

What's New in MySQL 5.7

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# Safe Harbor Statement

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# MySQL 5.7 is GA!

## Performance & Scalability

3 X Faster than MySQL 5.6

Enhanced InnoDB: faster online & bulk load operations

Replication Improvements (incl. multi-source, multi-threaded slaves...)

New Optimizer Cost Model: greater user control & better query performance

## Manageability

Native JSON Support

Improved Security: safer initialization, setup & management

Performance Schema Improvements

MySQL SYS Schema

And many more new features and enhancements. Learn more at: [dev.mysql.com](http://dev.mysql.com)

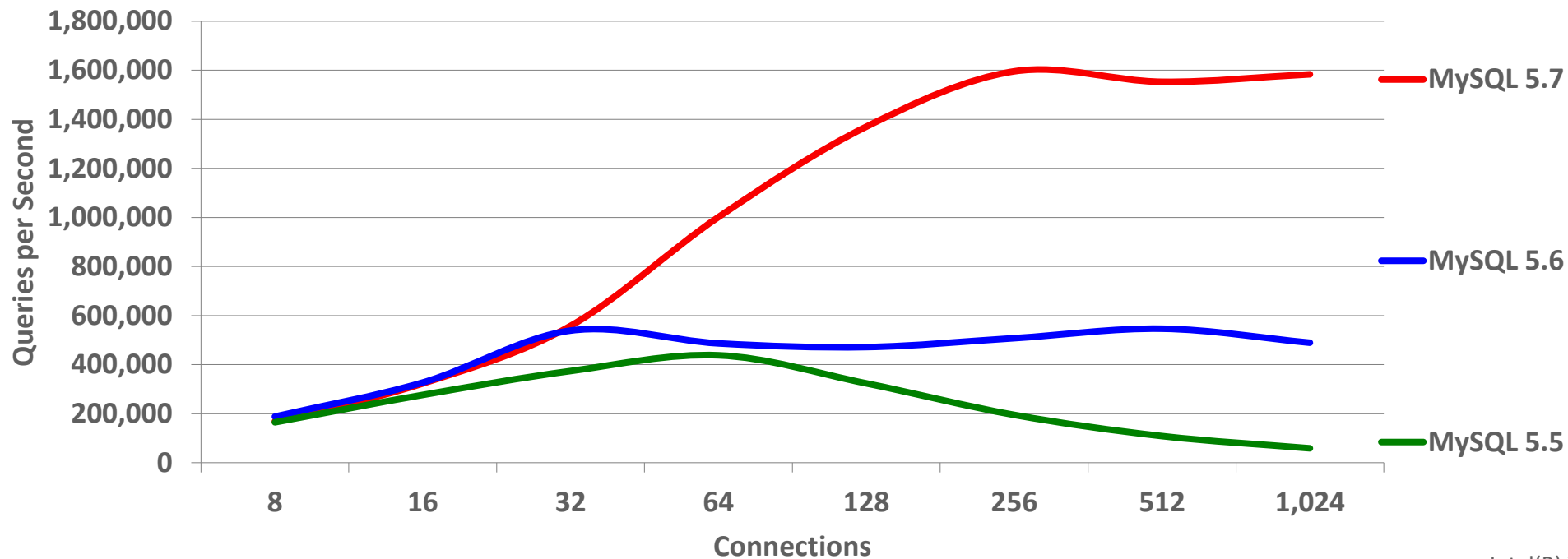
# MySQL 5.7 Sysbench Benchmark: SQL Point Selects / sec

3x Faster than MySQL 5.6

4x Faster than MySQL 5.5

1,600,000 QPS

MySQL 5.7: Sysbench OLTP Read Only (SQL Point Selects)



Intel(R) Xeon(R) CPU E7-8890 v3  
4 sockets x 18 cores-HT (144 CPU threads)  
2.5 Ghz, 512GB RAM  
Linux kernel 3.16

