MySQL 5.6 Experiences: Bugs, Problems and Solutions

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MySQL 5.6's current state and future - that's how I see it
MySQL 5.6's current state and future - that's how I see it

- **The sun is shining, the sky is blue** - positive reviews, great benchmark results
- **Looks like a warm seaside is ahead, close enough** - we can scale up to 1024 threads (but check [http://www.mysqlperformanceblog.com/2013/04/15/memory-allocators-mysql-performance-improvements-in-mysql-server-5-5-30-30-2/](http://www.mysqlperformanceblog.com/2013/04/15/memory-allocators-mysql-performance-improvements-in-mysql-server-5-5-30-30-2/)), replication is crash safe and more efficient..
- **There are some roads ahead, clearly visible, and people near the sea that are probably happy** - everybody looks happy about MySQL 5.6 GA, early adopters among Oracle customers, positive blog posts
- **There are clouds and some of them dark, rain and even storm is still possible** - MySQL 5.6 is slow for some, like Facebook
- **Land is nice, probably ancient** - who knows what bad things happened here, and what is hidden in the ground
- **There could be old rocks far in the sea and something in that grass and bushes on our way ahead... Bugs?**
Bugs: scary, dangerous, nice, new, ancient... all kinds of, in MySQL 5.6
But let's read the manual first...

- We can just start with this page:
- Remove extra details and add references to each major feature
- For every feature description from that page I am going to add extra references (articles about the feature, bugs related to the feature)
- I'll make some comments also (if I have anything useful to add)
- That's how we get "Bugs (#), Problems (?) and Solutions (!)"
Security improvements

.mylogin.cnf and mysql_config_editor

Details:
● password is no longer stored in plain text (like in .my.cnf)...
● but if someone can read .mylogin.cnf, they have your MySQL password
● ~/.mylogin.cnf is not a more secure place to store your password than ~/.my.cnf

Links:
(!) http://mysqlblog.fivefarmers.com/2012/08/16/understanding-mysql_config_editors-security-aspects/
(!) http://serge.freze@fond.com/2013/02/mysql-5-6-credentials-securely-stored/
(?#) http://www.skysql.com/blogs/kolbe/mysql-56-security-through-complacency

Bugs:
Bug #68680 - manual had some wrong details on where file is located on Windows, now fixed
Bug #68034 - how this feature can be used to workaround the bug (see Todd’s comment)
Bug #68277 - build problem related to mysql_config_editor, fixed in 5.6.11
Bug #66546 - some people were not happy that there is no way to hardcode password in the script, without getting warning
Security improvements

sha256_password plugin

Details:
- This plugin is built in, so it is always available and need not be loaded explicitly
- Authentication method is set per user
- Use of the sha256_password plugin requires that MySQL be built with SSL capabilities. YaSSL vs OpenSSL (this gives more, because of RSA)

Links:
- http://planet.mysql.com/entry/?id=34951 - how this is supported by PHP/mysqlInd
- http://lists.mysql.com/internals/38325 - some history
- http://palominodb.com/blog/2011/12/04/hashing-algorithm-mysql-password - by default it was SHA1 (SHA1('password'))

Bugs:
- Bug #68478 - with YaSSL (by default) SSL connection must be configured. Now this is clearly documented
- Bug #68858 - what authentication plugin is actually used by default?
Security improvements

The mysql.user table now has a password_expired column

Details:
- After an account's password has been expired, all operations performed in subsequent connections to the server using the account result in an error until the user issues a \texttt{SET PASSWORD} statement to establish a new account password
- It took some time to have this supported by connectors and clients... Use new clients!

Links:
(!) http://blog.ulf-wendel.de/2013/solution-mysql-5-6-password-expired-php-cant-connect/
(?!!) http://dev.mysql.com/doc/refman/5.6/en/alter-user.html - old problems before 5.6.7, still read the manual carefully

Bugs:
Bug #68385 - In a MySQL server newer than MySQL 5.5 using a non-upgraded \texttt{mysql.proc} table (for which \texttt{mysql_upgrade} had not been run), statements to set passwords caused a server crash due to a faulty check for the \texttt{password_expired} column. Fix will be in 5.6.12.
Security improvements

Checking password security

Details:
- Implemented by validate_password plugin, requires explicit installation
- validate% server variables, VALIDATE_PASSWORD_STRENGTH() --> 0 .. 100
- mysql_upgrade now produces a warning if it finds user accounts with passwords hashed with the older pre-4.1 hashing method.

Links:
(?#) http://datacharmer.blogspot.com/2012/03/mysql-56-too-verbose-when-creating-data.html
(!) http://mysqlblog.fivefarmers.com/2012/05/30/why-your-pre-4-1-client-wont-like-mysql-5-6/
(!) http://mysqlblog.fivefarmers.com/2012/11/12/improved-password-policy-utility-for-mysql-5-6/

Bugs:
Bug #68165 - mysql_upgrade does NOT check that there are other users doing something. This may lead to problems. “Not a Bug” for now.
Bug #65461 - this is a FR implemented (mysql_upgrade should warn when pre-4.1 passwords found)
Security improvements

--random-passwords on Unix

Details:
- Invoking `mysql_install_db` with `--random-passwords` causes it to assign a random password to the MySQL root accounts, set the “password expired” flag for those accounts, and remove the anonymous-user MySQL accounts.
- Unattended, but still secure installation is the goal

Links:
- (!) [http://www.howtoforge.com/how-to-install-mysql-5.6-on-ubuntu-12.10-including-memcached-plugin](http://www.howtoforge.com/how-to-install-mysql-5.6-on-ubuntu-12.10-including-memcached-plugin)

