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MySQL Technology Update

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Principal Consultant, Technical Sales Engineering

Northern California Oracle Users Group August 2013

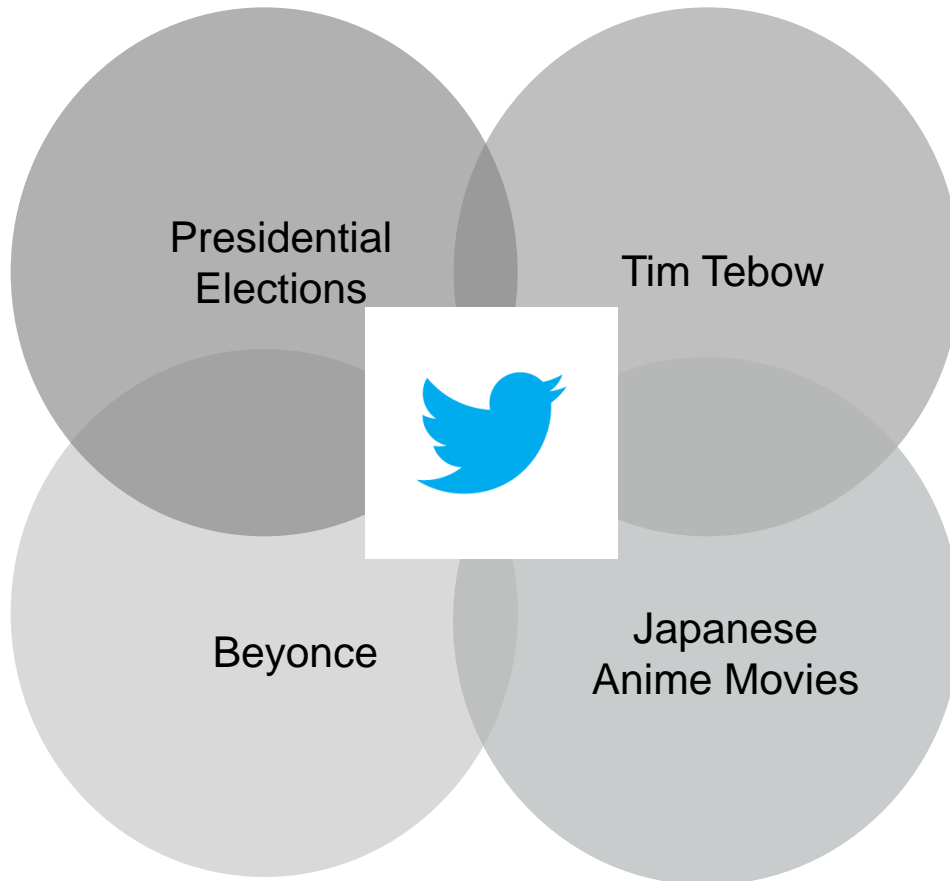
Safe Harbor Statement

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decision. The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

Agenda

- Oracle's MySQL Strategy and Overview
- Performance, Optimizer, and Online Operations
- Hadoop Integration
- NoSQL API
- Oracle Product Integrations
- Quickstart suggestions
- Q&A

Intersection?



Tweets

- Anime: 25,000 per second
- Beyonce:327,452 per minute
- Election: 9,965 per second 8-9 pm
- Tebow: 15,107 8:20 pm

Random Server at Twitter

- **212 days**

uptime of random MySQL server at twitter

- **127 billion**

number of queries executed on single server

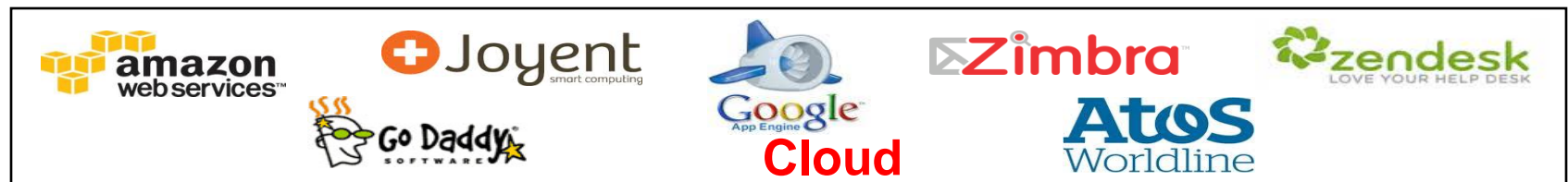
- **24.9 trillion**

innodb_rows_read, 1.36M per second

source: Jeremy Cole, Twitter DBA, MySQL UC 2011

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Industry Leaders Rely on MySQL



Driving MySQL Innovation

MySQL Enterprise Monitor 2.2
MySQL Cluster 7.1
MySQL Cluster Manager 1.0
MySQL Workbench 5.2
MySQL Database 5.5
MySQL Enterprise Backup 3.5
MySQL Enterprise Monitor 2.3
MySQL Cluster Manager 1.1

All GA!

2010

MySQL Enterprise Backup 3.7
Oracle VM Template for MySQL
Enterprise Edition
MySQL Enterprise Oracle
Certifications
MySQL Windows Installer
New MySQL Enterprise
Commercial Extensions

All GA!

MySQL Database 5.6 DMR*
MySQL Cluster 7.2 DMR
MySQL Labs!
("early and often")

2011

MySQL Cluster 7.2
MySQL Utilities 1.0.6
Database Migration Wizard
New Windows Tools/Features
**New MySQL Enterprise
Commercial Extensions**

**MySQL Database 5.6
MySQL Cluster 7.3
Workbench 6.0**

All GA!

2012

*Development Milestone Release



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MySQL Database Architecture

Performance, Reliability, Ease of Use

Support for common development languages/platforms



Connectors

Native C API, JDBC, ODBC, .NET, PHP, Python, Perl, Ruby, VB

Efficient multi-threaded session handling

MySQL Server

Connection Pool

Authentication - Thread Reuse - Connection Limits - Check Memory - Caches



SQL Interface

DML, DDL, Stored Procedures, Views, Triggers, etc.