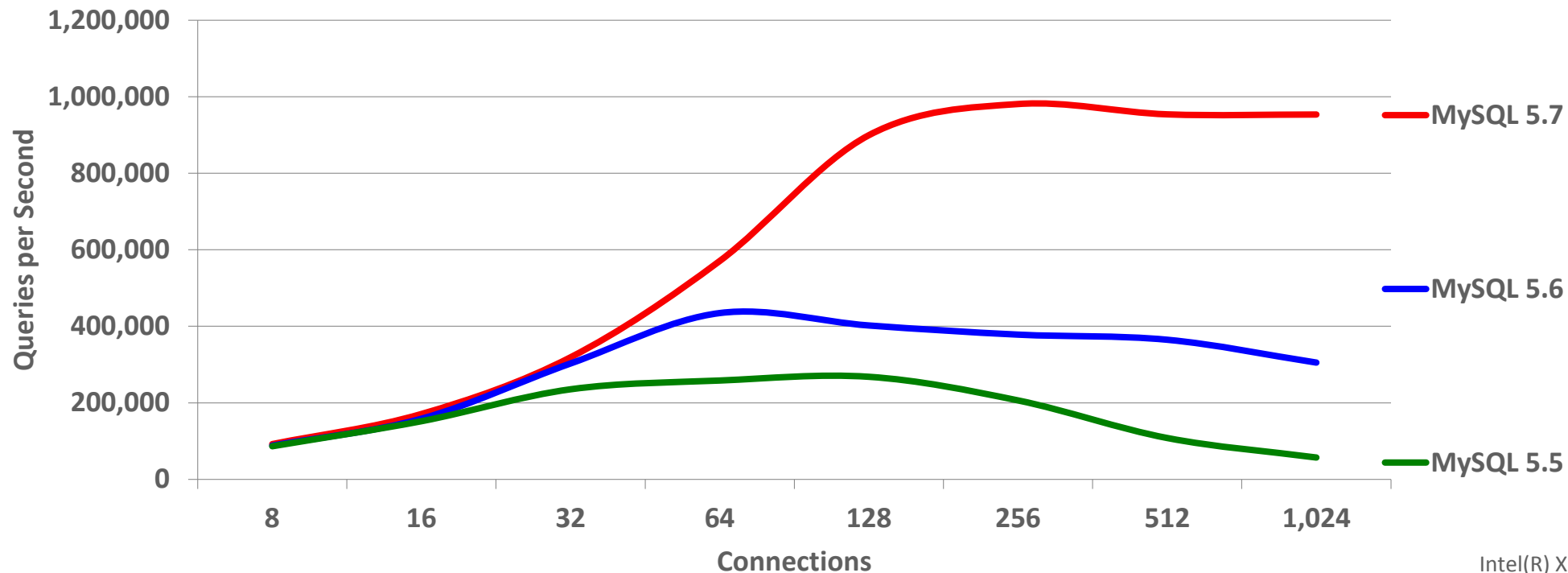
# MySQL 5.7 Sysbench Benchmark: Mixed OLTP Read Only

**3x Faster than MySQL 5.6**

**6x Faster than MySQL 5.5**

**Near 1M QPS**

MySQL 5.7: Sysbench OLTP Read Only (Mixed)



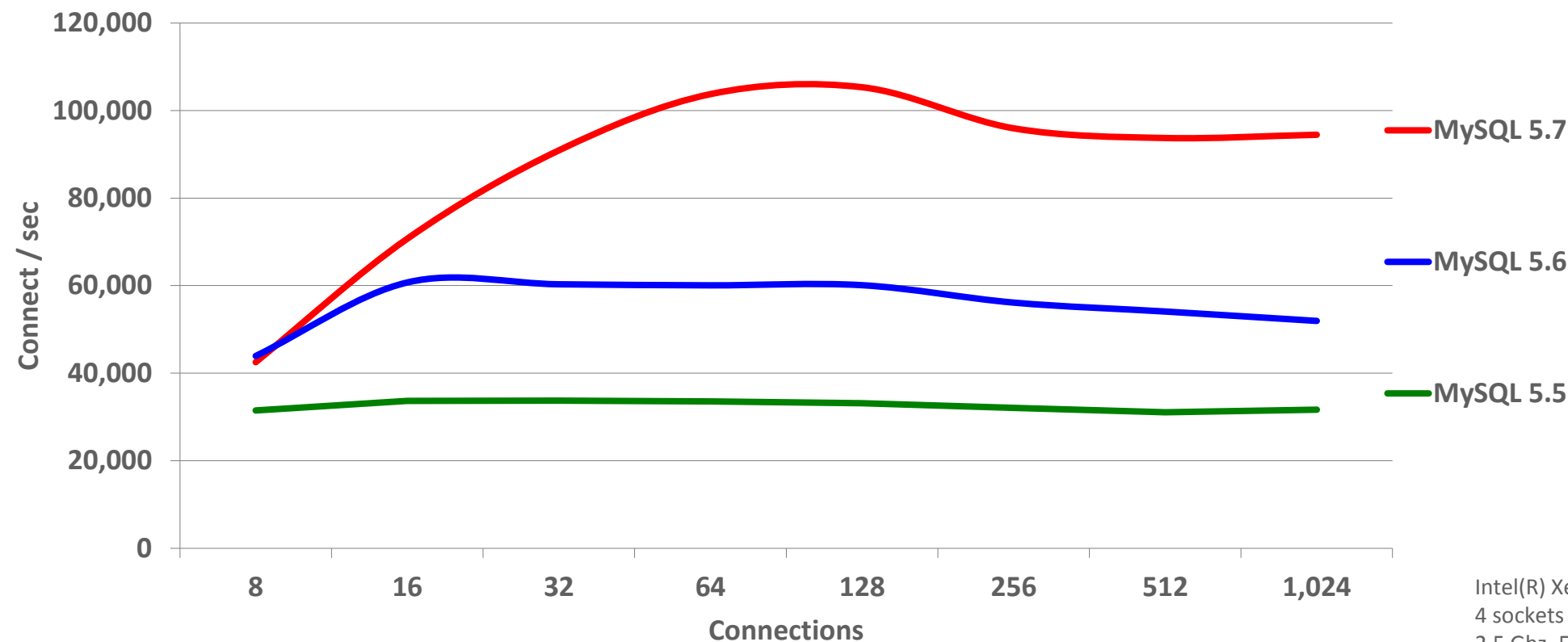
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# MySQL 5.7 Sysbench Benchmark: Connect / sec

