short-term resolution: crutches!
  - Experience with timeout options
    - connect_timeout - for broken connection attempts
    - wait_timeout - for disconnects
  - Can slow down application dramatically!
  - Use only for testing purpose to confirm what you are experiencing network issue before investing into hardware

Summary

Summary

- MySQL depends on hardware
- Both under-usage and over-usage are bad
- You can implicitly control how MySQL uses resources
  - Tune queries
  - Adjust server parameters
- Total control is not possible

More information

- Linux Performance by Brendan D. Gregg
- Memory Summary tables in Performance Schema

Place for your questions

???

Thank you!

http://www.slideshare.net/SvetaSmirnova

https://twitter.com/svetsmirnova