Parser

Query Translation, Object Privilege



Optimizer

Access Paths, Statistics



Caches & Buffers

Global and Engine Specific Caches & Buffers



Full DML, DDL parsing, cost based optimizer, caching of queries and result sets

Flexible Storage Engine options for application specific storage needs

Pluggable Storage Engines

Memory, Index & Storage Management



InnoDB



MyISAM



Cluster



Archive



Merge



Memory



Partner



Community



Custom

Flexible logging and physical storage options



File System

NTFS - NFS
SAN - NAS

Files & Logs

Redo, Undo, Data, Index, Binary, Error, Query, and Slow



MySQL Editions

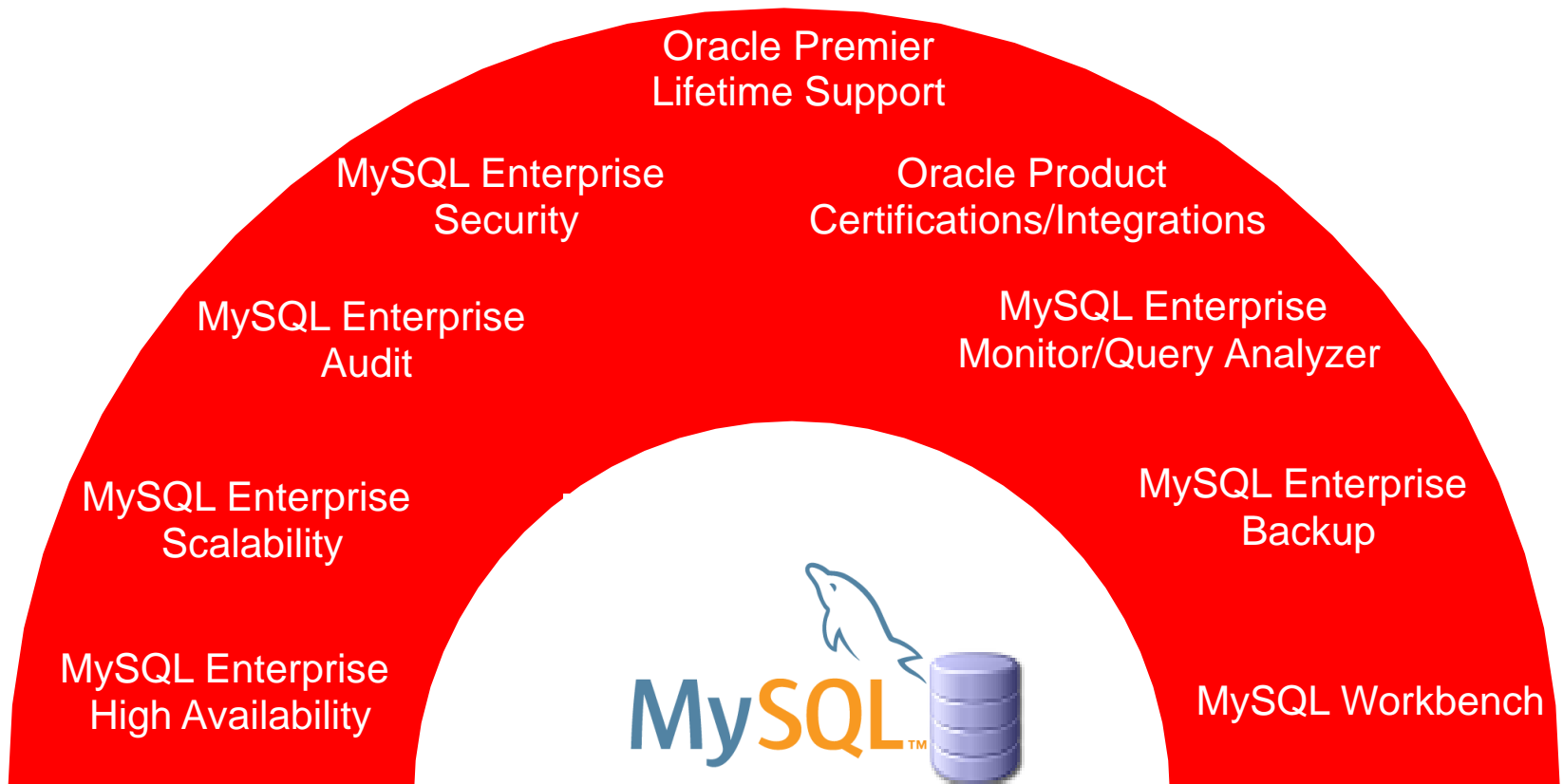
- Commercial
 - Standard
 - Enterprise – tools and additional features, integrations
 - Cluster (Carrier Grade Edition , CGE) – very scalable, high availability, includes tools and integrations

 - Embedded (OEM, ISV)

- Community

MySQL Enterprise Edition

Highest Levels of Security, Performance and Availability



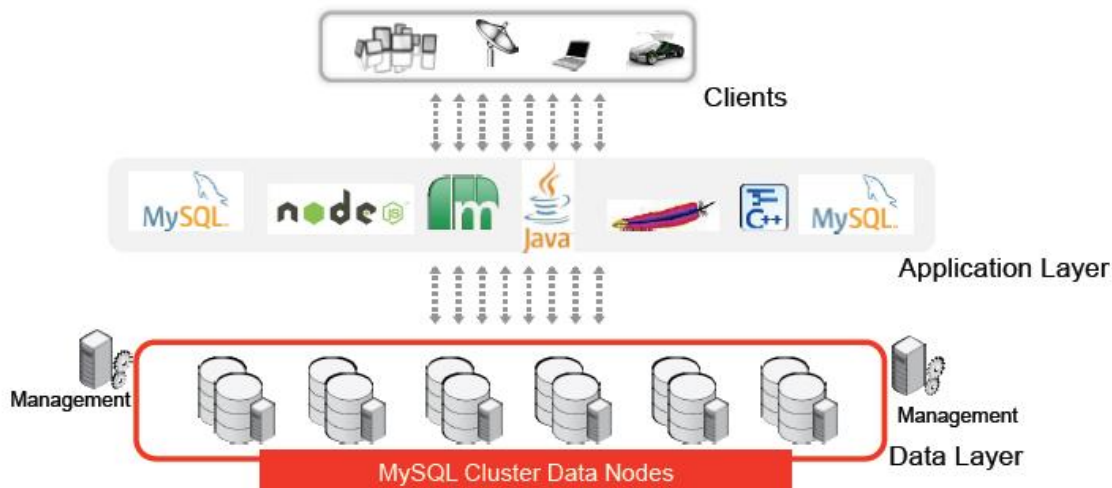
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5.5 Enterprise Extensions and Tools

- Security: External Authentication
- Auditing
- Scalability: Thread Pool
- High Availability: Windows Failover
- High Availability: DRBD support
- High Availability: Solaris Clustering
- High Availability: Oracle VM Template
- High Availability and Performance :MySQL Enterprise Monitor
- Hot, Online Backup: MySQL Enterprise Backup

MySQL Cluster

- 99.999 % availability
- Active/active geographic replication
- No single point of failure
- Auto sharding for write scalability
- SQL/NoSQL interfaces
- Online scaling and schema updates
- Scaling across data centers



Subscription Model

- Not the same as Oracle database licensing
 - Single or multi year subscription
 - Embedded model is different
- All subscriptions include support and consultative support
- Enterprise Edition includes tools and additional features
- Cluster Edition includes tools and is built on top of base MySQL codeline

Where do I get MySQL from?

edelivery.oracle.com or mysql.com/downloads

ORACLE
Oracle Software Delivery Cloud

Sign Out Cloud Portal (Main) Language (English) FAQs

Terms & Restrictions Search Download

Media Pack Search

Instructions

1. Review the [License List](#) to determine which Product Pack or Packs you need to download.
2. Select the Product Pack and Platform and click "Go".
3. If there is only one result, you will see the download page. If there are multiple results, select one and click "Continue".

Select a Product Pack: MySQL Database

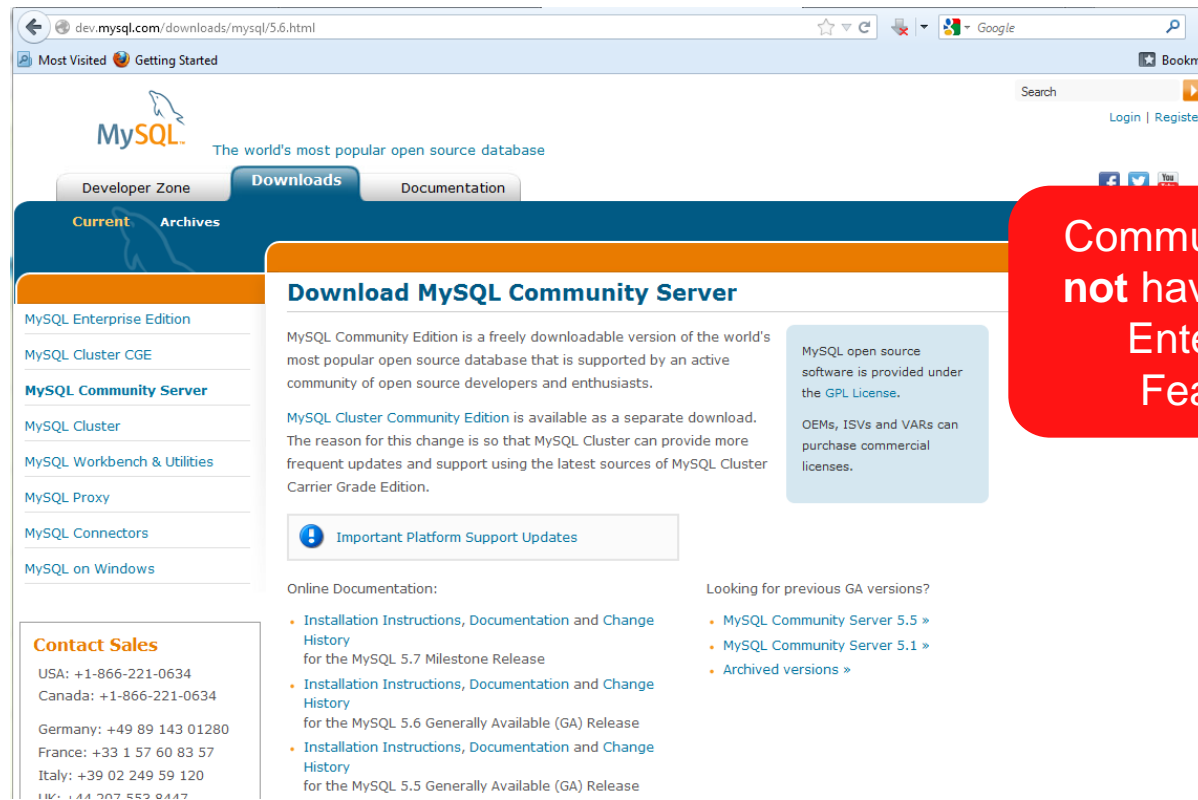
Platform: - Select a platform -

Results

Select	Description	Release	Part Number	Updated	# Parts / Size
*** No search conducted ***					

Where do I get MySQL Community from?