82% Faster than MySQL 5.6

100K Connect / Sec

MySQL 5.7: Sysbench OLTP Read Only (Connect)



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4 sockets x 18 cores-HT (144 CPU threads)  
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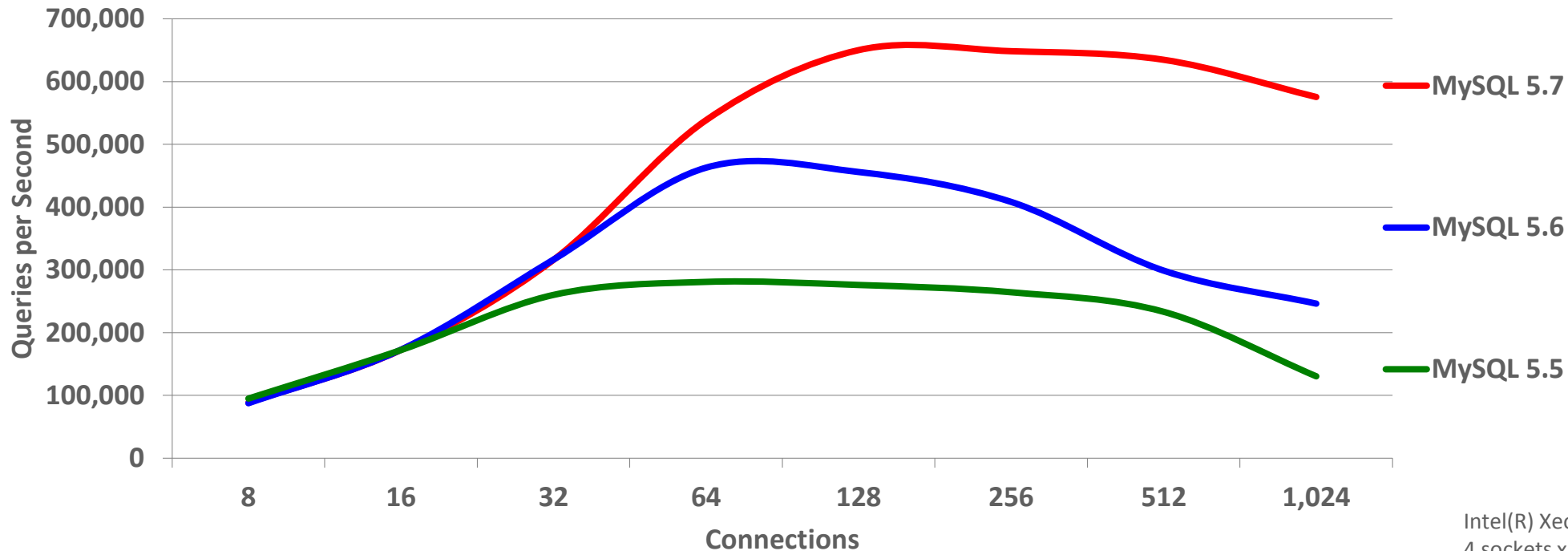


# MySQL 5.7 Sysbench Benchmark: Complex OLTP Read Write

**1.5x Faster than MySQL 5.6**

**3x Faster than MySQL 5.5**

MySQL 5.7: Sysbench OLTP Read Write (Complex)