Bugs:
- Bug #53796 - a FR implemented. Now we have unattended but still secure installation
- Bug #68118 - mysql_install_db is a Perl script (*.sh is still there) and had problems with errors processing. Fixed in 5.6.11
Security improvements

Logging of passwords

Details:
- passwords do not appear in plain text in statements written to the general query log, slow query log, and binary log
- The `mysql` client no longer logs to its history file statements that refer to passwords

Links:
(!) [http://databaseblog.myname.nl/2013/03/how-mysql-56-handles-passwords.html](http://databaseblog.myname.nl/2013/03/how-mysql-56-handles-passwords.html)
(!?) [http://forums.freebsd.org/showthread.php?t=38187](http://forums.freebsd.org/showthread.php?t=38187) - why some SELECTs from mysql.user tables are NOT logged

Bugs:
- Bug #68200 - “Password logging does not work as documented”. Now documented in details - beware of `log-raw`
- Bug #68626 - may be related, “GRANT statements logged twice in slow query log”
- Bug #44143 - related FR, still “Verified” for whatever reason
- Bug #68034 - Using an empty password on the command line triggers a warning. This may break scripts.
Security improvements

START SLAVE and storing passwords for slave

Details:
- START SLAVE permits connection parameters to be specified for connecting to the master
- No need to store in master.info

Links:
(?) http://www.skysql.com/blogs/kolbe/mysql-56-security-through-complacency

Bugs:
Bug #68605 - START SLAVE after import of table-based repositories gives empty error message
Bug #68602 - Note about "master.info repository" on CHANGE MASTER TO is misleading
Security in MySQL 5.6 - overview
Changes to server defaults

New defaults since 5.6.6

Details:
- The motivation for these changes is to provide better out-of-box performance...
- and to reduce the need for DBAs to change settings

Links (!):
http://www.mysqlperformanceblog.com/2013/02/21/mysql-5-5-and-mysql-5-6-default-variable-values-differences/ - great summary of real differences
https://blog.mozilla.org/it/2013/03/08/deprecated-removed-and-ignored-variables-in-mysql-5-6/ - useful related reading
Bug #67598 - open bug report to discuss new defaults (too late probably)
https://blogs.oracle.com/supportingmysql/entry/mysql_server_5_6_default - original announcement of new default my.cnf/my.ini files
(?) http://www.iheavy.com/2012/10/09/thoughts-on-upcoming-mysql-5-6-defaults/ - not everybody was happy
http://mysql.wisborg.dk/2013/02/06/changes-to-options-and-variables-in-mysql-5-6/ - more on new variables in 5.6 (including defaults)
Changes to server defaults

New defaults since 5.6.6

Details:
- There was a long internal discussion about new default values for server variables in Oracle...
- I had not cared enough to follow it closely
- Same as MySQL Community, it seems...

Bugs:

Bug #68917 - not all default values are properly documented
Bug #68777 - more on innodb_open_files value (should be already documented in the manual)
Bug #68287 - effect of changed defaults for poor Windows users (high memory usage)
InnoDB enhancements
FULLTEXT indexes

Details:
- You can create FULLTEXT indexes on InnoDB tables...
- and query them using the MATCH() ... AGAINST syntax.
- This feature includes a new proximity search operator (@)... 
- and several new configuration options and INFORMATION_SCHEMA tables (?)

Links:
- http://www.mysqlperformanceblog.com/2013/02/26/myisam-vs-innodb-full-text-search-in-mysql-5-6-part-1/
- http://www.mysqlperformanceblog.com/2013/03/04/innodb-full-text-search-in-mysql-5-6-part-2-the-queries/

Bugs:
- Bug #68720 - “Verified”, Literal phrases cannot be combined with + or - operator
- Bug #68150 - fixed in 5.6.11. “InnoDB FULLTEXT Phrase Logic Incorrect”
- Bug #62004 - parser plugins are NOT supported, but only 5.6.12 will tell you this
- Bug #68816 - verified FR to add support for parser plugins
InnoDB enhancements

FULLTEXT indexes

Details:
- It's expected to see bugs and missing details in the manual for a new feature like this...
- Upgrade to 5.6.11 if you need to use it!
- It was the highest priority for InnoDB team back in 2011-2012. Why?

Bugs:
- Bug #68450 - fixed in 5.6.11. “InnoDB stopword tables cannot be set if the tables use UTF8”
- Bug #68502 - fixed in 5.6.11. Some internal only tables are removed
- Bug #67857 - not sure if this is already documented
- Bug #68621 - InnoDB FULLTEXT index type is not documented
- Bug #68948 - InnoDB table fulltext index in boolean mode ignores leading *
InnoDB enhancements

Online ALTER TABLE

Details:
- Several ALTER TABLE operations can be performed without copying the table, without blocking inserts, updates, and deletes to the table, or both
- No need for pt-online-schema-change and similar tools any more?

