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Developer and DBA Guide to What's New in MySQL 5.6

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Program Agenda

DTCC2013

- Oracle's Investment in MySQL
- DBA/Developer Guide to MySQL 5.6
- Development Priorities
- Questions?

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MySQL 5.6 is GA!

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- The Best MySQL Release Ever
- All New Features and enhancements Available to all in the MySQL Community Edition
- Designed to Meet Your Most Demanding Web, Cloud and Embedded Application Requirements

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World's Most Popular Open Source Database

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- Over 15 million estimated installations
- Used by 9 of top 10 web sites in the world
- Embedded by 8 of the top 10 ISVs
- #1 database in the Cloud
- Integrated w/Hadoop in 80% of Big Data platforms
- Facebook: 182K fans, +35% YoY Growth
- Twitter: 29K followers, +67% YoY Growth
- Numerous Awards: Linux Journal, CRN, PHP Architect...

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Oracle Significantly Invests in MySQL

- Complete Solutions
- Best of Breed at Every Level
- On Premise and in the Cloud
- **MySQL: Web, Mobile & Embedded**

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Industry Leaders Rely on MySQL

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UNMATCHED INVESTMENT

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InnoDB

PERFORMANCE IMPROVEMENTS

REPLICATION

EMBEDDED

CLOUD

WINDOWS

HUNDREDS OF EXPERTS

ORACLE DRIVES MySQL INNOVATION

STRATEGIC

WORLD-CLASS SUPPORT

WEB

MySQL CLUSTER

NoSQL

LINUX

MySQL ENTERPRISE EDITION

LARGEST MySQL ENGINEERING & SUPPORT ORGANIZATION

DRIVING MySQL INNOVATION

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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
MySQL Enterprise Security
MySQL Enterprise Scalability

All GA!

MySQL Database 5.6 DMR*
MySQL Cluster 7.2 DMR

MySQL Labs!
("early and often")
2011

MySQL Cluster 7.2
MySQL Cluster Manager 1.4
MySQL Utilities 1.0.6
MySQL Migration Wizard
MySQL Enterprise Backup 3.8
MySQL Enterprise Audit
MySQL Database 5.6

All GA!

MySQL Cluster 7.3 DMR

Available Now!

A BETTER MySQL

2012-13

***Development Milestone Release**

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Oracle's Investment in MySQL Community

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Available to download and use under the GPL

- MySQL Database (Community Edition)
- MySQL Cluster
- MySQL Workbench
- MySQL Migration Wizard
- MySQL Utilities (in Python)
- MySQL Connectors
- MySQL Proxy
- Forums

mysql.com/downloads/

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MySQL 5.6: Best Release Ever!

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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: Scalability

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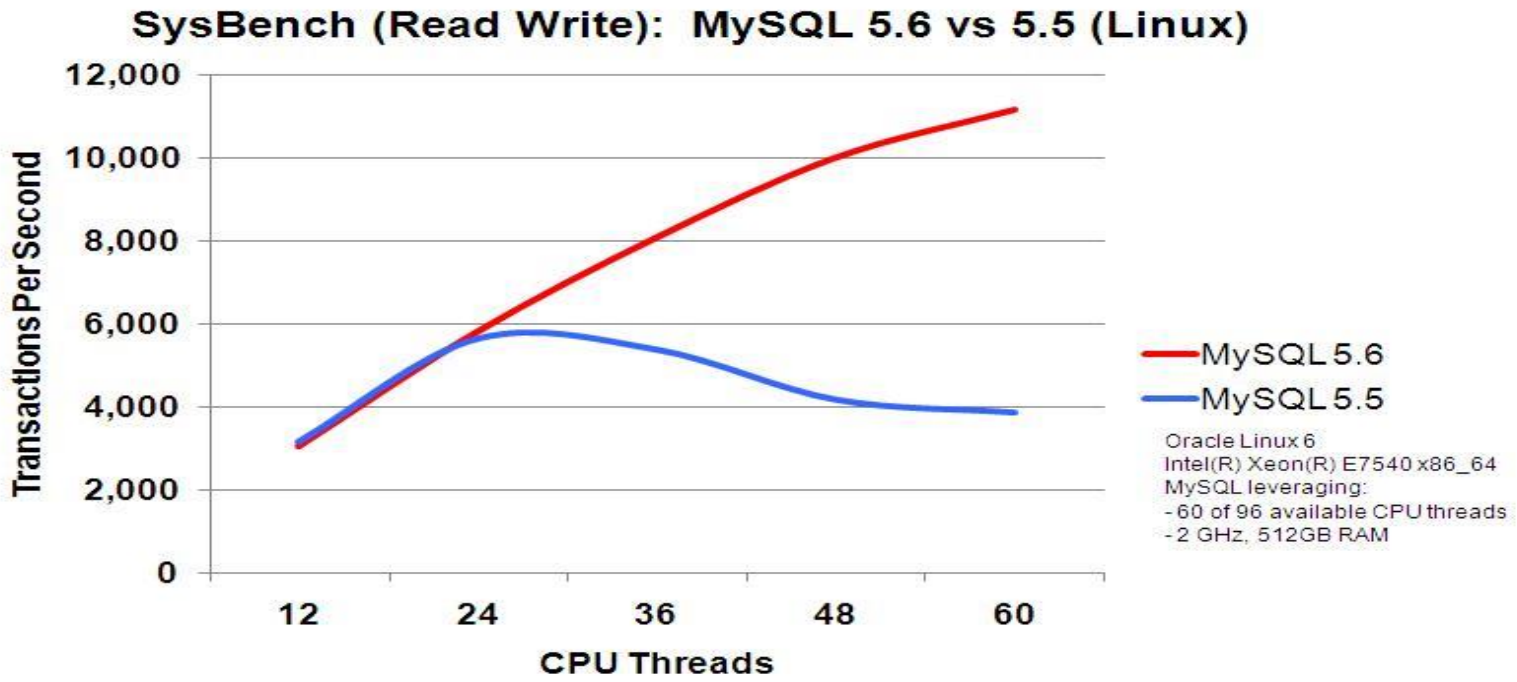

- Users can fully utilize latest generations of hardware and OS
- Scales as data volumes and users grow