- Community dev.mysql.com/downloads/mysql

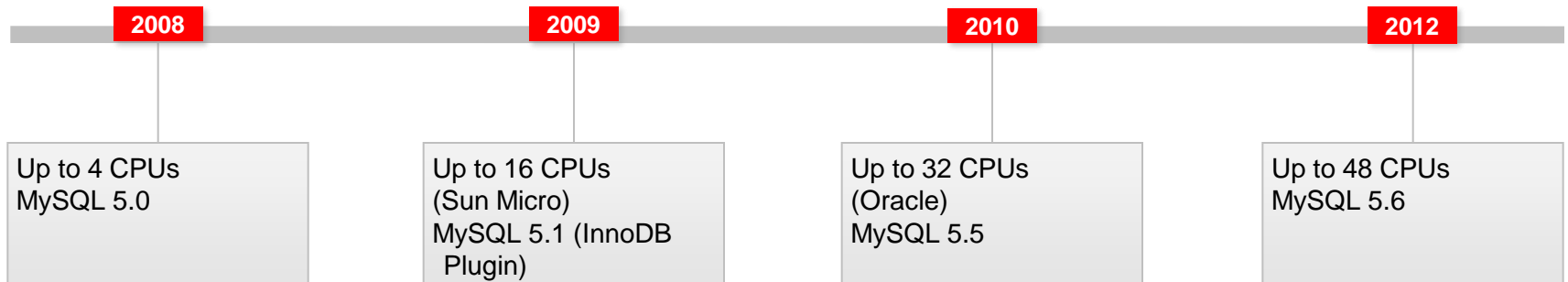


Community does not have MySQL Enterprise Features

MySQL 5.6

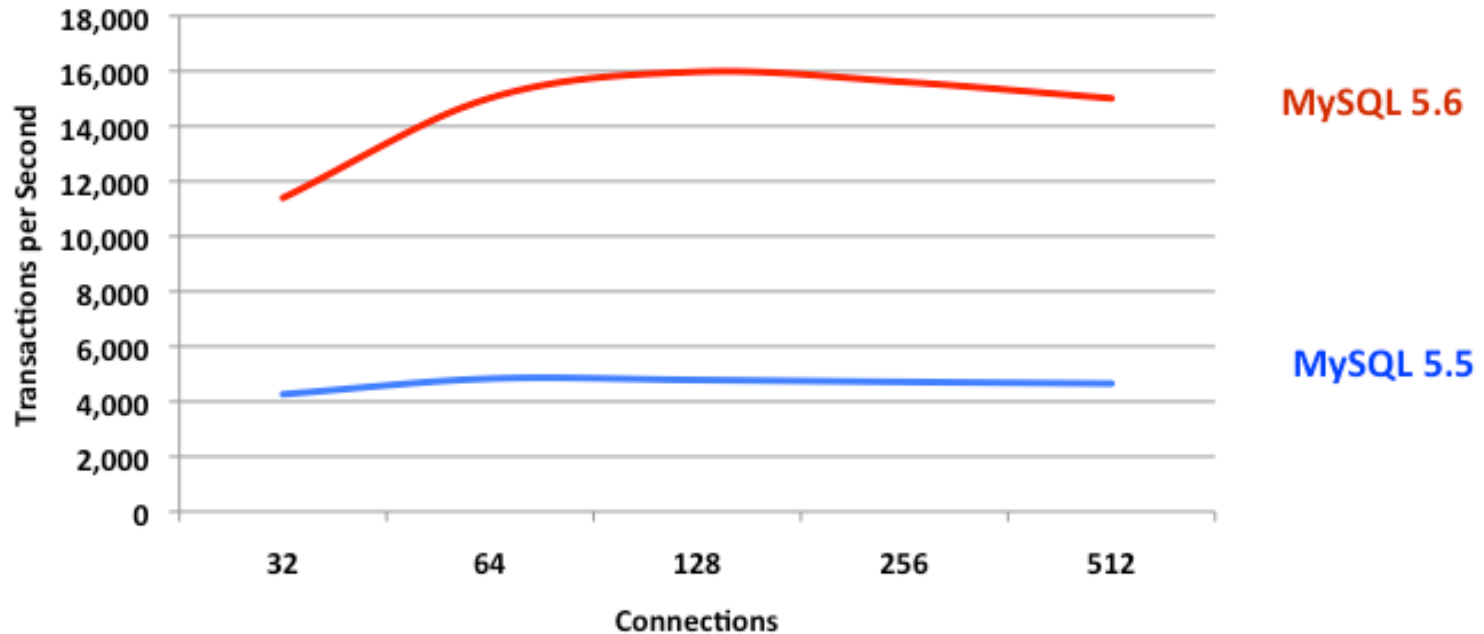
Performance

MySQL Scalability



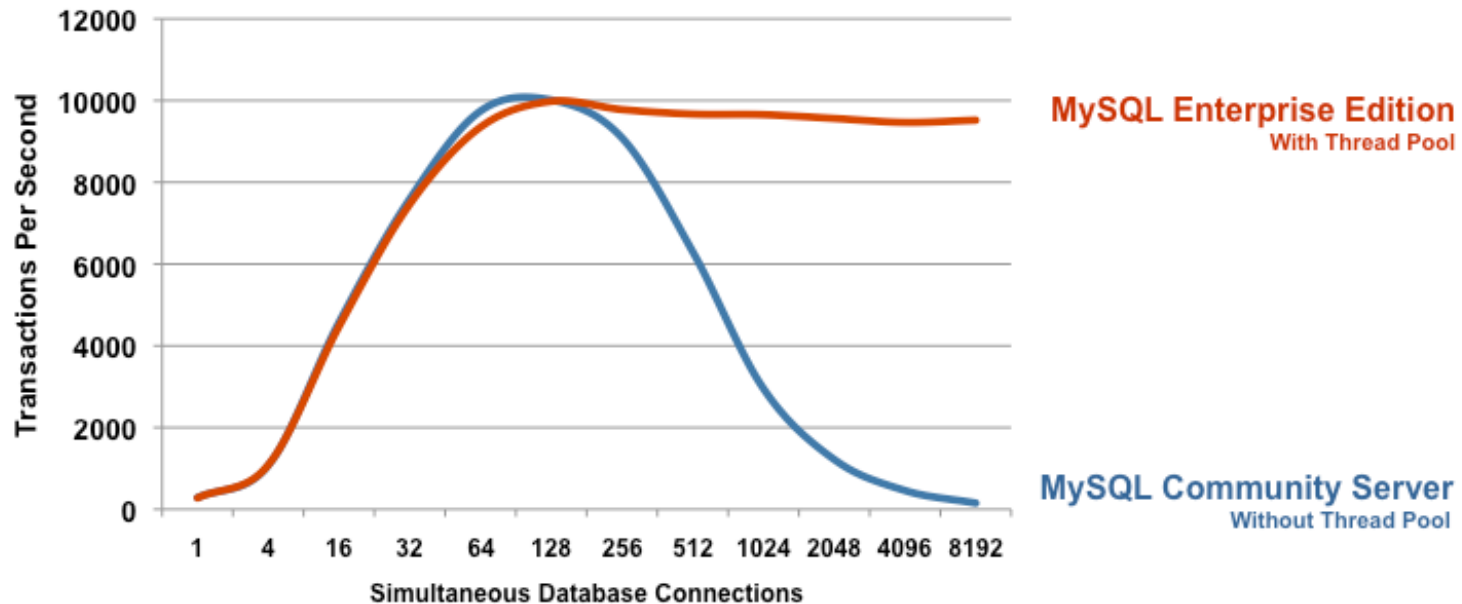
Benchmarks 5.6 - Up to 230% Faster Than 5.5

MySQL 5.6: 230% Faster than MySQL 5.5 (Read Only)