Intel(R) Xeon(R) CPU E7-8890 v3  
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2.5 Ghz, 512GB RAM  
Linux kernel 3.16

# MySQL 5.7: JSON Overview

- Native JSON data type
  - Native internal binary format for efficient processing & storage
- Built-in JSON functions
  - Allowing you to efficiently store, search, update, and manipulate Documents
- JSON Comparator
  - Allows for easy integration of Document data within your SQL queries
- Indexing of Documents using Generated Columns
  - InnoDB supports indexes on both stored and virtual Generated Columns
  - New expression analyzer automatically uses the best “functional” index available

# MySQL 5.7: Optimizer Improvements

**Queries execute faster, while using less CPU and disk space!**

- Optimizer and Parser refactoring
    - Cleanly separate the parsing, optimizing, and execution stages
  - **New** hint framework
    - Easier to manage
    - With support for additional **new** hints
  - Improved JSON EXPLAIN
  - EXPLAIN for running thread
  - Generated Columns
- **New** Cost based Optimizer
    - Configurable and tunable
      - mysql.server\_cost and mysql.engine\_cost tables
      - API for determining where data resides: on disk or in cache
  - Support for InnoDB based internal temp tables
  - SQL Standard compliant ONLY\_FULL\_GROUP\_BY mode is ON by default
  - Many specific new optimizations

# MySQL 5.7: Query Rewrite Plugin

- New pre and post parse query rewrite APIs
  - Users can write their own plug-ins
- Provides a post-parse query plugin
  - Rewrite problematic queries without the need to make application changes
  - Add hints
  - Modify join order
  - Many more ...
- Improve problematic queries from ORMs, third party apps, etc
- Eliminates many legacy use cases for proxies

# MySQL 5.7: Performance Schema

## Memory Instrumentation

- Aggregates statistics by
  - Type of memory used (caches, internal buffers, ...)
  - Thread/account/user/host indirectly performing the memory operation
- Attributes include
  - Memory used (bytes)
  - Operation counts
  - High/Low Water Marks

## Statement Instrumentation

- Stored Procedures
- Stored Functions
- Prepared Statements
- Transactions

## Additional Information

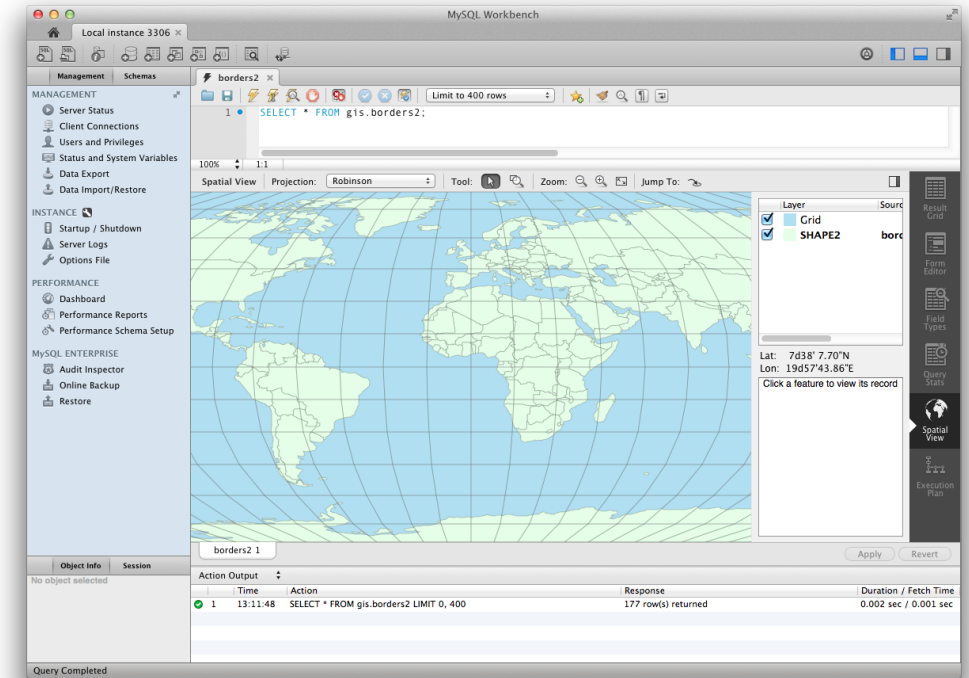
- Replication slave status
- MDL lock instrumentation
- Status and variables per thread
- Server stage tracking
- Track long running SQL
- Improved configuration and ease-of-use
- All while **reducing** total footprint and overhead