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MySQL 5.6: Scalability

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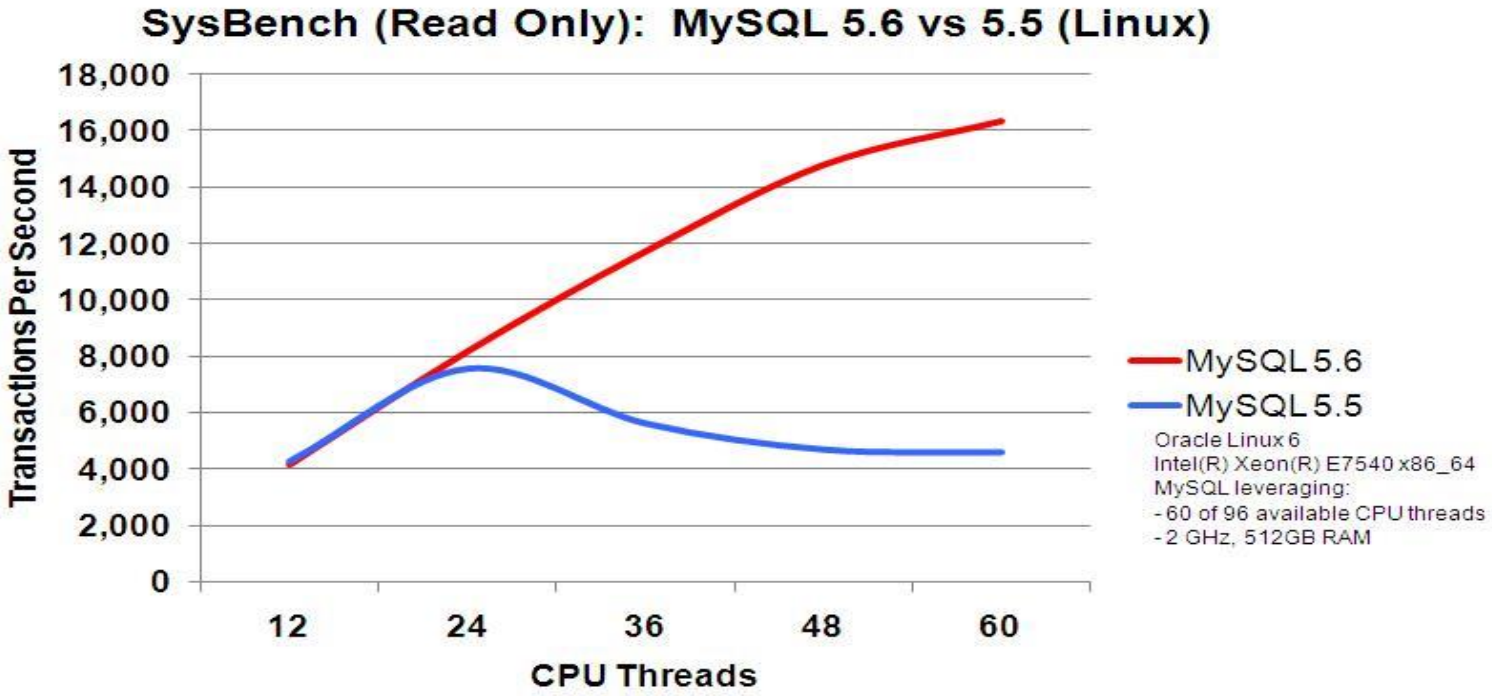

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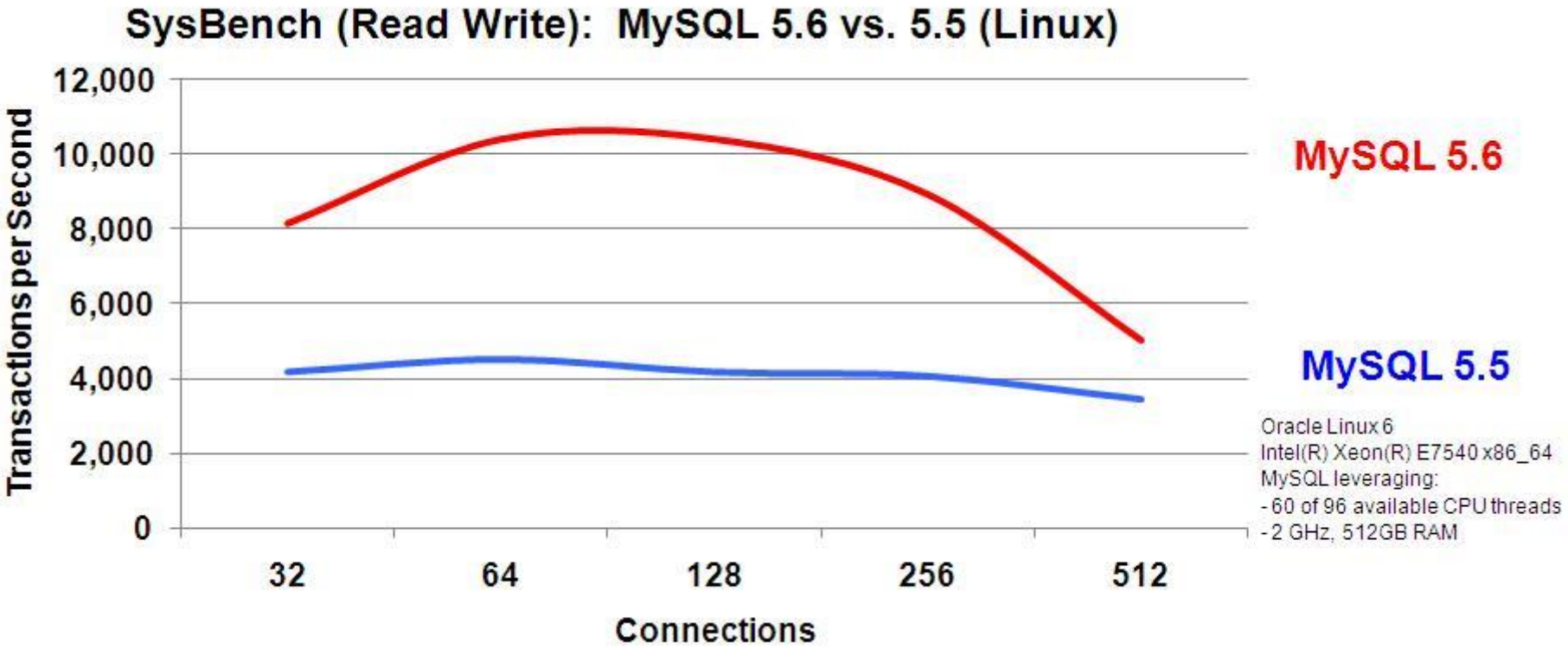
MySQL 5.6 SysBench Benchmarks