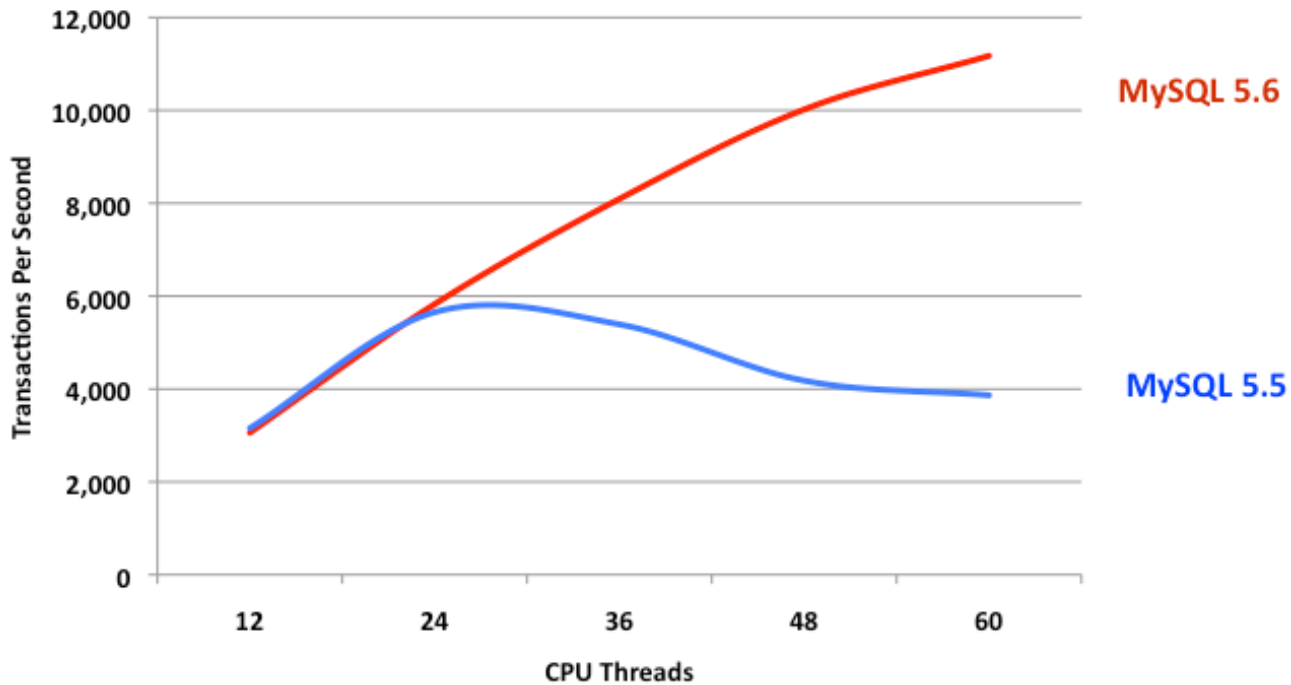
Benchmarks 5.6 Enterprise Edition - 13x Better Scalability with New Thread Pool

MySQL 5.6 Enterprise Edition: 80x Better Scalability (Read Write)



Benchmarks 5.6 Scales Beyond 48 CPU Threads

MySQL 5.6 Scales Beyond 48 CPU Threads (Read Write)



Performance Improvements

InnoDB and MySQL

- Refactored InnoDB
 - Split kernel mutex for better concurrent access
 - Separate thread for flushing operations
 - Multi-threaded purge
 - Reduced buffer pool contention
 - New adaptive hashing algorithm
- MySQL
 - Memory Allocation
 - Switch from malloc to better memory allocators for multi-threaded concurrency
 - Lock_open contention (bottleneck when opening tables)

MySQL 5.6 – Performance Schema

- Resource-intensive queries
- Tables/indexes with most load
- Users consuming the most resources
- Network load
- Aggregated statistics by
 - thread
 - user
 - host
 - object



Instrumentation and Diagnostic
Improvements

MySQL Performance

More Detail

- **Benchmark details**

<http://www.mysql.com/why-mysql/benchmarks/>

- **Performance Schema Blog**

<http://marcalf.blogspot.com/2013/02/mysql-56-performance-schema-is-ga.html>

Online Operations

Online DDL for InnoDB and Cluster

ADD INDEX

DROP INDEX

ADD COLUMN

DROP COLUMN

RENAME COLUMN

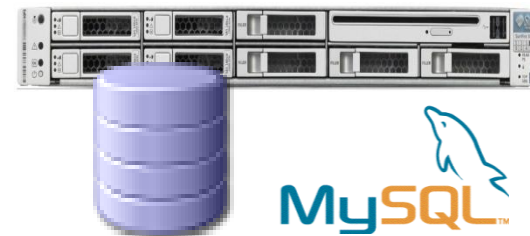
Your Shopping Cart [Update Cart](#) [Save Cart](#) [Email Cart](#) [Clear Cart](#) [Continue Shopping](#)

Description	Part #	Unit Price	Quantity	Total Price
Hardware				
Spare: 10 GbE FCoE ExpressModule Converged Network Adapter, dual port and twinax	#375-3685	US\$3,550.00	1	US\$3,550.00
Spare: 4XQDR CX2 PCI-E EM	#375-3697	US\$4,190.00	1	US\$4,190.00
Spare: Sun Dual Port 10 GbE PCIe 2.0 ExpressModule, Base-T	7101756	US\$2,250.00	1	US\$2,250.00

Promotion Code

Promotion codes may be added for one or more items in cart.
For each item, the best promotion will apply.

Subtotal: US\$9,990.00
Freight and tax are calculated at checkout



Optimizer

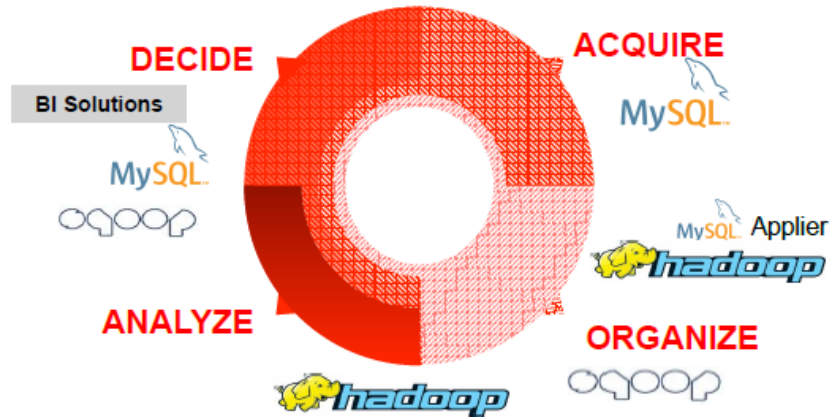
Optimizer Summary

- Index condition pushdown moves more processing for WHERE clauses into storage engine
- Larger, sequential I/O requests
- Additional Optimizations for Complex Queries
 - Optimize Many Tables in Join 25+
 - Postpone Materialization of Views/Subqueries in FROM
 - Indexes for Derived Tables
- Continued Improvements for Online Apps
 - Optimize “IN” clause
 - Optimized `SELECT col1, ... FROM t1 .. ORDER BY name LIMIT 10`
 - Better Optimizer Diagnostics
 - EXPLAIN for INSERT, UPDATE and DELETE
 - EXPLAIN output in JSON

<http://mysqloptimizerteam.blogspot.co.uk/>

Hadoop Integration

MySQL in the Big Data Pipeline



80% of Hadoop deployments are integrated with MySQL

Batch: Apache SQUOOP

Realtime: MySQL Applier for Hadoop (not GA but available for testing)

MySQL and Hadoop

More Detail

- **White paper: MySQL and Hadoop – Big Data Integration**

<http://www.mysql.com/why-mysql/white-papers/mysql-and-hadoop-guide-to-big-data-integration/>