## SYS views make it easier to

- 
- The screenshot displays the MySQL Workbench Performance Reports window. The left sidebar shows the navigation tree with categories like MANAGEMENT, INSTANCE, PERFORMANCE, and MYSQL ENTERPRISE. Under PERFORMANCE, 'Performance Reports' is selected. The main pane shows the 'Top File I/O Activity Report' under 'Hot Spots for I/O'. A table titled 'Top File I/O Activity Report' lists files and their total IOs.
- | File                                  | Total IOs |
|---------------------------------------|-----------|
| C:\ProgramData\...backup_history.CSV  | 72        |
| C:\Program...\backup_progress.CSV     | 38        |
| C:\ProgramData\...backup_history.frm  | 19        |
| C:\ProgramData\MySQL\...\proc.MYD     | 12        |
| C:\ProgramData\...backup_progress.frm | 6         |
| C:\Program Files\MySQL\...errmsg.sys  | 6         |
| C:\Program Files\MySQL\...Index.xml   | 2         |
| C:\ProgramData\MySQL\...borders2.frm  | 2         |
| C:\ProgramData\...configuration.frm   | 2         |
| C:\Progra...statement_analysis.frm    | 2         |
| C:\ProgramData\...any_by_table.frm    | 2         |
| C:\...\x@0024statement_analysis.frm   | 2         |
| C:\ProgramData\...with_buffer.frm     | 2         |
| C:\ProgramData\My...processlist.frm   | 2         |
| C:\ProgramData\...l_table_scans.frm   | 2         |
| C:\ProgramData\...with_buffer.frm     | 2         |
| C:\Program...\x@0024processlist.frm   | 2         |
| C:\ProgramData\...l_table_scans.frm   | 2         |
| C:\...\Vo_global_by_wait_by_bytes.frm | 2         |
| ...\Vo_global_by_wait_by_latency.frm  | 2         |
| C:\ProgramData\...ait_by_bytes.frm    | 2         |
| C:\Progra...innodb_index_stats.frm    | 2         |
| C:\Pro...schema_table_statistics.frm  | 2         |
| C:\...\events_statements_current.frm  | 2         |
| C:\...\events_statements_history.frm  | 2         |
| C:\ProgramData\...history_long.frm    | 2         |
| C:\ProgramData\...it_by_latency.frm   | 2         |
| C:\Pr...\Vo_by_thread_by_latency.frm  | 2         |
| ...statements_with_temp_tables.frm    | 2         |
| C:\Pr...statements_with_sorting.frm   | 2         |
| C:\ProgramData\...ement_type.frm      | 2         |
| C:\ProgramData\...temp_tables.frm     | 2         |
| C:\Progra...events_waits_current.frm  | 2         |