Links:
- (?) [http://mysqlha.blogspot.com/2013/02/mysql-56-online-ddl-for-busy-tables.html](http://mysqlha.blogspot.com/2013/02/mysql-56-online-ddl-for-busy-tables.html) - “Online DDL for InnoDB blocks all concurrent inserts/updates/deletes while the log is being applied”
- (?) [https://blogs.oracle.com/mysqlinnodb/entry/online_alter_table_in_mysql](https://blogs.oracle.com/mysqlinnodb/entry/online_alter_table_in_mysql) - some history and limitations
- (?) [http://code.openark.org/blog/mysql/state-of-inndb-online-ddl-in-mysql-5-6-9-rc-good-news-included](http://code.openark.org/blog/mysql/state-of-inndb-online-ddl-in-mysql-5-6-9-rc-good-news-included) - detailed review at 5.6.9 stage

Bugs:
- Bug #68498 - FR to make it “more online”
- Bug #68019 - should be fixed in 5.6.10, but still. In online DDL operations, a DROP FOREIGN KEY clause is not allowed in certain kinds of ALTER TABLE statement
- Bug #65701 - still “Verified”, ALTER improvements in 5.6 had NOT fixed it entirely
InnoDB enhancements

Improved tablespace management

Details:
● When creating a table, you can designate a location outside the MySQL data directory to hold the .ibd file
● You can export a table from one MySQL instance and import it in a different instance

Links:
(!) http://www.chriscalender.com/?p=1078 - “With InnoDB’s Transportable Tablespaces, Recovering Data from Stranded .ibd Files is a Thing of the Past”

Bugs:
Bug #68171 - manual still misses some details and examples for a real use
Bug #68868 - some not closely related, but missing things in the manual
Bug #67792 - initial size for a tablespace, FR that worthwhile implementing...
InnoDB enhancements

Different page sizes supported (4K and 8K, SSD)

Details:
- For uncompressed tables, see `innodb_page_size`
- You specify the size when creating the MySQL instance.
- All InnoDB tablespaces within an instance share the same page size

Links:
- (!) http://www.percona.com/doc/percona-server/5.1/flexibility/innodb_files_extend.html - Percona Server 5.x.y has this feature for a long time already
- (?) http://www.mysqlperformanceblog.com/2011/04/21/innodb-page-sizes-plans-and-ideas/ - I do miss bigger pages, 64K maybe, for compressed tables for example (and not only me, as this old post makes obvious)
- (?) http://www.mysqlperformanceblog.com/2011/04/07/innodb-row-size-limitation/ - something to re-evaluate for smaller page size (if used)

Bugs:
Bug #62018 - you may get no real benefits from smaller page sizes on SSD with MySQL 5.6.x (still "Verified"). btr_search_latch is on the way it seems
InnoDB enhancements

Improvements to buffer pool flushing

Details:
- Adaptive flushing...
- The new algorithm and default configuration values are expected to improve performance and concurrency for most users
- Advanced users can fine-tune their I/O responsiveness through several configuration options

Links:
(?) http://mysqlha.blogspot.com/2013/02/mysql-56-io-bound-update-only-workloads.html - real effect of recent changes, based on tests Facebook made
(!) www.mysqlperformanceblog.com/2009/12/04/effect-of-adaptive_flushing/ - adaptive flushing is an old Percona Server feature...
(!!) https://blogs.oracle.com/mysqlinnodb/entry/new_flushing_algorithm_in_innodb - original description of new implementation from the authors
InnoDB enhancements

Improvements to buffer pool flushing

Links:
(1) http://dimitrik.free.fr/blog/archives/2012/04/mysql-performance-improved-adaptive-flushing-in-56labs.html - one of early blog posts about Oracle’s implementation and its effect
(?) http://www.mysqlperformanceblog.com/2012/09/04/adaptive-flushing-in-mysql-5-6/ - Percona’s evaluation of the feature at early stage
(?) http://www.mysqlperformanceblog.com/2012/09/10/adaptive-flushing-in-mysql-5-6-cont/
(!?) http://dimitrik.free.fr/blog/archives/2013/01/mysql-performance-innodb-heavy-io-rw-workloads-limits-in-56.html - “the real improvement will come once a parallel flushing will be implemented in 5.7”
(?) http://blog.mariadb.org/sysbench-oltp-mysql-5-6-vs-mariadb-10-0/ - this post caused a lot of questions and discussions...

Bugs:
Bug #68481 - furious flushing isn't done any more and innodb_io_capacity is not used... How to control flushing now?
Bug #58966 - is there any way to force “good old” 5.1 behavior (even if it was not always good)?
Bug #68497 - now documentation should explain details of flushing properly (bug is “Closed”)
InnoDB enhancements

Memcached API (avoid the SQL overhead)

Details:
- You can code MySQL applications that access InnoDB tables through a NoSQL-style API
- This feature uses the popular **memcached** daemon to relay requests such as ADD, SET, and GET for key-value pairs. SQL and NoSQL can co-exist

Links:
- [http://www.mysqlperformanceblog.com/2013/03/29/mysql-5-6-innodb-memcached-plugin-as-a-caching-layer/](http://www.mysqlperformanceblog.com/2013/03/29/mysql-5-6-innodb-memcached-plugin-as-a-caching-layer/)
- ![https://blogs.oracle.com/mysqlinnodb/entry/new_enhancements_for_innodb_memcached](https://blogs.oracle.com/mysqlinnodb/entry/new_enhancements_for_innodb_memcached) - from the original authors...
- ![https://blogs.oracle.com/MySQL/entry/nosql_memcached_api_for_mysql](https://blogs.oracle.com/MySQL/entry/nosql_memcached_api_for_mysql) - on API and implementation details, from original authors
- ![http://dom.as/2013/04/16/the-saddest-bug-of-them-all-sql-is-dead/](http://dom.as/2013/04/16/the-saddest-bug-of-them-all-sql-is-dead/) - what kinds of problems this solves?