- **MySQL Applier for Hadoop**

- YouTube demo video

<http://www.youtube.com/watch?v=mZRAtCu3M1g&feature=youtu.be>

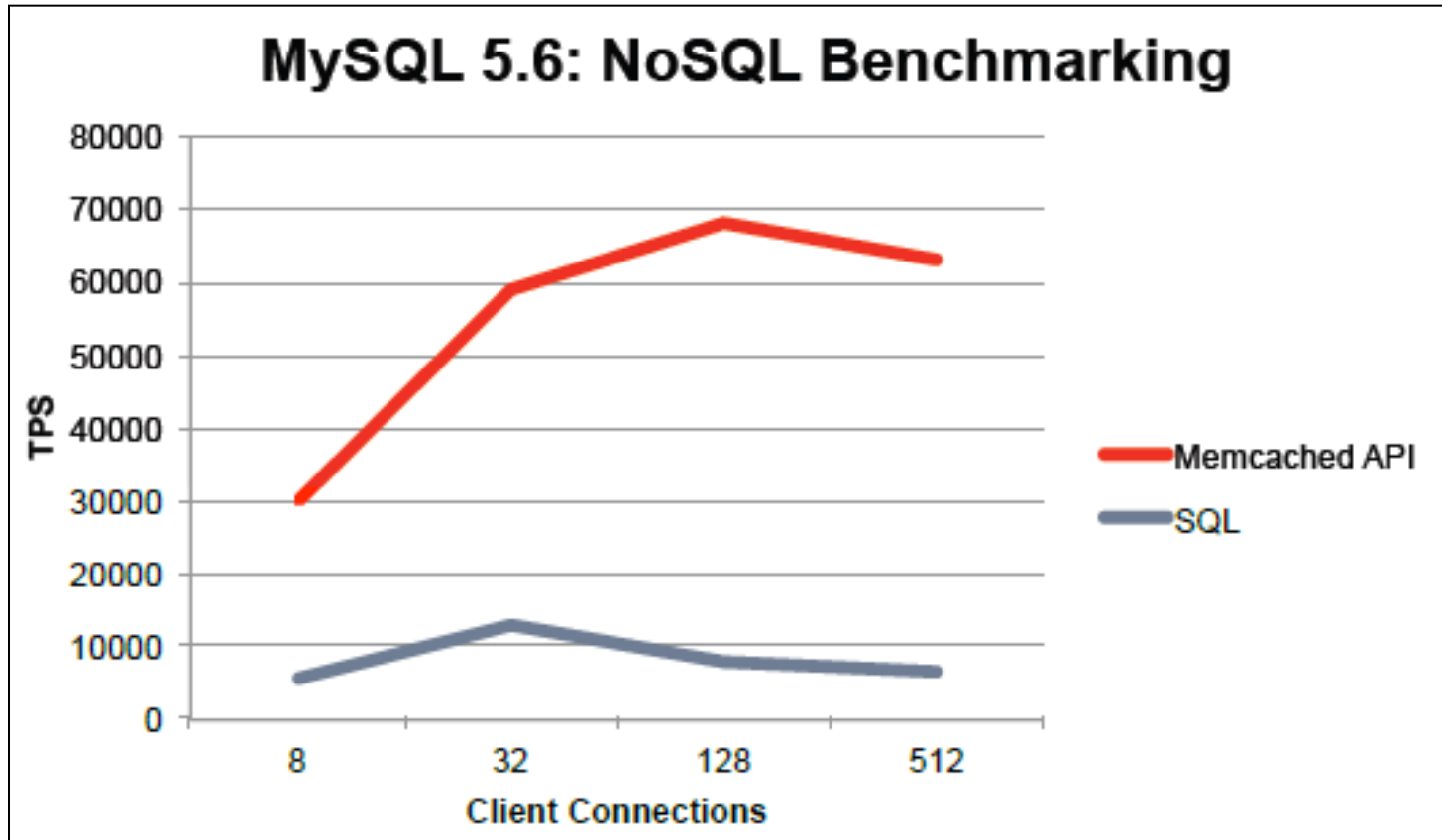
- Implementation details

<http://innovating-technology.blogspot.com/2013/04/mysql-hadoop-applier-part-2.html>

NoSQL API

MySQL NoSQL API

- Bypass SQL layer, no parsing, no optimization
- InnoDB and NDB storage engines
- Key-value data with ACID guarantees
- Use SQL on same data set
- MySQL Cluster has additional NoSQL APIs
 - Node.js
 - Java
 - JPA
 - HTTP/REST
 - C++

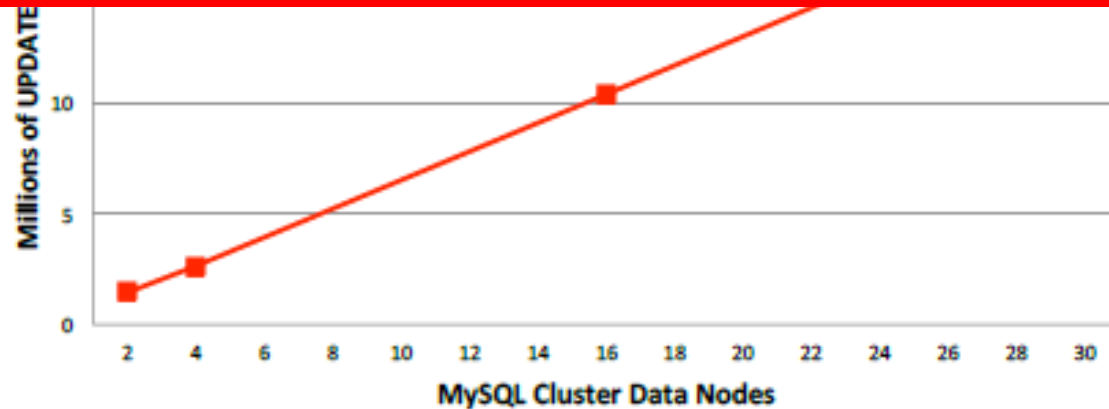


Over 9x faster INSERT operations

The benchmark was run on an 8-core Intel server configured with 16GB of memory and the Oracle Linux operating system.

1.2 Billion UPDATES per Minute

Each node delivered 650,000 ACID-compliant write operations per second



MySQL Cluster performance scaling out on commodity nodes and NoSQL API

Cluster of 30 commodity dual socket (2.6GHz), 8-core Intel servers, each equipped with 64GB of RAM, running Linux and connected via Infiniband

MySQL and NoSQL

More Detail

- **Guide to MySQL and NoSQL – Delivering the Best of Both Worlds**

<http://www.mysql.com/why-mysql/white-papers/guide-to-mysql-and-nosql-deli>

- **Writing applications for InnoDB memcached Interface**

<http://dev.mysql.com/doc/refman/5.6/en/innodb-memcached-developing.html>

- **MySQL Cluster API Developer Guide**

- <http://dev.mysql.com/doc/ndbapi/en/index.html>

Replication

MySQL Replication

- Replication
 - Simple
 - Robust
 - Proven

K.I.S.S



MySQL Replication

Tao of YouTube

“Choose the simplest solution possible with the loosest guarantees that are practical”

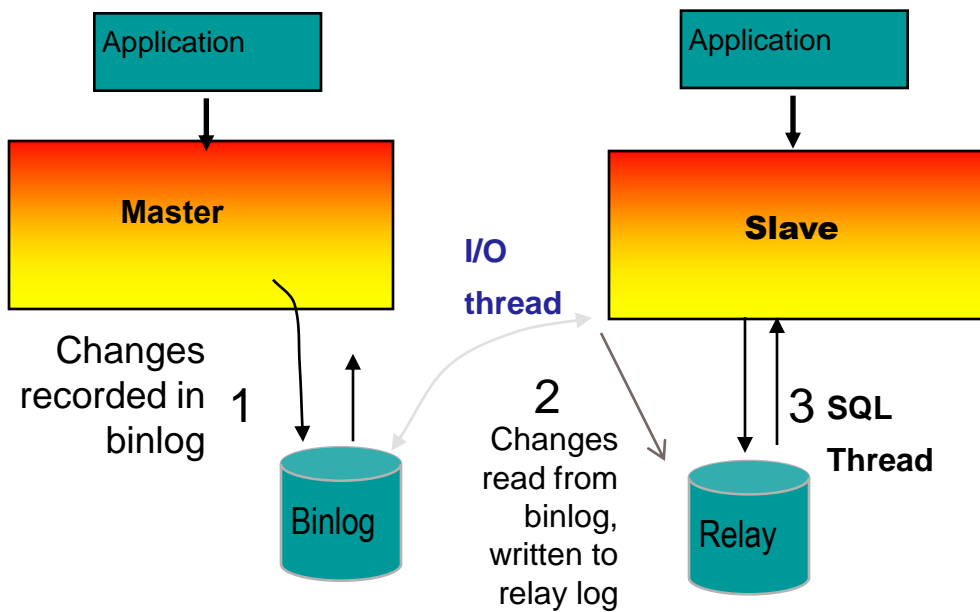
To solve a problem: One word - simple.