Up to 151% Performance Gain

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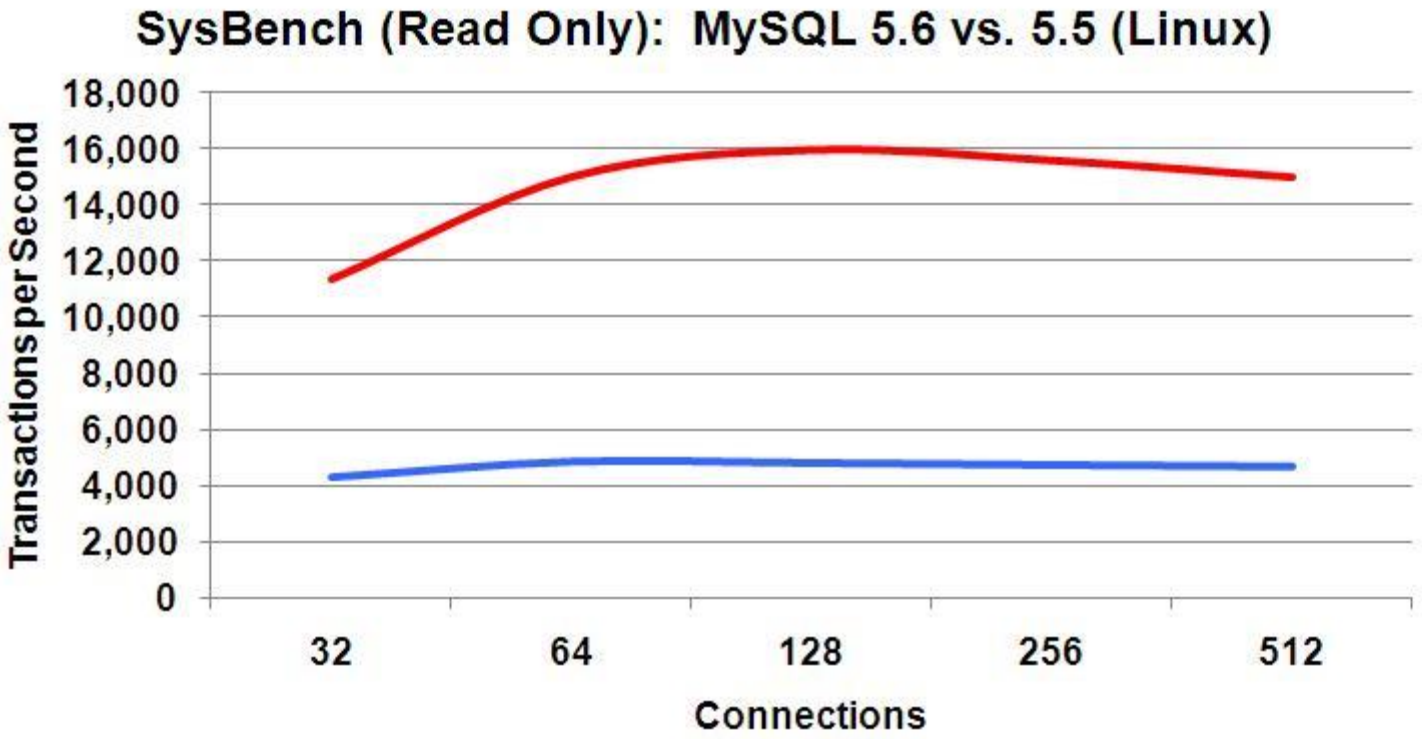
MySQL 5.6 SysBench Benchmarks



Up to 234% Performance Gain

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MySQL 5.6: InnoDB

BETTER RESOURCE UTILIZATION

- Removal of legacy bottlenecks
- Improved threading/concurrency
- Optimized for Read-Only Workloads
- SSD Optimizations

BETTER AVAILABILITY, FASTER SCALING

- Online DDL Operations
- Transportable Tablespaces
- Dump, Restore/Warm Buffer Pool

DEVELOPER AGILITY

- Full Text Search
- NoSQL, Key-value access to InnoDB

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MySQL 5.6: InnoDB

Better Performance, Scalability

- Several internal improvements (e.g. Split kernel mutex, efficient Buffer Pool Flushing, more...)
- Optimized for Read Only workloads
- Persistent Optimizer Statistics
  - Increased plan stability, accurate statistics
  - Better user control, automatic/manual
- SSD Optimizations
  - 4, 8k page sizes
  - .ibd files outside of MySQL data dir
  - separate tablespaces for undo log

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MySQL 5.6: InnoDB

Optimized for Read Only Workloads

- Ideal for highly concurrent, read intensive web apps
- Enables developer control of read only transactional overhead

```
SET autocommit = 1;
SELECT c FROM sbtest WHERE id=N;

SET autocommit = 0;
START TRANSACTION READ ONLY;
SELECT c FROM sbtest WHERE id=N;
COMMIT;
```

On by default

Developer controlled

Less complexity, more apps can be standardized on InnoDB

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MySQL 5.6: InnoDB

Online DDL Operations

- **CREATE INDEX**
- **DROP INDEX**
- **Change AUTO_INCREMENT value for a column**
- **ADD/DROP FOREIGN KEY**
- **Rename COLUMN**
- **Change ROW FORMAT, KEY_BLOCK_SIZE for a table**
- **Change COLUMN NULL, NOT_NULL**
- **Add, drop, reorder COLUMN**

- Adds flexible schemas, online changes, no downtime
- No need to consider NoSQL options

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MySQL 5.6: InnoDB

Dump and Restore/Warm Buffer Pool

- Shortens warm up times after restart (from hours to minutes)
- At shutdown/startup or manually at any time
- Small footprint on disk - stores tablespace and page IDs only

Dump current state of Buffer Pool at shutdown:

```
mysql> SET innodb_buffer_pool_dump_at_shutdown=ON;
```

Load Buffer Pool from dump at startup:

```
mysql> SET innodb_buffer_pool_load_at_startup=ON;
```

- Better Elasticity - Quickly spin up new instances to meet demand
- Great for Cloud, Hosted, SaaS, On-premise deployments

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MySQL 5.6: InnoDB

Full Text Search

- FULLTEXT indexes on InnoDB tables
- Keys on text-based content
- Speeds up searches for words, phrases
- Fully transactional, fast look up
- Natural language/Boolean modes, proximity search, relevance ranking

```
create table quotes
( id int unsigned
auto_increment primary
key
,author varchar(64)
, quote varchar(4000)
, source varchar(64)
, fulltext(quote)
) engine=innodb;
```

```
select author as "Apple" from quotes
    where match(quote) against ('apple' in natural language mode);
```

Less complexity, more apps can be standardized on InnoDB

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MySQL 5.6: InnoDB

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Transportable Tablespaces

- Enables export/import of tables between running MySQL instances

Export:

```
CREATE TABLE t(c1 INT) engine=InnoDB;
FLUSH TABLE t FOR EXPORT; -- quiesce the table and create the meta data file
$innodb_data_home_dir/test/t.cfg
UNLOCK TABLES;
```

