



A Guide to MySQL Enterprise Monitor

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Table of Contents

MySQL Enterprise Monitor	3
MySQL Enterprise Monitor Architecture	5
MySQL Enterprise Monitor Service Manager	6
MySQL Query Analyzer	9
MySQL Advisors	11
Conclusion.....	13
Learn More	14



MySQL Enterprise Monitor

MySQL is the world's most popular open source database, relied on for its performance and scalability, quality, ease-of-use, and low cost. Using MySQL Enterprise Monitor improves these qualities even as you add more sophisticated capabilities to your application, and as your data volume and number of MySQL servers increase. MySQL Enterprise Monitor helps ensure that MySQL is optimized for your application right from the start. MySQL Enterprise Monitor also enables you to monitor and manage hundreds or even thousands of MySQL instances efficiently and effectively.

Overview

MySQL Enterprise Monitor is a web-based application that is included with MySQL Enterprise Edition. It can be used during development and post-deployment to optimize, monitor, and troubleshoot your MySQL databases and Replication topologies.

MySQL Enterprise Monitor provides:

- **Visual Query Analysis** – Monitor query performance and pinpoint SQL code that is causing a slow-down.
- **Performance & Availability Monitoring** - Continuously monitor MySQL uptime and availability, along with queries and performance-related server metrics.
- **InnoDB Monitoring** - Monitor key InnoDB metrics that impact MySQL performance.
- **Disk Monitoring** – Forecast future capacity requirements using trend analysis and projections.
- **Security Monitoring** - Identify and resolve security vulnerabilities across all MySQL servers.
- **Firewall Monitoring** - Monitor MySQL Enterprise Firewall activity, and protect your MySQL servers against database attacks. Receive alert and configuration advice.
- **Audit Monitoring** – Enforce MySQL Enterprise Audit configuration and usage across all MySQL servers.
- **Access Control Lists (ACLs)** – Define access and permission by role vs. individual users, map to LDAP or Active Directory roles, control access to data and views.
- **Operating System Monitoring** - Monitor operating system level performance metrics such as load average, CPU usage, RAM usage and swap usage.
- **MySQL Cluster Monitoring** - Monitor key MySQL Cluster metrics that impact performance and availability.
- **Replication Monitoring** – Gain visibility into the performance, and health of all MySQL Masters and Slaves.
- **Group Replication and InnoDB Cluster Monitoring** – Monitor and manage your distributed and highly available MySQL setups with ease.
- **Backup Monitoring** – Ensure online, hot backups are running as expected.



Use Cases

Web properties, Cloud and SaaS providers, Software Vendors, and Enterprise users can use and benefit from MySQL Enterprise Monitor in a number of ways:

- **As a Monitoring & Management tool**
 - Provide 24/7, value-added, proactive support.
 - Ensure SLAs.
 - Provision and ease scheduled maintenance of MySQL servers and Replication topologies.
 - Trouble-shoot more efficiently and effectively.
 - Lower your total costs.
 - Increase customer satisfaction.

“Using MySQL Enterprise Monitor gives us the ability to manage over 30 MySQL databases without a full-time DBA.”

Clickability

- **For Development**
 - Check MySQL performance.
 - Identify expensive queries.
 - Optimize indexes.
 - Verify hardware requirements.
 - Check for security vulnerabilities.
 - Follow MySQL best practices.
 - Lower development costs, and increase performance and customer satisfaction.

“With MySQL Query Analyzer we were able to identify and analyze problematic SQL code and triple our database performance. More importantly, we were able to accomplish this in three days rather than in weeks.”

Big Fish Games

- **By Software Vendors as Value-Added Support Service**
 - Remotely monitor your customers’ business-critical MySQL deployments.
 - Provide 24 x 7 value added support.
 - Ease scheduled maintenance.
 - Troubleshoot more effectively and at lower cost.
 - Ensure customer SLAs.
 - Lower total support costs.
 - Bring in incremental revenue with a premium support offering.
 - Increase customer satisfaction.



- **By Software Vendors As a Bundled Monitoring and Management Tool**
 - Offer as a value-added product for larger, more technically proficient customers.
 - Enable your customers to monitor and manage their critical MySQL deployments.
 - Lower your and their costs.
 - Bring in additional revenue for value-added tool.
 - Increase customer satisfaction.

MySQL Enterprise Monitor Architecture

There are four main components in the MySQL Enterprise Monitor:

- **MySQL Server** provides MySQL-related metrics, including Query Analyzer data, which is collected using MySQL Performance Schema.
- **Service Manager** collects all MySQL and OS/Host-related metrics and provides the web based user interface.
- **Repository** stores all historical monitoring data.
- **Agents** are optionally used to collect for OS/Host metrics, but they are not required for database metrics.

The architecture for MySQL Enterprise Monitor and each of its components is shown here. Note that MySQL Enterprise Monitor can be used locally to monitor and manage MySQL Servers in your environment or remotely with your customers' MySQL Servers. You can also leverage the Role Based Access Controls (RBAC) in MySQL Enterprise Monitor to offer a multi-tenant MySQL monitoring service to your customers.