“Look for the most simple thing that will address the problem space...”

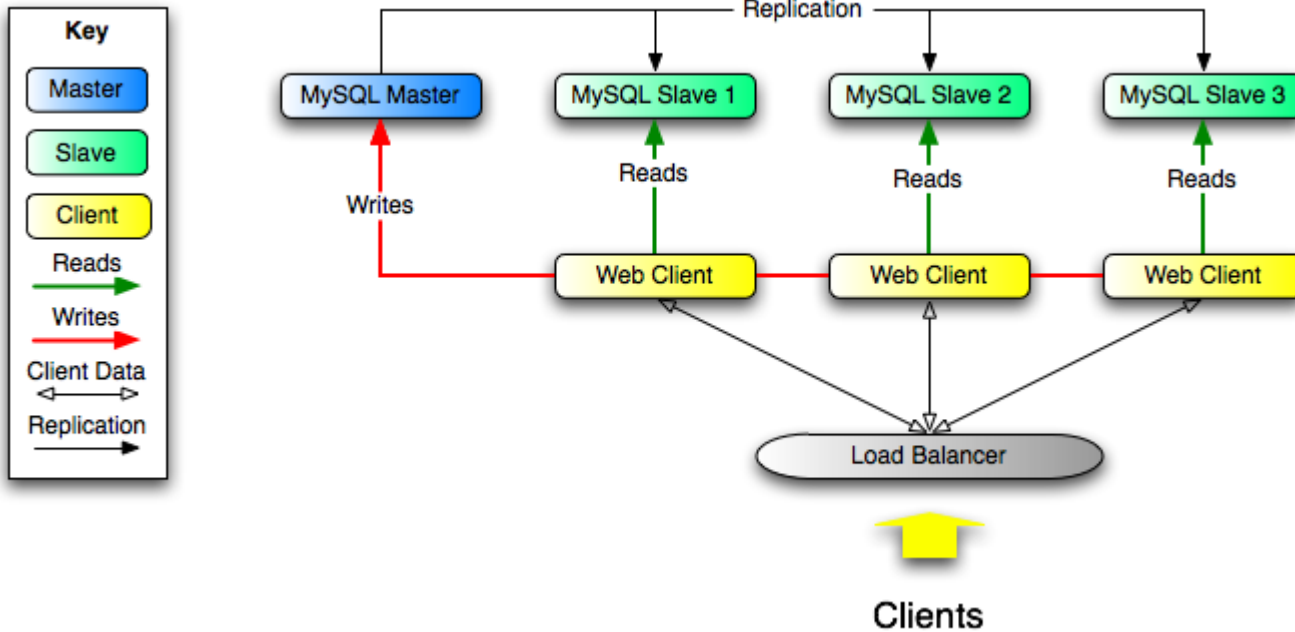
<http://highscalability.com/blog/2012/3/26/7-years-of-youtube-scalability-lessons-in-30-minutes.html>

Replication Basics: the Big Picture

- Native in MySQL
- Each slave adds minimal load on master

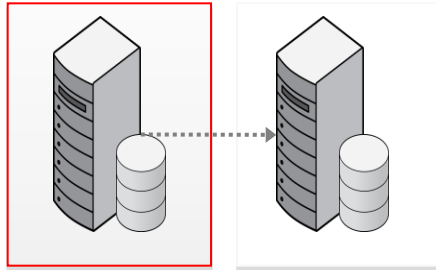


Replication Basics: Scale Out Example

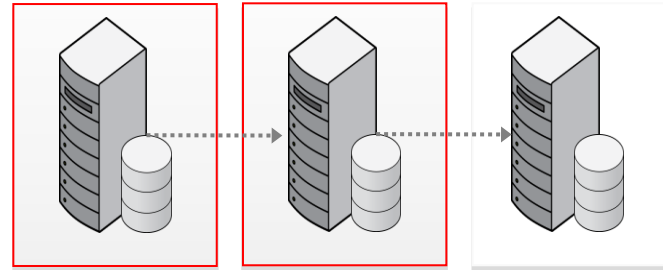


Replication Basics: Topologies

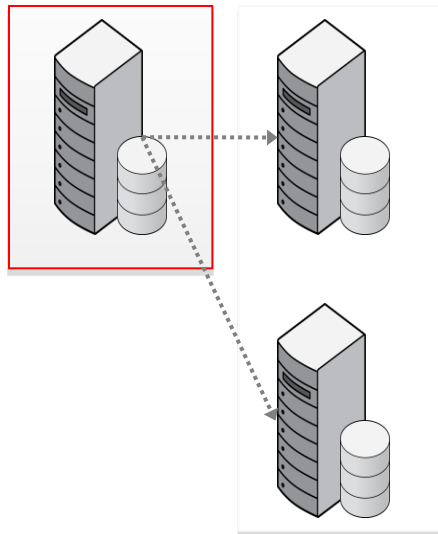
Single



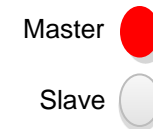
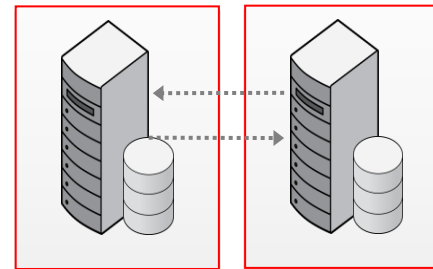
Chain



Multiple

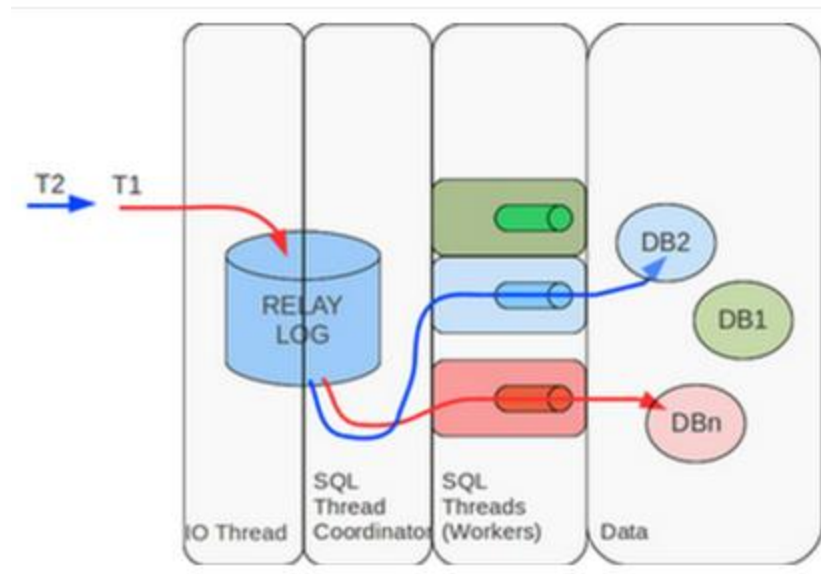


Dual Master/Circular



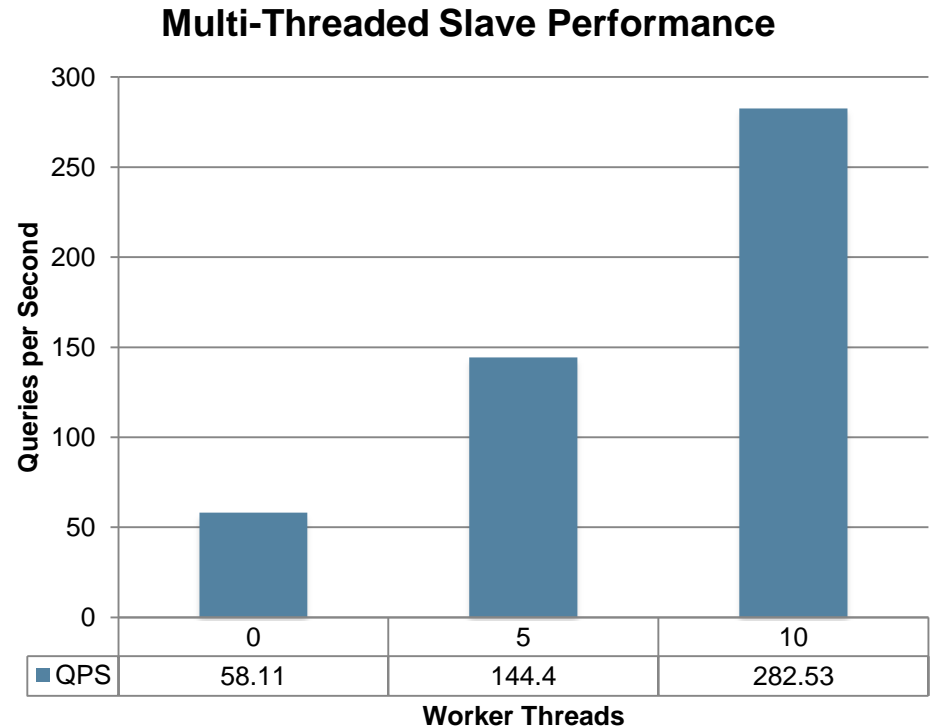
5.6 Replication Multi Threaded Slaves

- Improves replication performance by using multiple threads to apply events
- Slave SQL thread acts as the coordinator for slave worker threads
- Threads split based on schema