Import:

```
CREATE TABLE t(c1 INT) engine=InnoDB; -- if it doesn't already exist
ALTER TABLE t DISCARD TABLESPACE;
-- The user must stop all updates on the tables, prior to the IMPORT
ALTER TABLE t IMPORT TABLESPACE;
```

- Better Elasticity - Quickly spin up new instances to meet demand
- Great for Cloud, Hosted, SaaS, On-premise deployments

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MySQL 5.6: InnoDB

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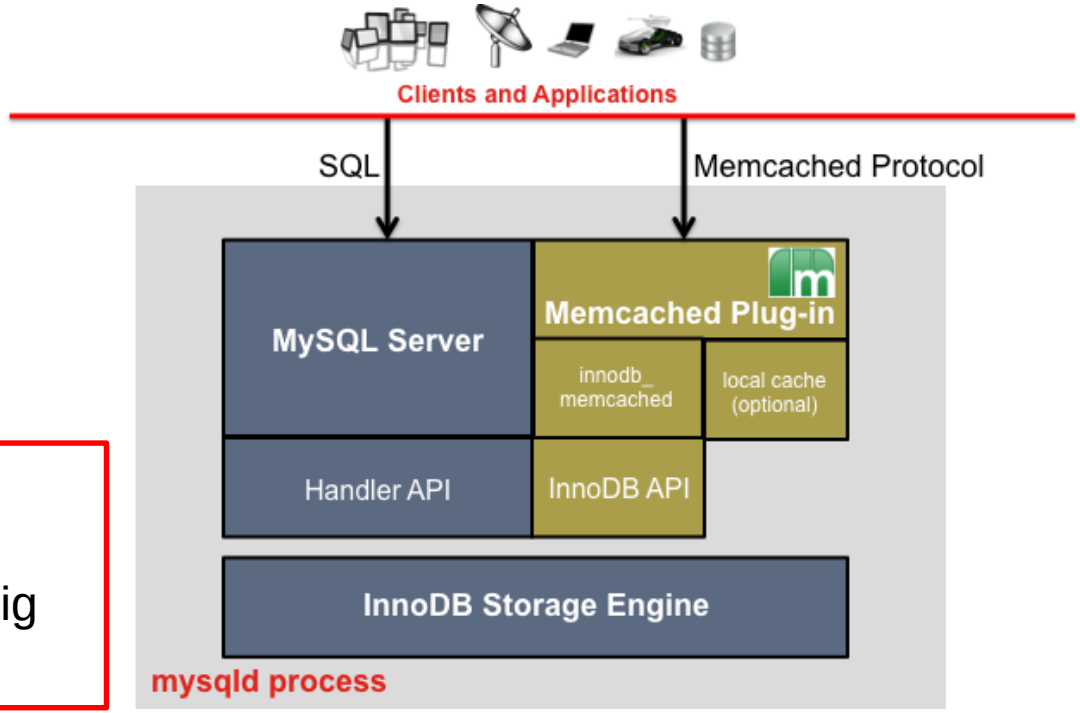
NoSQL Key Value Access to InnoDB

Same app can leverage:

- Key-value access to InnoDB via familiar Memcached API
- SQL for rich queries, JOINs, FKs, etc.
- Fully transactional

- Up to 9x performance boost for updates
- Great for fast data ingestion in Big Data pipeline



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Performance

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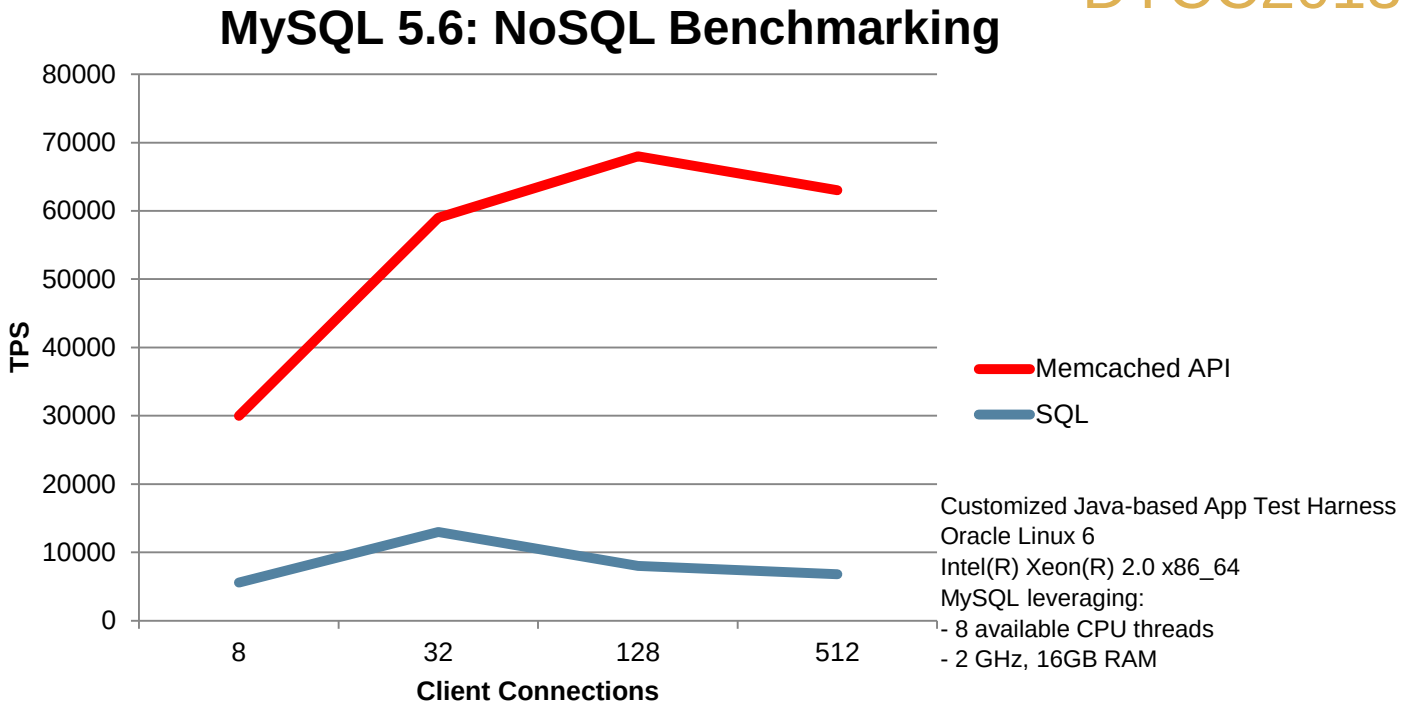

Up to 9x Higher "SET / INSERT" Throughput

blogs.oracle.com/mysqlinnodb/entry/new_enhancements_for_innodb_memcached

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MySQL 5.6: Optimizer

BETTER QUERY PERFORMANCE, EXECUTION TIMES

- Subquery Optimizations
- File Sort Optimizations for most common web use cases
- Index Condition Pushdown
- Batched Key Access and Multi-Range Read