Bugs:
- **Bug #68530** - still “Open”, “5.6 memory leak with innodb memcached plugin”
- **Bug #67026** - FR for “CSV output format”, still “Open”
- **Bug #68974** - still "Open". "NOT NULL columns prevent Memcached plugin from writing new records"
InnoDB enhancements

Persistent optimizer statistics for InnoDB tables

Details:
- Optimizer statistics for InnoDB tables are gathered at more predictable intervals and can persist across server restarts
- You can also control the amount of sampling done for InnoDB indexes

Links:
(!) https://blogs.oracle.com/mysqlinnodb/entry/innodb_persistent_statistics_at_last - original announcement

Bugs:
Bug #67638 - still “Verified”: “optimizer bugs must be handled with greater care in 5.6+ - one has to make sure the table he's using already has got decent index statistics”
Bug #68629 - documentation was incorrect originally
Bug #68163 - one more “noisy” case, fixed in 5.6.11
Bug #43968 - one of the problems this new feature solves
InnoDB enhancements

Optimizations for read-only transactions

Details:
- These optimizations are applied automatically when practical, or
- You can specify `START TRANSACTION READ ONLY` to ensure the transaction is read-only.

Links:
- (!) [https://blogs.oracle.com/mysqlinnodb/entry/repeatable_read_isolation_level_in](https://blogs.oracle.com/mysqlinnodb/entry/repeatable_read_isolation_level_in) - internals and 5.6 read only optimizations described in details

Bugs:
- Bug #66587 - read only transactions are still visible in INNODB STATUS it seems (to the contrary of documentation claims)
- Bug #49169 - see last comments, interesting related reading (on how Oracle is approaching problems and reports/followup questions from Percona)
InnoDB enhancements

Separate tablespaces for UNDO logs

Details:

● You can move the InnoDB undo log out of the system tablespace into one or more separate tablespaces

Links:

(?) http://serge.frezeфонd.com/2013/03/mysql-5-6-innodbundo_tablespaces-very-usefull-only-if/
(!) https://blogs.oracle.com/mysqlenterprisebackup/entry/mysql_enterprise_backup_3_8 - use proper MEB version (xtrabackup 2.0.6 does NOT support this feature yet)
(!) http://www.fromdual.com/shrinking-innodb-system-tablespace-file-ibdata1-poc - one of that hacks people had to use before 5.6 to decrease ibdata* size
(?) http://www.mysqlperformanceblog.com/2010/06/10/reasons-for-run-away-main-innodb-tablespace/ - UNDO in main tablespace had been a problem for a decade...
(!) http://blog.jcole.us/2013/01/03/the-basics-of-innodb-space-file-layout/ - check ibdata1 file overview (must read, entire series, in any case)

Bugs:

Bug #68915 - you have to follow procedures that are not entirely clearly documented
Bug #67528 - one of the problems that is (hopefully) fixed with this feature
InnoDB enhancements

Improvements for REDO logs handling

Details:
- The InnoDB redo log files now have a maximum combined size of 512GB, increased from 4GB.
- The startup behavior now automatically handles the situation where the size of the existing redo log files does not match the size specified by innodb_log_file_size and innodb_log_files_in_group.

Links:
(!) http://www.mysqlperformanceblog.com/2011/02/03/how-innodb-handles-redo-logging/ - background theory
(!) http://www.mysqlperformanceblog.com/2011/09/18/disaster-mysql-5-5-flushing/ - discussion (in comments) why and when bigger redo may be useful
(!) http://www.percona.com/doc/percona-server/5.5/scalability/innodb_io_55.html#innodb_log_file_size - bigger logs on 64-bit systems are available for a long time already in Percona Server

Bugs:
Bug #58779 - one of original FRs + explanation why limit is 512G (not 4T as initially advertised)
InnoDB enhancements

Internal performance enhancements

Details:
- reducing contention by splitting the kernel mutex
- moving flushing operations from the main thread to a separate thread
- enabling multiple purge threads
- reducing contention for the buffer pool on large-memory systems

Links:
(!) https://blogs.oracle.com/MySQL/entry/mysql_5_6_is_a - all official Ads/marketing on one page, thanks to Rob
(!) https://blogs.oracle.com/mysqlinnodb/entry/mysql_5_6_multi_threaded - on multiple purge threads
(!) https://blogs.oracle.com/mysqlinnodb/entry/mysql_5_6_innodb_scalability - on kernel mutex
InnoDB enhancements

Internal performance enhancements

Details:
- Famous brainstorm meeting in Paris, May 2012
- Famous "G5" fix (it was decided to NOT backport it to 5.5.x) for systems with multiple CPU sockets

Links:
(!) https://blogs.oracle.com/mysqlinnodb/entry/introducing_page_cleaner_thread_in - on new page cleaner/separate flush thread
http://www.pythian.com/blog/some-fun-around-mysql-history-list/ - for historical interest

Bugs:
Bug #63196 - one of the problems that multiple purge threads code in 5.6 solved
Bug #49169 - interesting comments on what else was (and was NOT) fixed in the process of splitting kernel mutex
Bug #54982 - interesting discussion on one use case of kernel mutex
Bug #68555 - something still to fix
InnoDB enhancements

Deadlocks detection

Details:
- InnoDB uses a new, faster algorithm to detect deadlocks.
- Information about all InnoDB deadlocks can be written to the MySQL server error log

Links:
(!) http://www.mysqlperformanceblog.com/2012/09/19/logging-deadlocks-errors/ - solution for previous versions (pt-deadlock-logger)
(!) http://ebergen.net/wordpress/2009/08/27/[InnoDB]-deadlock-count-patch/ - previous solution to at least count deadlocks

Bugs:
Bug #1784 - original FR asking for logging all deadlocks
Bug #50413 - just a useful reading related to deadlocks
Bug #49047 - old story...
Partitioning enhancements