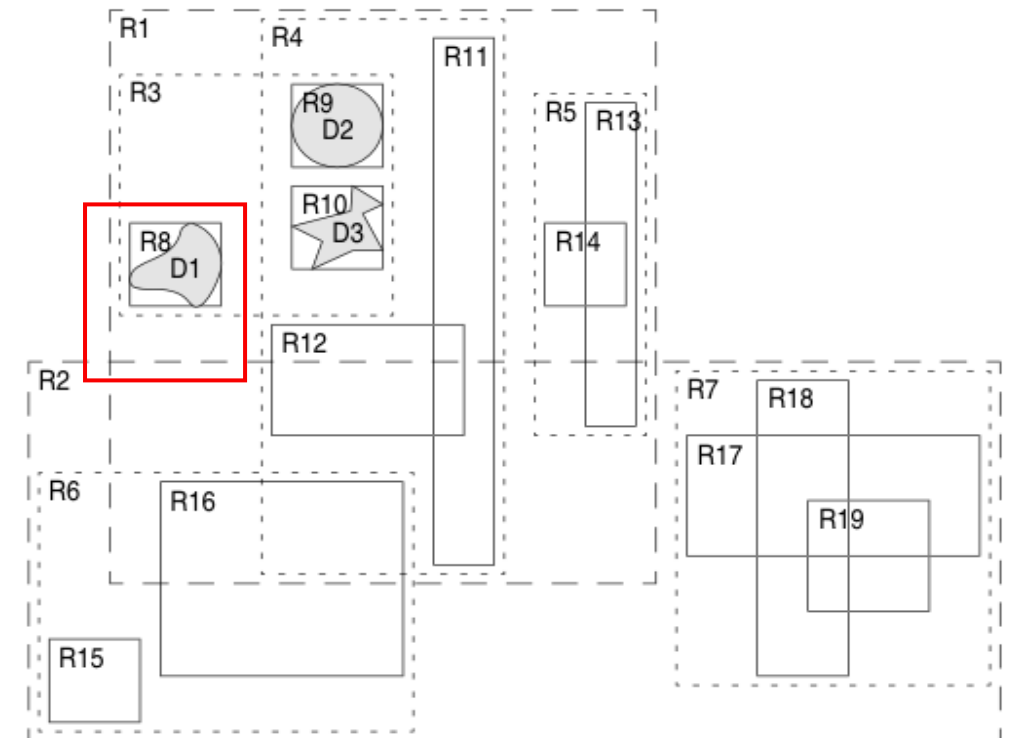
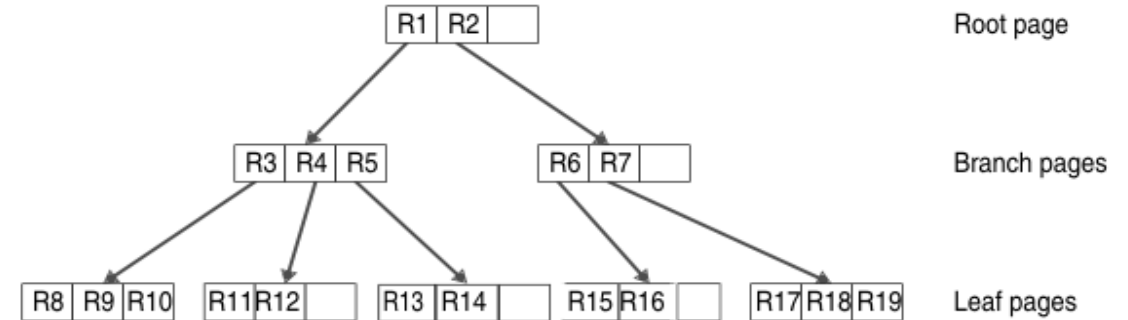
# MySQL 5.7: GIS Improvements

- Replaced custom code with Boost.Geometry
  - For spatial calculations
  - For spatial analysis
  - Enabling full OGC compliance
  - We're also Boost.Geometry **contributors!**
- InnoDB R-tree based spatial indexes
  - Full ACID, MVCC, & transactional support
  - Index records contain minimum bounding box
- GeoHash
- GeoJSON
- Helper functions such as **ST\_Distance\_Sphere()** and ST\_MakeEnvelope()



# MySQL 5.7: GIS - InnoDB Spatial Indexes

- R-tree based
  - Full transactional support
  - Predicate locking to prevent phantoms
  - Records contain minimum bounding box
    - Small and compact
  - Currently only supports 2D data
    - We would like to add 3D support in the future
  - Supports historical spatial index DDL syntax



# MySQL 5.7: InnoDB Improvements

- Native Partitioning
  - Eliminates previous limitations
  - Eliminates resource usage problems
  - Transportable tablespace support
- Native Full-Text Search
  - Including full **CJK support!**
- Native Spatial Indexes
- Transparent page compression
- Support for 32K and 64K pages
  - Use with transparent page compression for very high compression ratios
- General TABLESPACE support
  - Store multiple tables in user defined shared tablespaces
- Support for MySQL Group Replication
  - High priority transactions
- Improved support for cache preloading
  - Load your hottest data loaded at startup
- Configurable fill-factor
  - Allows for improvements in storage footprint
- Improved bulk-data load performance
- **Resize the InnoDB Buffer Pool online**