BETTER DIAGNOSTICS

- EXPLAIN for INSERT, UPDATE, DELETE
- Structured EXPLAIN output (JSON)
- Optimizer Traces

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MySQL 5.6: Optimizer

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- Subquery Optimizations
- File sort optimizations for most web use cases
  - 4x better execution time – 40s to 10s
- Index Condition Pushdown
  - 160x better execution time – 15s to 90ms
- Batched Key Access and Multi Range Read
  - 280x better execution time – 2800s to 10s

- Better complex query execution times ever growing data sets (Big Data!)
- MEM + Query Analyzer key to utilizing full benefits of 5.6 Optimizer
- MySQL Consultative Support provides guidance on configuration

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MySQL 5.6: Optimizer

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Subquery Optimizations

```
SELECT title FROM film WHERE film_id IN
   (SELECT film_id FROM film_actor
         GROUP BY film_id HAVING count(*) > 12);
```

- For Developers
  - No more re-writing legacy application or packaged subqueries into joins
- Performance
  - DBT 3 Query #13 benchmark:
  - Execution time drops from DAYS to seconds

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MySQL 5.6: Optimizer

Postpone Materialization of views/subqueries in FROM

```
EXPLAIN SELECT * FROM (SELECT * FROM a_big_table);
SELECT … FROM derived_table AS dt
         join table AS t WHERE dt.fld = t.dlf
```

- Late materialization
  - Allows fast EXPLAINs for views/subqueries
  - Avoid materialization when possible, faster bail out
  - A key can be generated for derived tables
- 240x better execution time (drops from ~8 min to ~2 sec)

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MySQL 5.6: Optimizer

File Sort Optimizations with Small Limit

```
CREATE TABLE products(
  productid int auto_increment PRIMARY KEY,
  productname varchar(200)
);

SELECT * FROM products ORDER BY productname LIMIT 100;
```

Web use case – list top 100 products sorted by name

- Use **`sort_buffer_size`** to sort all in memory, avoid creating intermediate sorted files
- Produce ordered result set using a single table scan
- Example above: 20 million rows, using default **`sort_buffer_size`**
  - 4x better execution time (drops from 40s to 10s)

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MySQL 5.6: Optimizer

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Index Condition Pushdown (ICP)

```
CREATE TABLE person (
      personid INTEGER PRIMARY KEY,
      firstname CHAR(20),
      lastname CHAR(20),
      postalcode INTEGER,
      age INTEGER,
      address CHAR(50),
      KEY k1 (postalcode,age)
   ) ENGINE=InnoDB;
```

- With ICP Disabled
  - 15 s (buffer pool 128 Mb)
  - 1.4 s (buffer pool 1.5 Gb)
- With ICP Enabled
  - Execution time drops to 90 ms for both
- Controlled by **`optimizer_switch`** **`index_condition_pushdown`** flag

```
SELECT lastname, firstname FROM person
   WHERE postalcode BETWEEN 5000 AND 5500 AND age BETWEEN 21 AND 22;
```


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MySQL 5.6: Optimizer

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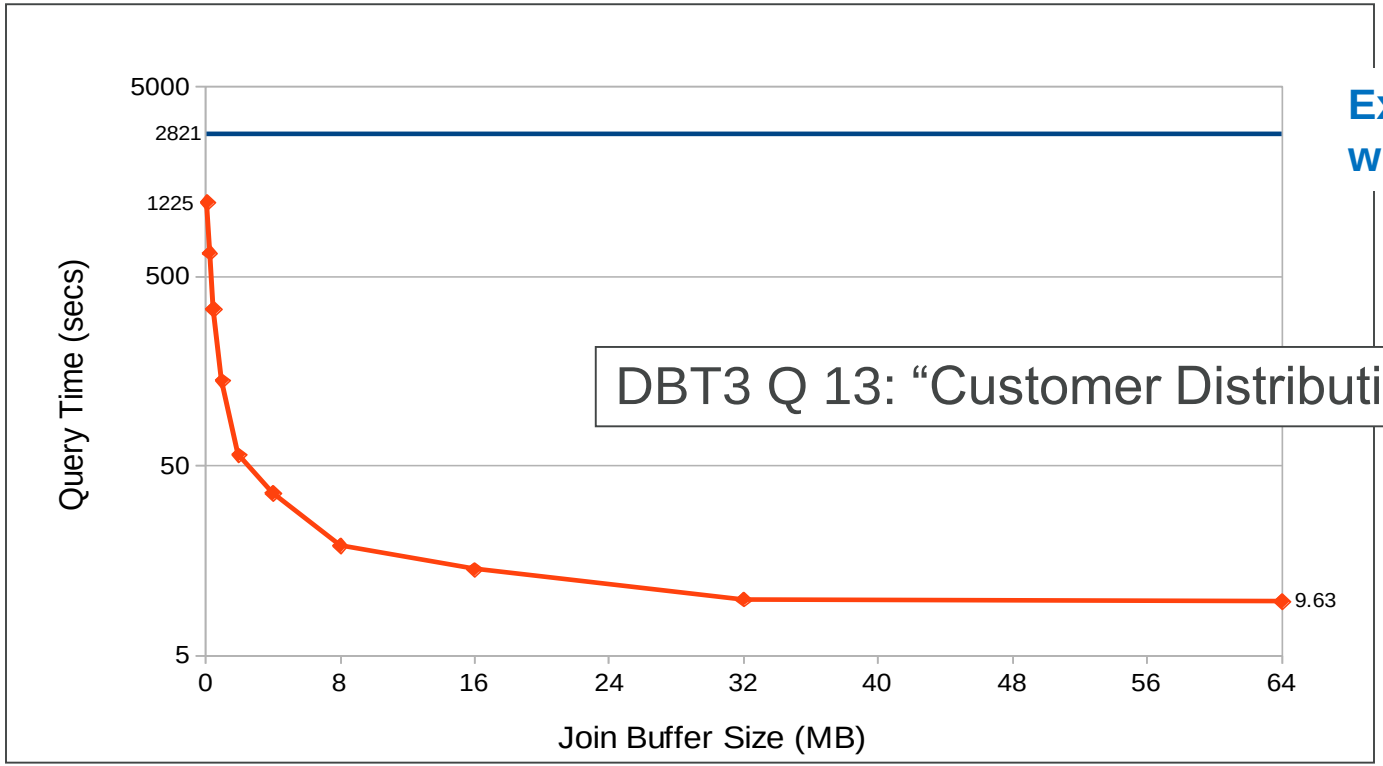
Batched Key Access (BKA) and Multi-Range Read (MRR)