Details:
- The maximum number of partitions is increased to 8192
- `ALTER TABLE ... EXCHANGE PARTITION` statement
- `SELECT * FROM t PARTITION (p0, p1) ...` - (sub)partition selection for DML, including LOAD...
- Partition lock pruning

Links:
- (!) http://mikaelronstrom.blogspot.com/2012/10/my-personal-list-of-new-features-in.html - early post
- (?) http://dev.mysql.com/doc/refman/5.6/en/partitioning-limitations.html - there are still many limitations
- (?) http://www.mysqlperformanceblog.com/2010/12/11/mysql-partitioning-can-save-you-or-kill-you/ - partitioning is not a silver bullet

Bugs:
- Bug #67982 - regression vs 5.1, probably still not fixed in 5.5.x and 5.6.x. “Got error 124 from storage engine on DELETE from a partitioned table”
- Bug #65112 - old known problem that seems not solved in 5.6.x
- Bug #37252 - original bug related to locking that is now fixed
- Bug #63083 - one of limitations that are still there
Several new features

Details:

- Instrumentation for table input and output
- Event filtering by table, based on schema and/or table names
- Event filtering by thread. More information is collected for threads
- Summary tables for table and index I/O, and for table locks
- Instrumentation for statements and stages within statements
- Configuration of instruments and consumers at server startup (not only at runtime)

Links:

(!) http://marcalff.blogspot.com/2013/04/on-configuring-performance-schema.html - recent article from Mark Alff on how to configure P_S
https://www.facebook.com/notes/mysql-at-facebook/my-mysql-is-faster-than-your-mysql/10151250402570933 - influence of P_S in 5.6.10 and... 5.1.63 or 5.1.52+FB patch are still fastest in too many cases
(?) http://www.mysqlperformanceblog.com/2013/02/18/is-mysql-5-6-slower-than-mysql-5-5/ - Pecona’s experience with P_S performance impact
PERFORMANCE_SCHEMA

Links:

(!) http://mysqlintheenterprise.com/2013/03/21/a-visual-guide-to-the-mysql-performance-schema/ - some kind of a beginner’s guide
(!) http://mysql.wisborg.dk/category/mysql/performance_schema/ - useful posts from Jesper on the topic
(!) http://www.markleith.co.uk/2012/07/13/monitoring-processes-with-performance-schema-in-mysql-5-6/ - blog post (based on design now a bit outdated) from one of original authors and design decision makers
(!?#) http://mysqlentomologist.blogspot.com/2013/01/how-to-use-performanceschema-to-check.html - my own configuration experience
http://www.mysqlperformanceblog.com/2011/12/02/three-ways-that-the-poor-mans-profiler-can-hurt-mysql/ - P_S or PMP?
- How to get any information about MDL locks for PERFORMANCE_SCHEMA?
PERFORMANCE_SCHEMA

Bugs:

Bug #68413 - Facebook: “performance_schema overhead is at least 10%”
Bug #68097 - still some details to document in the manual
Bug #68574 - “No instrumentation for InnoDB files in P_S on windows”
Bug #68514 - beware of memory usage impact with P_S
Bug #67736 - useful reading about pre-5.6.10 experience with P_S (CPU impact)
Bug #68785 - new features work well together (or not)...
Bug #66589 - still not fixed (do not use mysqlhotcopy)
Bug #64941 - one of the problems that MySQL 5.6 fixed
Several replication enhancements were added

Details:
- Transaction-based replication using *global transaction identifiers* (also known as “GTIDs”)
- `--gtid-mode` and `--enforce-gtid-consistency`
- GTID-based replication is completely transaction-based

Links:
http://www.mysqlperformanceblog.com/2013/02/08/how-to-createrestore-a-slave-using-gtid-replication-in-mysql-5-6/ - GTID changes well known procedures for DBA (?!)
http://www.mysqlperformanceblog.com/2013/03/26/repair-mysql-5-6-gtid-replication-by-injecting-empty-transactions/ - what to do instead of SLAVE_SQL_SKIP_COUNTER=n… (!)
http://www.percona.com/resources/technical-presentations/mysql-56-gtid-nutshell-percona-live-university-toronto - more from Miguel on the topic (!)
http://svenmysql.blogspot.com/2012/10/failover-and-flexible-replication.html - one of early posts explaining ideas and goals of GTID-based replication (!)
Replication and logging

Global transaction IDs

Links:
(!) http://svenmysql.blogspot.com/2012/10/advanced-use-of-global-transaction.html - one of early tutorials
(!) https://blogs.oracle.com/MySQL/entry/deep_dive_into_gtids_and
(?!) http://datacharmer.blogspot.com/2013/01/easily-testing-mysql-56-gtid-in-sandbox.html - early testing results from Giuseppe
(?!) https://lists.launchpad.net/maria-developers/msg04837.html - early discussion of Oracle’s implementation
(?) http://kristiannielsen.livejournal.com/17008.html - MariaDB’s implementation and views
(?!?) http://datacharmer.blogspot.com/2013/02/parallel-replication-and-gtid-tale-of.html - replication features working together...
(!) https://twitter.com/jswanhart/status/296250444345380865 - even twit on the topic may be usefull (extra 44 bytes per transaction)
(!) http://drcharlesbell.blogspot.com/2012/04/mysql-utilities-and-global-transaction.html - new MySQL Utilities to use with GTID-based replication
(?!?) http://code.openark.org/blog/mysql/thoughts-on-mysql-5-6-new-replication-features - early experience
Replication and logging - GTIDs

Bugs:

Bug #68566 - “mysqlbinlog should be more friendly with GTID”
Bug #68525 - problem when enforce-gtid-consistency is used
Bug #68386 - fixed in 5.6.11, 5.6.10 was hardly usable at scale because of this bug
Bug #68638 - “read_gtids_from_binlog improperly calls my_error with ER_MASTER_FATAL_ERROR_READ” (minor, but still...)
Bug #68598 - ”CREATE TEMPORARY TABLE and DROP TEMPORARY TABLE statements are not supported inside transactions when using GTIDs", limitation that should be properly documented now
Bug #68589 - documentation fixed months after GA
Bug #65189 - customer asked to NOT make some of gtid_* server variables, but who cared...
Bug #68314 - mysqldump from 5.6 demands GTIDs even for pre-5.6 versions :)
Bug #68038 - mysqldump-related, fixed in 5.6.11
Bug #67507 - probably same as above, but still “Verified”
Bug #67099 - FR, “In many environments the slave is NEVER expected to be promoted to a master so there is no need to enable binlogging.”...
Bug #60964 - mysqlbinlog might print "### Row event for unknown table" even though transactions succeeded on both master and slave. “Not a bug” (check comments)
Bug #68967 - about server_id_bits. Is it related? Who knows, it’s not documented...
Replication and logging

Row image control

Details:
- Logging only columns required for uniquely identifying and executing changes on each row - to save disk space, network resources, and memory usage
- `binlog_row_image` server system variable: **minimal** (log required columns only), **full** (log all columns), or **noblob**

Links:

Bugs:
- **Bug #68767** - still “Open”, but beware of `binlog_row_image` set to minimal if MERGE tables are used
- **Bug #65116** - not all old known RBR problems are solved. “REPLACE INTO does not update auto increment when replicated row based”
- **Bug #68607** - one more RBR problem to solve... “REPLACE statement not properly logged in binary log in RBR”
- **Bug #68953** - “Binlog write errors silently ignored”. “Verified”.
- **Bug #66363** - “Large transaction writing rbr with `sync_binlog` hangs entire server on `fsync`” (still “Verified”)
- **Bug #67942** - regression in 5.5 and 5.6. “CREATE TABLE is not written in binary log if connection is killed...”
Replication and logging

Crash safe binary logs

Details:
- Only complete events are logged or read back
- Server logs the length of the event and uses this information to verify that the event was written correctly
- Server can also write checksums for the events using CRC32, see binlog_checksum system variable
- To cause the server to read checksums from the binary log, use the master_verifyChecksum
- The --slave-sql-verify-checksum system variable causes the slave SQL thread to read checksums

Links:
- http://www.mysqlperformanceblog.com/2013/02/15/replication-checksums-in-mysql-5-6/ - Percona’s experience
- http://www.percona.com/doc/percona-server/5.5/reliability/crash_resistant_replication.html - Percona’s way to do crash resistant replication

Bugs:
- Bug #68892 - bad GRANT can break replication (not directly related)
- Bug #68281 - “Not a bug”, but still useful reading. “sync_master_info=1 kills slave MTS concurrency”
Replication and logging

--master-info-repository and --relay-log-info-repository

Details:
- Connection information can be logged into InnoDB tables
- To guarantee crash safety on the slave, run the slave with the --relay-log-recovery option enabled

Links:
- (?) http://datacharmer.blogspot.com/2012/08/mysql-56-replication-gotchas-and-bugs.html - some consequences, may be unexpected...
- (?) http://www.skysql.com/blogs/kolbe/mysql-56-master-info-repository-documentation-behavior-and-reality - Kolbe’s (SkySQL) comments
- (?) http://www.skysql.com/blogs/kolbe/mysql-56-security-through-complacency - some more from him

Bugs:
- Bug #68460 - “blocked with FLUSH TABLES WITH READ LOCK + SHOW SLAVE STATUS”
- Bug #68604 - “MySQL crashes trying to start slave” (after loading slave_master_info from another instance)
- Bug #68605 - “START SLAVE after import of table-based repositories gives empty error message”
- Bug #68599 - “Warning issued about master.info when using master-info-repository=table” (minor, but still...)
New features of `mysqlbinlog`

Details:
- `mysqlbinlog` now has the capability to back up a binary log in its original binary format.
- When invoked with the `--read-from-remote-server` and `--raw` options, `mysqlbinlog` connects to a server, requests the log files, and writes output files in the same format as the originals.

Links:

Bugs:
- Bug #68347 - genuine bug with -R option: “mysqlbinlog does not reset the "at" byte position counter with ROTATE_EVENT”
- Bug #67643 - mysqlbinlog version increase, fixed only in 5.6.11
- Bug #68566 - mysqlbinlog and GTID related FR
- Bug #68547 - “Open”, related FR: “Remote Binlog Back-up should save binlog file along with position no.”
Multi-threaded slave (MTS)

Details:
- N slave worker threads as determined by the value of the `slave_parallel_workers` server system variable
- Slave assumes that data and updates are partitioned on a per-database basis
- It is not necessary to coordinate transactions between different databases, but order can be different...