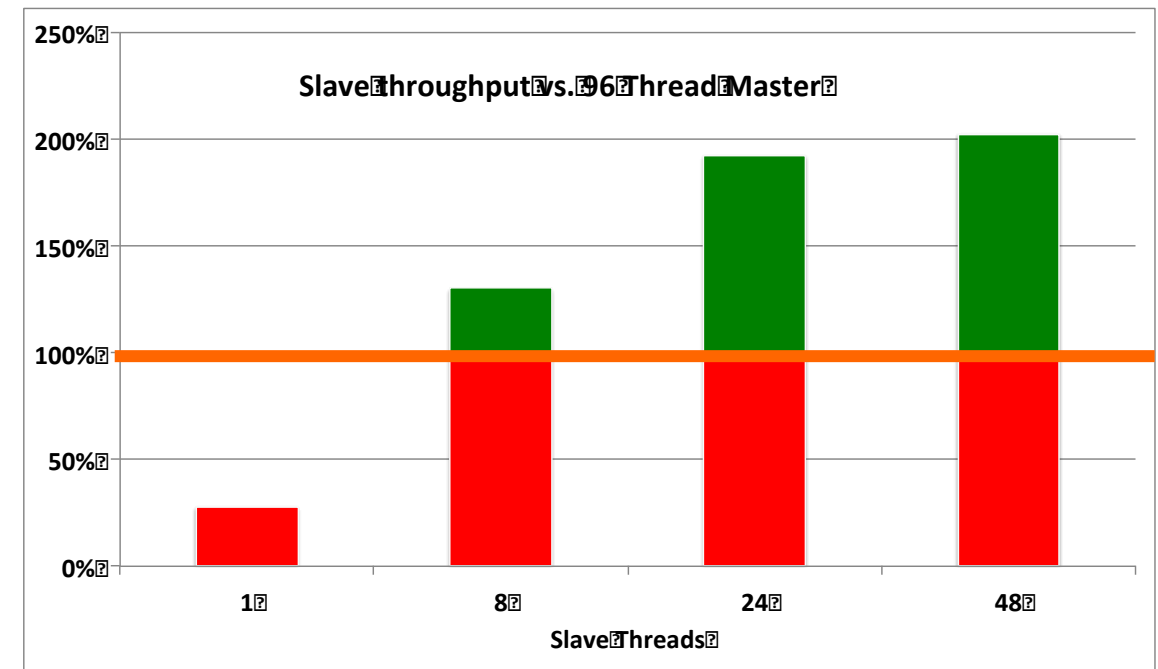
# MySQL 5.7: Security Improvements

- InnoDB Tablespace Encryption
  - MySQL KeyRing
  - AES 256 Encryption now the default
  - Password rotation policies
  - Deployment: enable secure unattended install by default
  - Easier instance initialization and setup: `mysqld --initialize`
  - New detection and support for systemd
- SSL
    - Enabled by default
    - Auto-detection of existing keys and certs
    - Auto generation of keys and certs when needed
    - New helper utility: `mysql_ssl_rsa_setup`
    - New `--require_secure_transport` option to prevent insecure communications
    - Added SSL support to binary log clients
  - Extended Proxy User Support
    - Added Built-in Authentication Plugins support for Proxy Users
    - Allows multiple users to share a single set of managed privileges

# MySQL 5.7: Replication Improvements

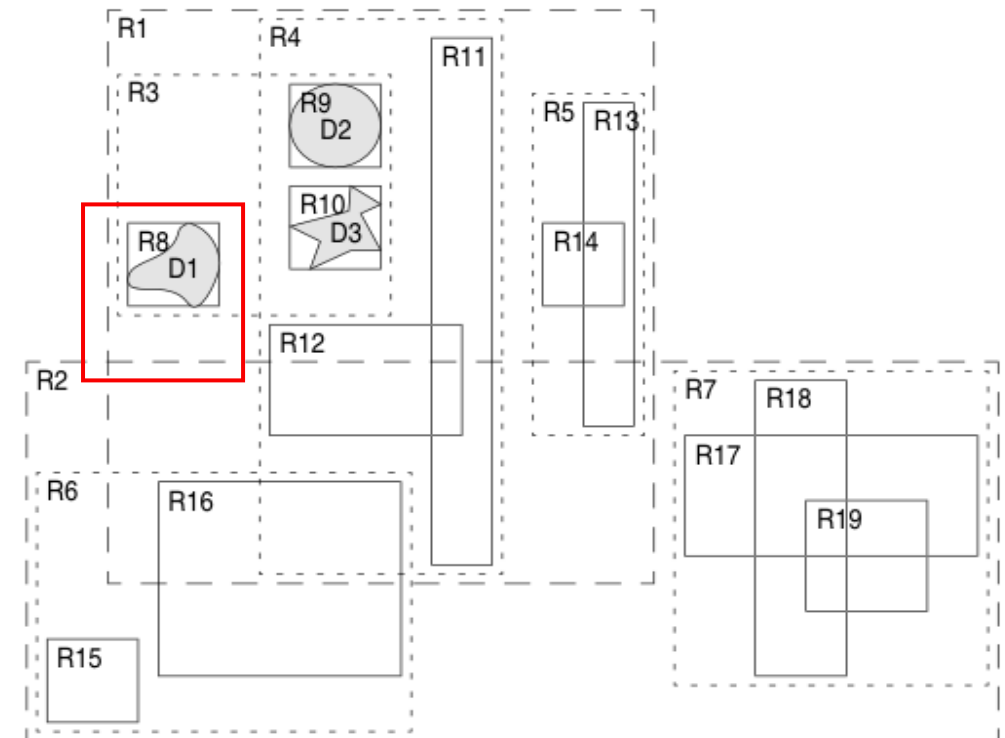
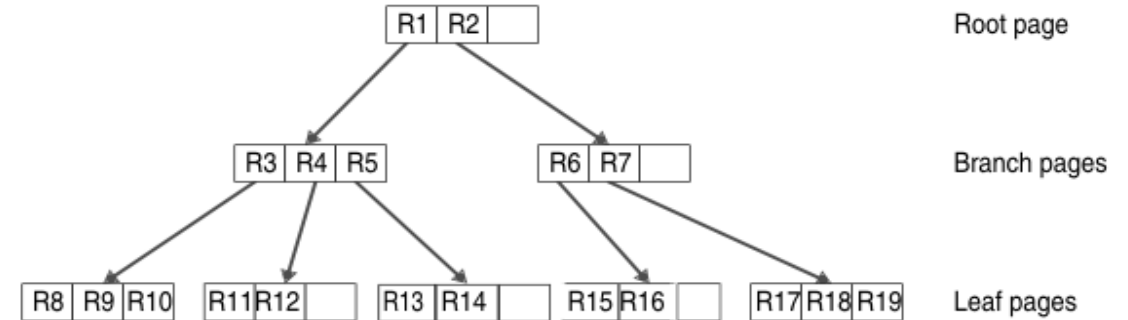
- GTID enhancements
  - On-line, phased deployment of GTIDs
  - Binary logging on slave now optional
- Enhanced Semi-synchronous replication
  - Write guaranteed to be received by slave before being observed by clients of the master
  - Option to wait on Acks from multiple slaves
- Multi-Source Replication
  - Consolidate updates from multiple Masters into one Slave
- Dynamic slave filters