Execution time without BKA + MRR

Execution time with BKA + MRR

Controlled by `optimizer_switch` `flags`

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Customer Requirements for Replication

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PERFORMANCE

- Improve read consistency from slaves
- Reduce risk of data loss if master fails
- Minimize overhead

FAILOVER & RECOVERY

- Self-Healing
- Improve availability

DATA INTEGRITY

- Correct, consistent & accessible

DEV/OPS AGILITY

- Enhance responsiveness to business
- Reduce TCO

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MySQL 5.6: Best Replication Features Ever

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PERFORMANCE

- Multi-Threaded Slaves
- Binary Log Group Commit
- Optimized Row-Based Replication

FAILOVER & RECOVERY

- Global Transaction Identifiers
- Replication Failover & Admin Utilities
- Crash Safe Slaves

DATA INTEGRITY

- Replication Event Checksums

DEV/OPS AGILITY

- Time Delayed Replication
- Remote Binlog Backup
- Informational Log Events

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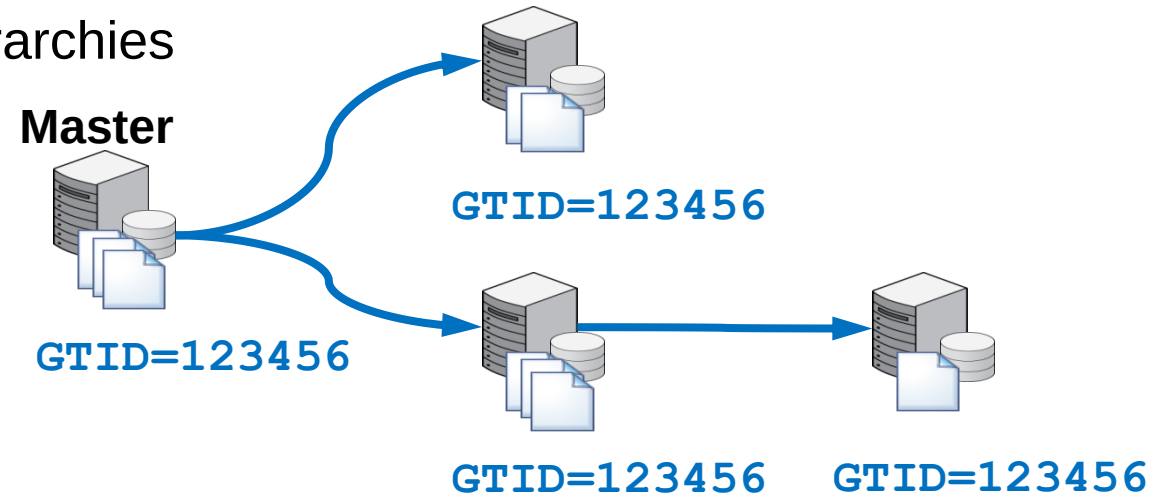
MySQL 5.6: Replication

Global Transaction Ids

- Simple to track & compare replication across the cluster
  - Unique identifier for each transaction written to the Binlog
- Automatically identify the most up-to-date slave for failover
- Deploy n-tier replication hierarchies

Eliminates the need for *complex* 3rd party solutions



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MySQL 5.6: Replication HA Utilities (Python)

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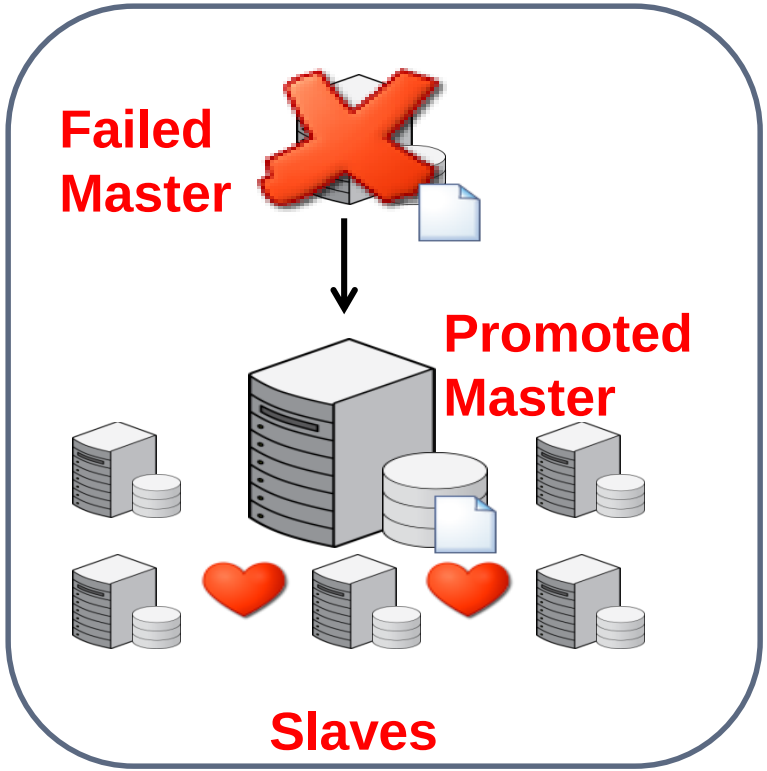

- Enabling self-healing replication topologies
- Automated failover & recovery
  - `mysqlfailover` Utility
- Switchover & administration
  - `mysqlrpladmin` Utility

- Delivers HA within the core MySQL distribution
  - Eliminates the need for 3rd party solutions
  - Allows extensibility to support variety of HA mechanisms

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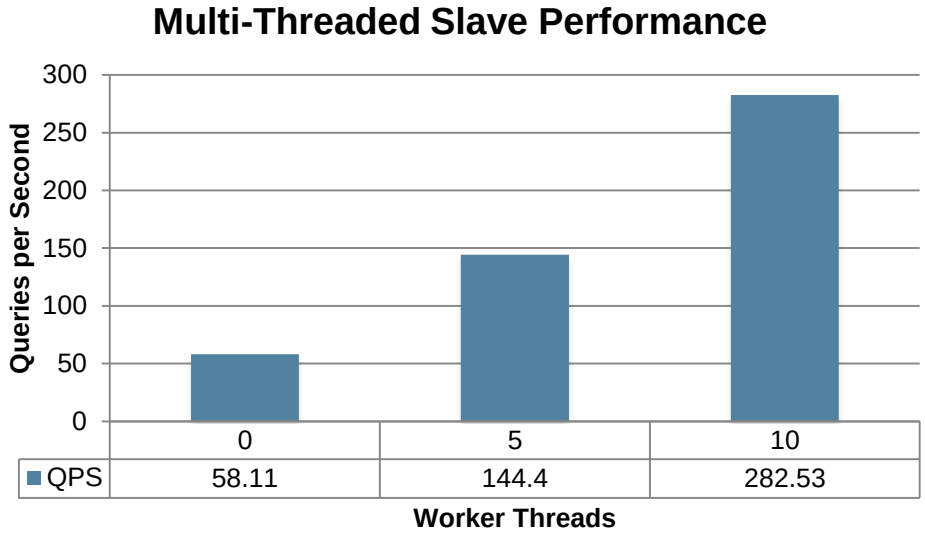
MySQL 5.6: Replication