5.6 Multi-Threaded Slaves

- 5x Performance Gain
- Reduce Slave Latency
- Per Schema
 - Threads per Schema
 - Multi-tenancy

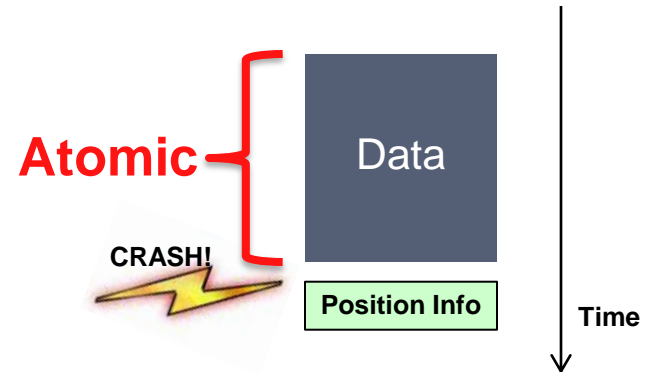


Oracle Linux 6.1, Oracle Sun Fire x4150 m2 Server

MySQL 5.6 Crash-Safe Slaves

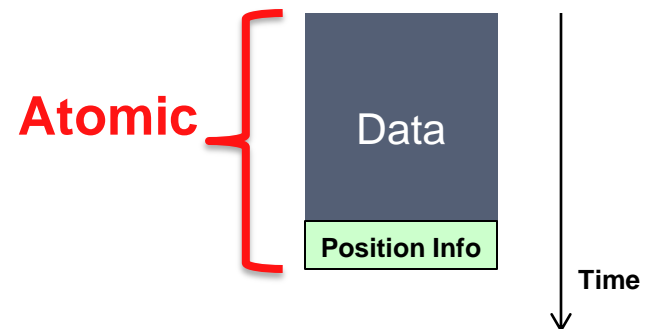
Before:

- Transaction Data: **in tables**
- Replication Info: **in files**



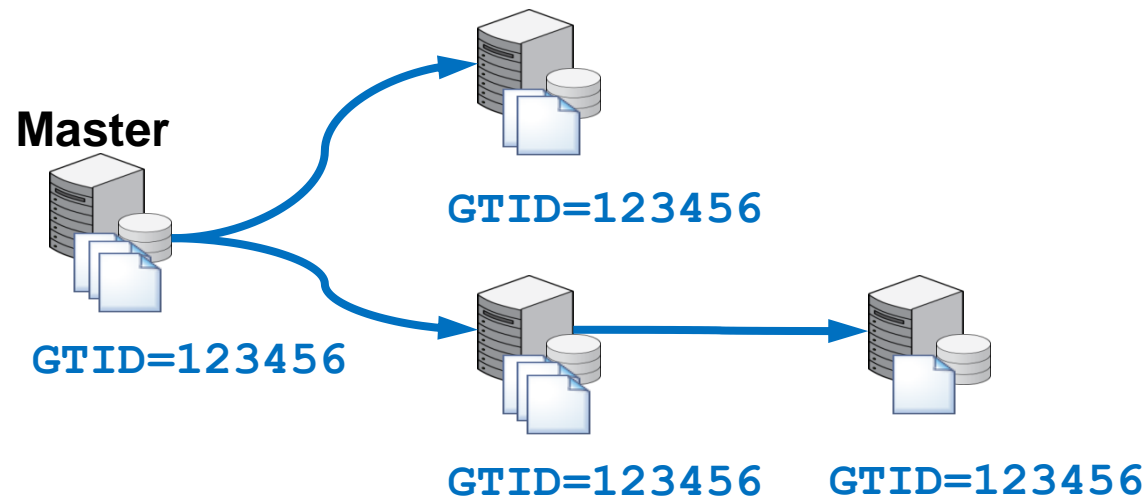
MySQL 5.6

- Transaction Data: **in tables**
- Replication Info: **in tables**



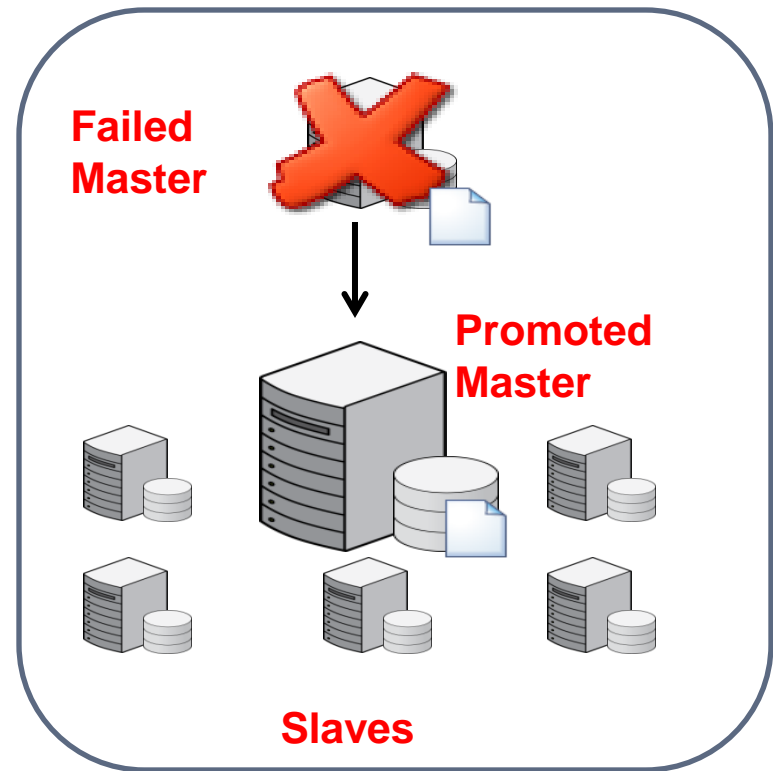
MySQL 5.6 Global Transaction Identifier

- Unique ID for Binlog
- Locate and Track Transactions
- Automate Failover



MySQL 5.6 High Availability Utilities

- failover
 - automatically promote slave on failure
 - switchover
 - Automatically promotes slave on switchover
 - mysqlreplfailover
 - automatically promote slave on failure
-
- Workbench download



MySQL 5.6 Binary Log Group Commit

- Significantly Reduce Replication Overhead
- Multiple Transactions
- One Commit



MySQL Replication

More Detail

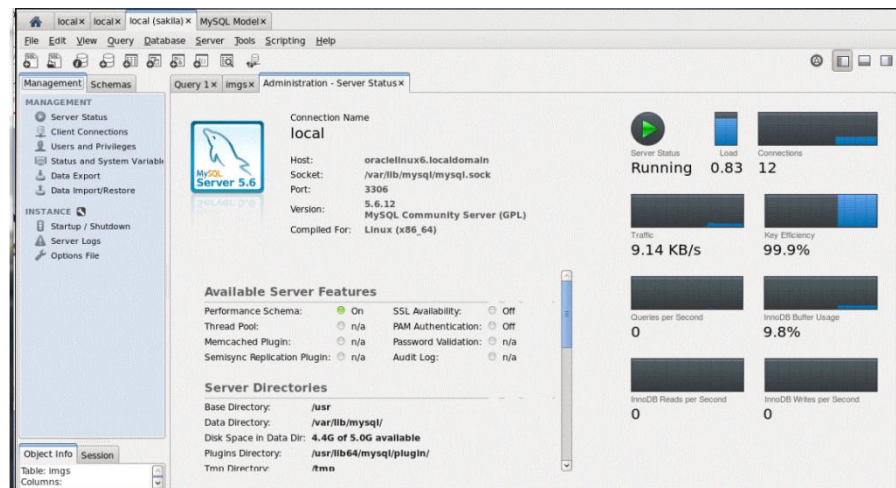
- **MySQL 5.6 Replication - Enabling the Next Generation of Web & Cloud Services**