- **8-10x** Faster slave throughput
  - Often removes slave as a bottleneck; keep pace with master with 8+ slave threads
  - Option to preserve Commit order
  - Automatic slave transaction retries



# MySQL 5.7: GIS - InnoDB Spatial Indexes

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  - Records contain minimum bounding box
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  - Supports historical spatial index DDL syntax



# MySQL 5.7: Syslog Support for Linux/Unix platforms

- Native support for syslog
- Simple option to (re)direct log output to native syslog facility
- Start-up server configuration option
- Dynamically in the running server
  - System variable `log_syslog` (ON/OFF, defaults to OFF).

# MySQL 5.7: Locking

## Multiple User Level Locks per Connection

- User-level locks can be used to organize mutual exclusion
  - When accessing some resource
  - When table or row-level locks are not appropriate
- Request multiple locks by issuing a series of GET\_LOCK statements
- Replaces custom user-level lock implementation
  - With one based on the MDL lock manager
  - Deadlocks between different connections acquiring user-level locks, metadata locks, and those waiting for table flushes are properly detected and reported as errors.

# MySQL 5.7: Improved MDL locking

- Fast-path for DML locks
- Lock-free DML lock acquisition
- Lock-free hash
  - Now uses MurmurHash library
- Removes bottlenecks around DML access to a single table
  - 10% increased throughput in OLTP\_RO/POINT\_SELECT sysbench
  - Optimized for typical DML heavy workloads

# MySQL 5.7: Server-side Statement Timeouts

- Server side statement timeouts
  - Global for server, per session, or for individual SELECT statements
- `SELECT /*+ MAX_EXECUTION_TIME(1000) */ * FROM my_table;` d by removing USER option

# MySQL Enterprise Edition

- **New!** MySQL Enterprise **Transparent Data Encryption**
  - Data-at-Rest Encryption
  - Key Management/Security
- MySQL Enterprise **Encryption**
  - Public/Private Key Cryptography
  - Asymmetric Encryption
  - Digital Signatures, Data Validation
  - User Activity Auditing, Regulatory Compliance
- MySQL Enterprise **Firewall**
  - Block SQL Injection Attacks
  - Intrusion Detection
- MySQL Enterprise **Authentication**
  - External Authentication Modules
    - Microsoft AD, Linux PAMs
- MySQL Enterprise **Audit**
  - User Activity Auditing, Regulatory Compliance
- MySQL Enterprise **Monitor**
  - Changes in Database Configurations, Users Permissions, Database Schema, Passwords
- MySQL Enterprise **Backup**
  - Securing Backups, AES 256 encryption

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