Multi-Threaded Slaves

- Increases slave throughput, reducing lag
- Applies events to different databases in parallel using concurrent SQL threads
- 5x performance gain



- SysBench, running across 10 x schemas
- Oracle Linux 6.1, Oracle Sun Fire x4150 m2 Server

- Great for systems which isolate application data using databases
  - Cloud, SaaS, Hosting, other multi-tenant deployments

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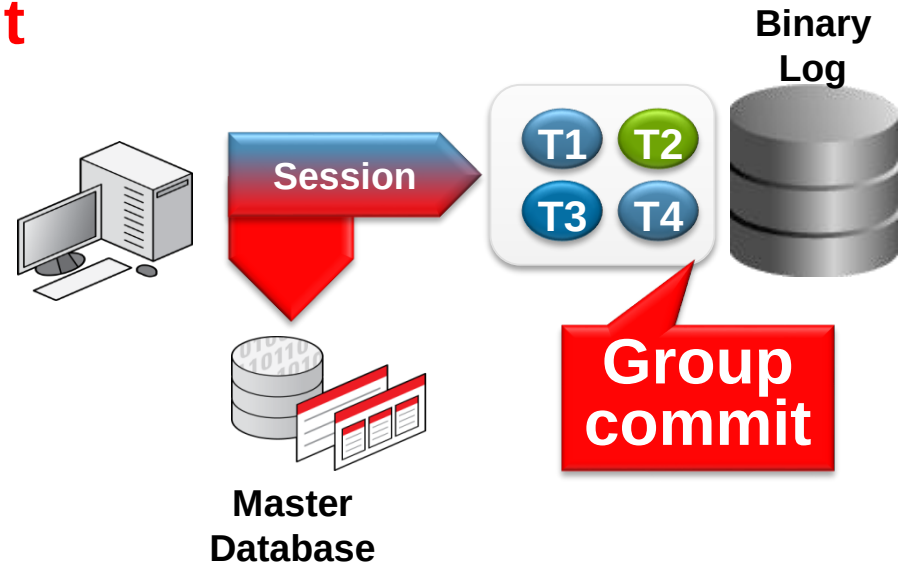
MySQL 5.6: Replication

Binary Log Group Commit

- Increases replication throughput by increasing performance of the master
- Commits multiple transactions as a group to Binlog on disk
- Finer grained locking; reducing lock wait times



- Better transactional throughput, less slave lag when coupled with MTS
- MySQL Consultative Support provides guidance on configuration

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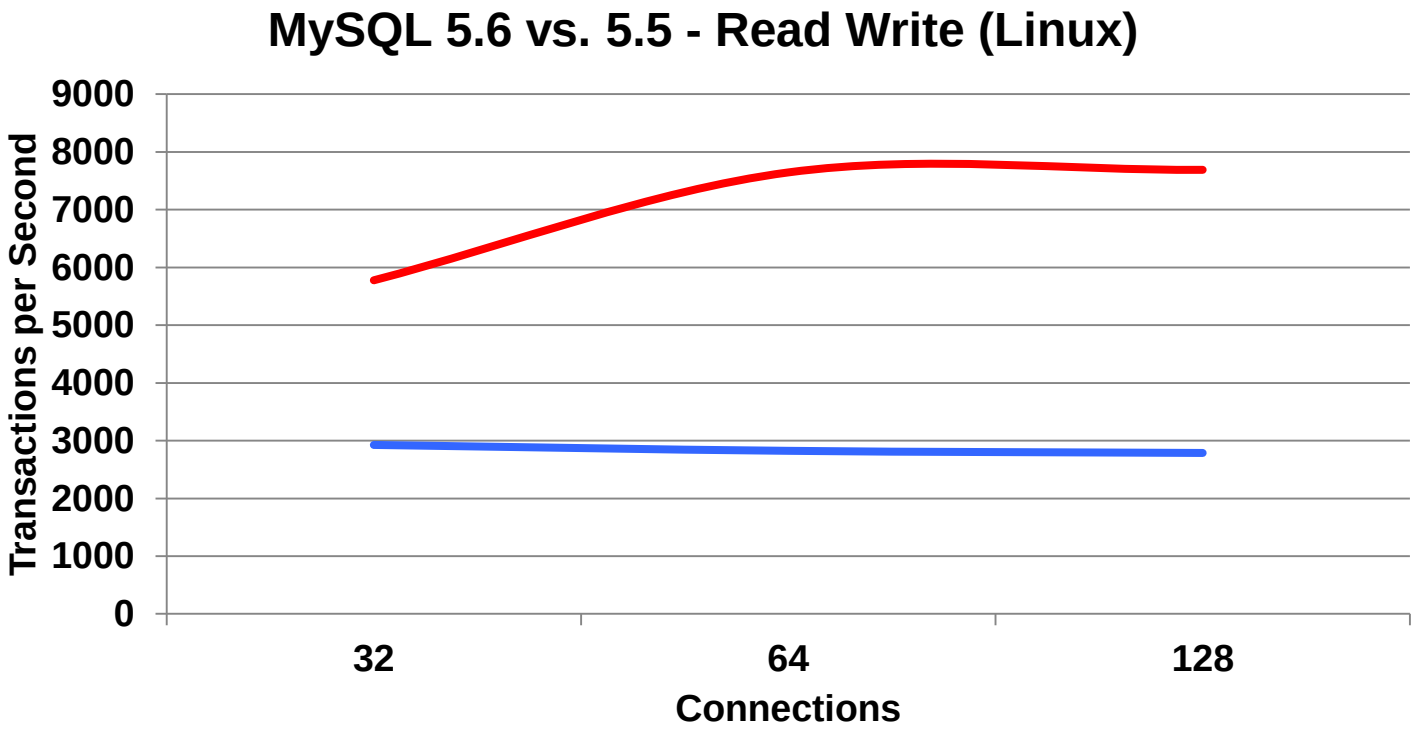
Binary Log Group Commit Performance

Binlog=1



Oracle Linux 6
Intel(R) Xeon(R) E7540 x86_64
MySQL leveraging:
- 48 of 96 available CPU threads
- 2 GHz, 512GB RAM

180% Performance Gain

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MySQL 5.6: Replication

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Optimized Row Base Replication