<http://dev.mysql.com/tech-resources/articles/mysql-5.6-replication.html>

Workbench 6

New MySQL Workbench

- New streamlined user interface
- Visually design, model, generate, and manage databases
- Create and execute MySQL queries
- Configure servers, administer users, backup and recovery, inspect audit data
- Database migration
 - SQL Server
 - Sybase ASE
 - Postgres
 - ODBC



MySQL Workbench 6

More Detail

- **Download**

- Commercial – edelivery.oracle.com

- **MySQL Workbench: Database Design, Development, Administration, and Migration**

- <http://www.mysql.com/why-mysql/white-papers/mysql-workbench-database-design-development-administration/>

- **Video Tutorial**

- http://www.youtube.com/watch?v=X_umYKqKaF0

- **Tomas Ulin (Engineering VP) Blog**

- <http://insidemysql.com/mysql-workbench-6-0-a-sneak-preview/>

Oracle Product Integrations

Oracle Product Certifications ⁶			
Certified with Oracle Linux ⁶	✓	✓	✓
Certified with Oracle VM ⁶	✓	✓	✓
Certified with Oracle Solaris ⁶	✓	✓	✓
Certified with Oracle GoldenGate ⁶		✓	✓
Certified with Oracle Fusion Middleware ⁶		✓	✓
Certified with Oracle Secure Backup ⁶		✓	✓
Certified with Oracle Database Firewall ⁶		✓	✓

Oracle Integrations

- GoldenGate
- Database Firewall
- Oracle Secure Backup
- WebLogic Server
- Database Adapter for Oracle SOA Suite
- Oracle Business Process Management
- Oracle Virtual Directory
- Oracle Data Integrator

Quickstarts for MySQL

MySQL Editions Page

- Best place to start: mysql.com/products

MySQL Editions

MySQL is the world's most popular open source database. Whether you are a fast growing web property, technology ISV or large enterprise, MySQL can cost-effectively help you deliver high performance, scalable database applications.

MySQL Community Edition is the freely downloadable version of the world's most popular open source database.

- Learn more about the MySQL Community Edition
- Download the MySQL Community Edition

Commercial customers have the flexibility of choosing from multiple editions to meet specific business and technical requirements:

- MySQL Standard Edition
- MySQL Enterprise Edition
- MySQL Cluster Carrier Grade Edition

ISVs, OEMs and VARs can learn more about MySQL as an Embedded Database

	MySQL Standard Edition	MySQL Enterprise Edition	MySQL Cluster Carrier Grade Edition
Annual Subscription ^{2,3,4,5}	USD 2,000	USD 5,000	USD 10,000
/1-4 Socket Server /Year	Buy Now	Buy Now	Buy Now
Oracle Premier Support ³			
24x7 Support	✓	✓	✓
Unlimited Support Incidents	✓	✓	✓
Knowledge Base	✓	✓	✓
Maintenance Releases, Bug Fixes, Patches, Updates	✓	✓	✓
MySQL Consultative Support	✓	✓	✓
MySQL Features			
MySQL Database Server	✓	✓	✓
MySQL Connectors	✓	✓	✓
MySQL Replication	✓	✓	✓
MySQL Partitioning		✓	✓
MySQL Workbench ¹	✓	✓	✓

MySQL Connect Conference

September 21-23, 2013 in San Francisco

■ Conference

<http://www.oracle.com>

Upgrade your experience





- > JavaOne
- > MySQL Connect
- > Oracle PartnerNetwork

- Enhancing
- Replication
- Getting Started
- Performance

<http://www.oracle.com>

Saturday September 21, 10:30 a.m.–11:00 a.m.
Current MySQL Usage Models and Future Developments
MySQL 5.6 and MySQL Cluster 7.3 delivered numerous highly anticipated features, strengthening MySQL's position as the leading web and cloud database. How and why are the foremost social networking companies and e-commerce businesses successful with MySQL today, and what future developments should be considered to ensure that MySQL will meet their requirements moving forward? Join panelists from Facebook, Twitter, LinkedIn, and PayPal as they share their perspectives and insights.

Panelists:

	Davi Arnaut, Senior Software Engineer, LinkedIn
	Daniel Austin, Chief Architect, PayPal
	Mark Callaghan, Member of the Technical Staff, Facebook
	Calvin Sun, Senior Engineering Manager, Twitter

CE

\$100 each

nl

MySQL Webinars

- Live and on-demand

<http://www.mysql.com/news-and-events/on-demand-webinars/>

The screenshot shows the MySQL.com website's 'On Demand Webinars' page. The page features a navigation menu with links for Products, Services, Partners, Customers, Why MySQL?, News & Events, and How to Buy. The main content area is titled 'On Demand Webinars' and includes a search filter for 'Topic' (set to 'All') and 'Language' (set to 'English'). Below the filter, the page is organized into several categories, each with a list of webinar titles and dates:

- Architecture**
 - MySQL Reference Architectures: Best Practices for Web, Mobile & Cloud Applications (2013-05-21)
 - MySQL Reference Architectures: Best Practices for Web, Mobile & Cloud Applications (2013-04-18)
- Backup**
 - MySQL Backups: From strategy to implementation, five easy steps to "getting it done" for Linux and Windows (2013-04-24)
- Big Data**
 - MySQL and Hadoop: Big Data Integration - Unlocking New Insights (2013-01-30)
- Connectors**
 - MySQL Connector/Java: Best Practices & Tips for Java-based Product Developers (2013-05-20)
 - What's New MySQL Connector/.NET 6.6 (2013-01-24)
- DRBD**
 - MySQL HA with DRBD (2012-11-15)
- Embedded**
 - For ISVs and OEMs: Why MySQL 5.6 is an Even Better Embedded Database for Your Products (2013-04-25)
 - MySQL Security Enhancements and Important Security Tips for ISVs & OEMs (2013-02-21)
 - Top 10 Reasons to Use MySQL as an Embedded Database (2012-11-13)
- Hadoop**
 - MySQL Applier for Apache Hadoop: Real-Time Event Streaming to HDFS (2013-05-23)
- High Availability**

On the left side of the page, there is a 'Contact Sales' section with phone numbers for various countries: USA (+1-866-221-0634), Canada (+1-866-221-0634), Germany (+49 89 143 01280), France (+33 1 57 60 83 57), Italy (+39 02 249 59 120), UK (+44 207 553 8447), Japan (0120-065556), China (10800-811-0823), India (0008001005870), and Brazil (+55 11 5189-1097). A 'More Countries >' link is also present.

Online MySQL Demos

- [Improving your SQL Performance using MySQL Query Analyzer](#)
- [Monitor your MySQL Servers](#)
- [Get your "Virtual MySQL DBA Assistant"](#)
- [Customize your MySQL Advisors](#)
- [Monitor MySQL Replication and Scale Out](#)
- [MySQL Cluster](#)
- [MySQL Cluster Auto Installer](#)
- [Workbench](#)

Oracle University

- MySQL for Database Administrators
 - MySQL for Beginners
 - MySQL Cluster
 - MySQL High Availability
 - MySQL Performance Tuning
-
- Some of the classes may be taken as self-study

MySQL 5.6: Best Release Ever!

IMPROVED PERFORMANCE AND SCALABILITY

- Scales to 48 CPU Threads
- Up to 230% performance gain over MySQL 5.5

IMPROVED INNODB

- Better transactional throughput and availability

IMPROVED OPTIMIZER

- Better query exec times and diagnostics for query tuning and debugging

IMPROVED REPLICATION

- Higher performance, availability and data integrity

IMPROVED PERFORMANCE SCHEMA

- Better Instrumentation, User/Application level statistics and monitoring

New! NoSQL ACCESS TO INNODB

- Fast, Key Value access with full ACID compliance, better developer agility

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MySQL 5.6

Questions?

ORACLE®