Links:
- [Oracle’s benchmarks](https://blogs.oracle.com/MySQL/entry/benchmarking_mysql_replication_with_multi)
- Early high level architecture review and benchmarks from one of the authors (Andrei Elkin)
- Some useful speculations
- Useful related reading (attempts to speed up single threaded replication)

Bugs:
- Bug #68506 - “Got SIGSEGV on MTS recovery + SQL thread error”
- Bug #68465 - “Make slave_transaction_retries work with MTS”
- Bug #68281 - beware of sync_master_info=1 when using MTS (“Not a Bug”, but still)
Replication and logging

Binlog group commit is finally implemented

Links:
(!) http://www.percona.com/doc/percona-server/5.5/performance/binary_group_commit.html - exists for a long time in Percona Server
(!?) http://kristiannielsen.livejournal.com/16382.html - MariaDB’s work
(!) http://www.mysqlperformanceblog.com/2011/07/13/testing-the-group-commit-fix/ - benchmarking Percona’s version
(!) http://dev.mysql.com/worklog/task/?id=5223 - original Oracle’s WL

Bugs:
Bug #68569 - deadlock with group commit
Bug #49326 - original FR
Bug #68250 - “Current semi-synchronous replication may cause deadlock”. Status is unclear, but there are claims that 5.6 is even more likely to be affected because of binlog group commit.
Bug #68251 - “3-way deadlock on semisync replication and binlog rotate”. Reported on 5.6.9, still “Verified”.
Bug #67929 - “Race in bin log dump thread results in slave missing events”. Not related to group commit, but note that only 5.6.11 will have the fix.
Optimizer enhancements

Disk-Sweep Multi-Range Read (MRR)

Details:
- With MRR optimization, MySQL tries to reduce the number of random disk access for range scans by first scanning the index only and collecting the keys for the relevant rows. Then the keys are sorted and finally the rows are retrieved from the base table using the order of the primary key.

Links:
[(!) https://kb.askmonty.org/en/multi-range-read-optimization/] - MRR theory from MariaDB
[(!) http://www.mysqlperformanceblog.com/2012/03/21/multi-range-read-mrr-in-mysql-5-6-and-mariadb-5-5/] - MRR explanation from Percona (Ovais)

Bugs:
- Bug #68919 - regression vs 5.5.x because of MRR (good it can be switched off)
- Bug #62676 - documentation is still not perfect...
- Bug #60864 - one more case
- Bug #68977 - one more documentation problem (MRR decision is cost-based by default actually)
Optimizer enhancements

Index Condition Pushdown (ICP)

Details:
- If parts of the WHERE condition can be evaluated by using only fields from the index, the MySQL server pushes this part of the WHERE condition down to the storage engine...
- ICP can reduce the number of accesses the storage engine has to do against the base table and the number of accesses the MySQL server has to do against the storage engine

Links:
http://www.mysqlperformanceblog.com/2013/03/14/mysql-5-6-10-optimizer-limitations-index-condition-pushdown/ - ICP limitations (?)

Bugs:
Bug #68554 - “Optimizer wrongly choses covering index over ICP”
Bug #68154 - “explain output 'Using index condition' not proper”
Optimizer enhancements

EXPLAIN for DML statements + JSON output format

Details:
- The EXPLAIN statement now provides execution plan information for DELETE, INSERT, REPLACE, and UPDATE statements
- In addition, the EXPLAIN statement now can produce output in JSON format

Links:
(?) http://s.petrunia.net/blog/?p=75 - Sergey Petrunia’s review of the feature

Bugs:
Bug #67638 - “Odd optimizer choice for UPDATE .. ORDER BY ... LIMIT query”
Bug #68299 - “unexpected "Using where" in "explain update/delete"”
Subqueries optimizations

Details:
- Materialization of subqueries in the FROM clause is postponed until their contents are needed
- Optimizer may add an index to a derived table to speed up row retrieval from it
- Optimizer uses semi-join and materialization strategies

Links:
(!) http://igors-notes.blogspot.com/2012/10/once-more-about-comparison-of-subquery.html - not invented by Oracle (from Igor Babaev)
(!) http://igors-notes.blogspot.com/2012/02/comparing-optimizer-features-of-mariadb.html - more about history from Igor
(?) http://s.petrunia.net/blog/?p=78 - “No, Sheeri, MySQL 5.6 does not optimize subqueries away”
(!) http://s.petrunia.net/blog/?p=73 - More on cost-based choice between subquery Materialization and IN-EXISTS

Bugs:
Bug #68254 - still “Open”, “subquery optimize to wrong semi-join with extensions syntax to group by”
Batched Key Access (BKA)

Details:
- BKA join algorithm is now available that uses both index access to the joined table and a join buffer
- BKA algorithm supports inner join, outer join, and semi-join operations, including nested...
- Improved join performance due to more efficient table scanning

Links:
(!) http://jorgenloland.blogspot.com/2012/12/favorite-mysql-56-features-optimizer.html - general review of optimizer improvements
(!) http://www.mysqlperformanceblog.com/2012/04/04/join-optimizations-in-mysql-5-6-and-mariadb-5-5/ - Percona’s review (by Ovais)
(!) http://oysteing.blogspot.com/2011/10/batched-key-access-speeds-up-disk-bound.html - one of earlier posts
http://www.mysqlperformanceblog.com/2012/05/31/a-case-for-mariadbs-hash-joins/ - interesting benchmark
http://s.petrunia.net/blog/?p=49 - MySQL 6.0 news: Batched Key Access is in (history of this feature)

Bugs:
Bug #68899 - “dynamic range” access path is not cost-based (beware of big join_buffer_size)
Optimizer enhancements

Optimizer tracing

Details:
- The optimizer now has a tracing capability, primarily for use by developers
- A set of optimizer_trace_xxx system variables
- The INFORMATION_SCHEMA.OPTIMIZER_TRACE table

Links:
(!) http://guilhembichot.blogspot.com/2011/09/optimizer-tracing-how-to-configure-it.html - early post about the feature from one of authors
(!) http://opensourcedba.wordpress.com/2012/01/05/optimizer-tracing/ - some more links there
https://blogs.oracle.com/svetasmirnova/entry/my_18_mysql_5_6 - Sveta likes it :)
(!) http://jorgenloland.blogspot.com/2011/10/optimizer-tracing-query-execution-plan.html - what it is and what it is NOT