- New option: `binlog-row-image=minimal`
- Increases throughput for master and slave
  - Reduces Binlog size, memory & network bandwidth
- Only replicates elements of the Row image that have changed

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MySQL 5.6: Performance Schema

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New Instrumentation

- Statements/Stages
- Table and Index I/O
- Table locks
- Users/Hosts/Accounts
- Network I/O

```
[mysqld]
performance_schema=on
```

New Features

- Show contents of Host cache
- New Summary tables
- Easier configuration
  - Start up defaults in my.cnf
  - Auto tune
- Reduced overhead
- On by default

Provides user/session level stats on resource usage for Cloud-based consumption/reporting/charge back

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MySQL 5.6: In Summary

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New! NoSQL ACCESS TO INNODB

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

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MySQL Database Development Priorities

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- Optimized for Web, Cloud-based, Embedded use cases
- Simplified, Pluggable architecture
  - Maintainability, more extensible
  - More NoSQL options (HTTP, JSON, JavaScript, etc.)
- Refactoring
  - Data Dictionary in InnoDB
  - Optimizer/Parser/Protocol
- InnoDB
  - Optimized for SSD
  - GIS
- Easy HA, Replication and Sharding

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New MySQL 5.6 Training

Learn about the world's most popular open-source database

MySQL DTCC2013

Learn MySQL From Oracle

- Expert-led training to help you install, configure, and administer MySQL 5.6.
- Extensive hands-on practices guide you through each concept
- Explore real-world problems and discover best practices as you work with the tools and techniques used by professional MySQL database administrators
- Content developed in collaboration with product engineering.

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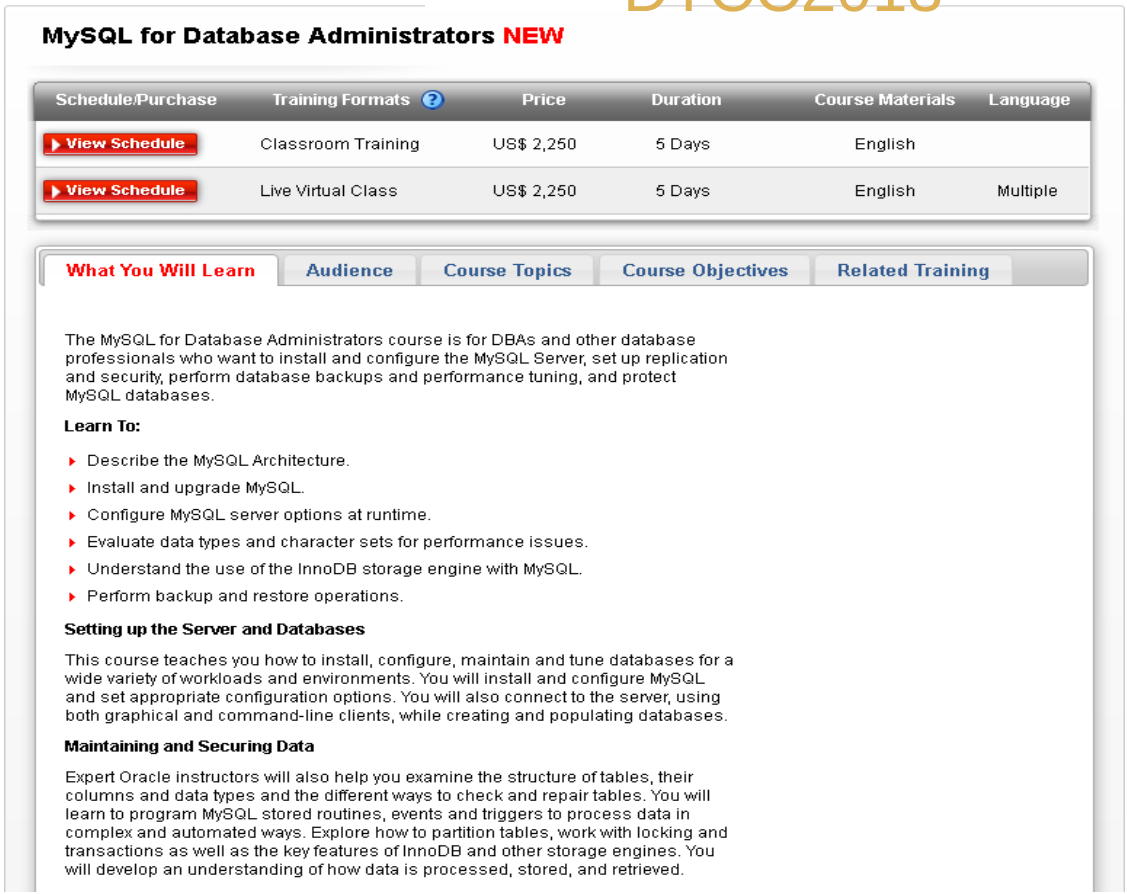

MySQL for Database Administrators NEW

Schedule/Purchase	Training Formats	Price	Duration	Course Materials	Language
View Schedule	Classroom Training	US$ 2,250	5 Days	English	
View Schedule	Live Virtual Class	US$ 2,250	5 Days	English	Multiple

What You Will Learn | Audience | Course Topics | Course Objectives | Related Training

The MySQL for Database Administrators course is for DBAs and other database professionals who want to install and configure the MySQL Server, set up replication and security, perform database backups and performance tuning, and protect MySQL databases.

Learn To:

- Describe the MySQL Architecture.
- Install and upgrade MySQL.
- Configure MySQL server options at runtime.
- Evaluate data types and character sets for performance issues.
- Understand the use of the InnoDB storage engine with MySQL.
- Perform backup and restore operations.

Setting up the Server and Databases

This course teaches you how to install, configure, maintain and tune databases for a wide variety of workloads and environments. You will install and configure MySQL and set appropriate configuration options. You will also connect to the server, using both graphical and command-line clients, while creating and populating databases.

Maintaining and Securing Data

Expert Oracle instructors will also help you examine the structure of tables, their columns and data types and the different ways to check and repair tables. You will learn to program MySQL stored routines, events and triggers to process data in complex and automated ways. Explore how to partition tables, work with locking and transactions as well as the key features of InnoDB and other storage engines. You will develop an understanding of how data is processed, stored, and retrieved.

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网上讲座直播— MySQL

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通过 MySQL 获得更好的成效，就从您的计算机开始！

获取世界上最流行的开源数据库的最新信息

本次免费网上讲座由现场演示和互动问答两部分组成。

主题： MySQL网上讲座

- 日期： 2013 年 4 月 23 日
- 时间： 10:00AM -11:30AM

立即注册！ http://valuemarketing.com.cn/oracle/20130403/oracle.html

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MySQL

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Developer and DBA Guide to What's New in MySQL 5.6

Questions?