A Look Under the Hood of CBO: The 10053 Event - that's what I'd like to see instead

Bugs:
Bug #33486 - original FR
Let me produce some flame...
State of optimizer in MySQL 5.6

Old and new Optimizer bugs

Links:
(? ) http://www.mysqlperformanceblog.com/2013/03/11/mysql-5-6-vs-5-5-on-the-star-schema-benchmark/ - is it optimizer that matters most? Interesting case of 5.5.30 vs 5.6.10 studied in details

Bugs:
Bug #54808 - “Optimizer use REF joins where it should use EQ_REF”, still “Verified”
Bug #58604 - “crash in cleanup code of explain partitions after killing connection”, still “Verified”, 5.6.1 was listed among versions affected
Bug #59187 - “Wrong result with NULL NOT IN subquery”, still “Verified”, 5.6.2 was listed as affected
Bug #62504 - “select count(distinct N1), count(distinct N2) from test.AA works incorrectly”, 5.6.10 is also affected
Bug #65957 - “Poor correlated subquery performance with order by and limit”, regression comparing to 5.0.x. 5.6.6 was affected
Bug #67815 - “MySQL consistently uses a low cardinality non-referenced column in a index scan”
Bug #68350 - “query proc - re-execute of stored routine, inefficient query plan”
State of optimizer in MySQL 5.6

Generic optimizer bugs in 5.6.x not listed above

**Bug #68656** - “ORDER BY ignored in some situations for UPDATE query”. Regression since 5.5.6(!)
**Bug #68825** - extra optimizer overhead in 5.6 is like 1%
**Bug #68713** - memory left uninitialized in one case...
**Bug #68871** - minor, but still...
**Bug #68749** - basic case of wrong results in 5.5 and 5.6 (“Basic SELECT count(distinct id) is broken.”). Let’s question QA?
**Bug #68046** - one of the ways 5.6.10 was badly broken: “IN() clause with many constant values does not perform”. Regression in 5.6.6+, fixed in 5.6.11.
**Bug #69005** - wrong results with Order by lower(column) (regression vs 5.5)
**Bug #68897** - wrong results in 5.6.10 (regression vs 5.0.x)
Conditions handling in SPs

MySQL now supports the **GET DIAGNOSTICS**, and more...

Details:
- Block scope is used in determining which handler to select
- Condition precedence is more accurately resolved
- Bug #55843 fixed (diagnostics area clearing has changed)
- Now the handler for the condition with highest precedence is chosen, even if it is not the first condition raised by the statement

Links:
- ![http://code.openark.org/blog/mysql/mysql-error-handling-on-server-side-a-no-go](http://code.openark.org/blog/mysql/mysql-error-handling-on-server-side-a-no-go) - problem that is now solved
- ![Bug #61392](http://code.openark.org/blog/mysql/mysql-error-handling-on-server-side-a-no-go) - one of the problems solved, “The RETURN statement did not clear the diagnostics area as it should have. Now the diagnostics area is cleared before executing RETURN.”

Bugs:
- **Bug #11660** - original FR, implemented
- **Bug #38806** - original problem, “Wrong scope for SQL HANDLERS in SP”, solved
- **Bug #68831** - does not work as expected sometimes, “HANDLER FOR SQLEXCEPTION not catching Error 1452 (FK constraint) for UPDATE”
Several data type changes have been implemented

Details:
- MySQL now permits fractional seconds (6 digits) for TIME, DATETIME, and TIMESTAMP values
- DEFAULT CURRENT_TIMESTAMP and ON UPDATE CURRENT_TIMESTAMP clauses - for any TIMESTAMP and DATETIME columns
- explicit_defaults_for_timestamp system variable
- YEAR(2) columns in existing tables are treated as before, but YEAR(2) in new or altered tables are converted to YEAR(4)

Bugs:
- Bug #68864 - “INTERVAL treats null values of text columns as float/int”. Not new in 5.6.
- Bug #68760 - “Datetime rounding problem”, looks like regression vs 5.5.30
- Bug #68759 - “Inconsistent results on comparison a time field with a non-time literal”, looks like regression vs 5.5.31
- Bug #68577 - “Incorrect enum values returned when using UNION after CREATE AS SELECT”. Not new...
- Bug #68192 - “Limitation on DOUBLE or REAL length is ignored with INSERT .. SELECT”. Not new in 5.6
- Bug #68062 - “TIME_TO_SEC() doesn't support fractional seconds”. Reported against 5.6.8 and still NOT fixed.
Do we have a hope?
Features without serious problems

- InnoDB support for read only media (Bug #67600 - you should not miss innodb_read_only option or server will crash...)
- New InnoDB-related I_S tables: INNODB_SYS_*, INNODB_BUFFER_* (also in 5.5.28+), INNODB_FT_*, INNODB_METRICS (209 counters as of 5.6.10)
- InnoDB data dictionary size control (table_definition_cache)
- Preloading the InnoDB buffer pool
- Delayed replication (MASTER_DELAY vs pt-slave-delay) and other small replication improvements
- SELECT ... FROM single_table ...
  ORDER BY non_index_column [DESC] LIMIT [M,]N
- Host cache: new Connection_errors.xxx status variables, host_cache_size variable, P_S.host_cache table
- Improved OpenGIS support (Bug #68091 - “ST_Overlaps and ST_Intersects give erroneous results”, still a bug even in 5.6.11)
Thank you!

Questions and Answers

Please, report bugs to: http://bugs.mysql.com