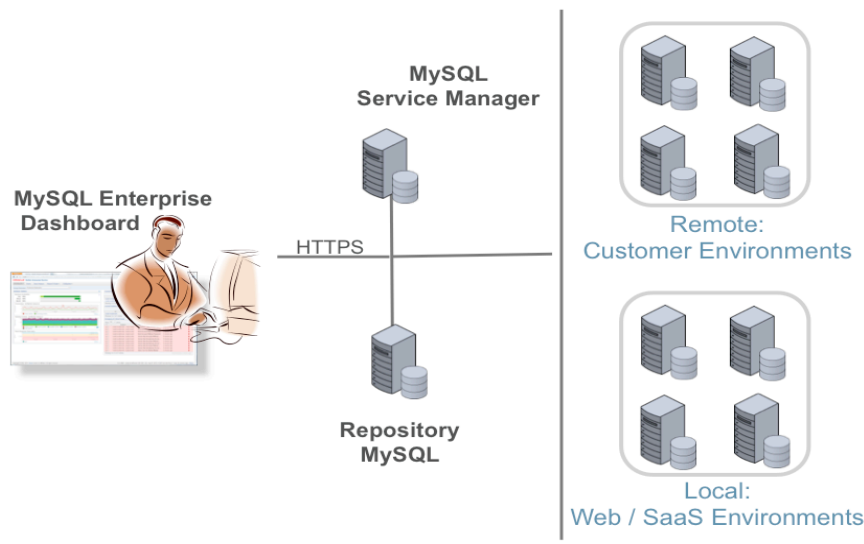


Figure 1: MySQL Enterprise Monitor Architecture



MySQL Enterprise Monitor Service Manager

Using the Enterprise Service Manager, you and your customers can monitor MySQL and OS-specific metrics for one or groups of MySQL Servers. The Enterprise Service Manager provides at-a-glance dashboard views into the security, availability, and performance of all your MySQL servers through its browser-based console. The console includes the following tabs: Dashboards, Events, Query Analyzer, Reports & Graphs, and Configuration, as shown below.

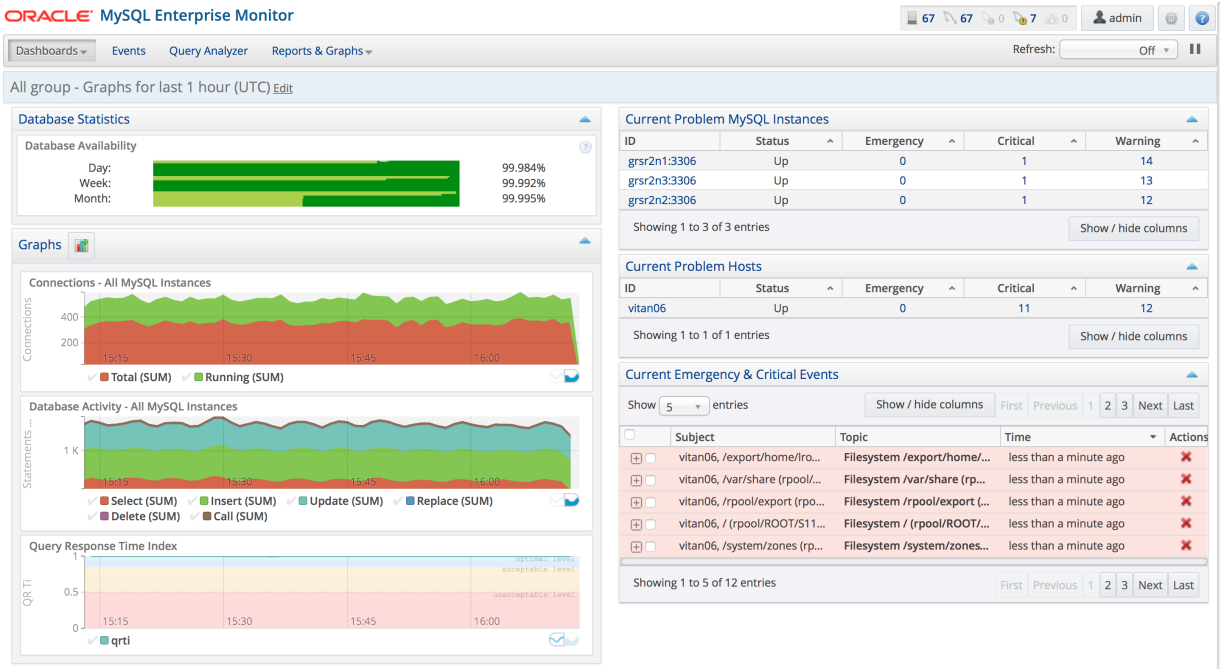


Figure 2: MySQL Enterprise Monitor Overview Dashboard

Monitor What Matters

MySQL Enterprise Monitor enables you to monitor a variety of key MySQL components and capabilities, including:

- **InnoDB Monitoring**
 - Monitors key performance metrics.
 - Helps you stay on top of locking issues.
 - Provides configuration advice.
 - Provides a visual breakdown of buffer pool usage.



	Current	Worst	Subject	Topic
+	!	!	mylab.localdomain, mylab.localdomain:3306	Root Account Without Password
+	!	!	mylab.localdomain, mylab.localdomain:3306	Server Has Accounts Without A Password
+	✓	!	mylab.localdomain, mylab.localdomain:3306	Average Statement Execution Time Excess...
+	✓	!	mylab.localdomain, mylab.localdomain:3306	SQL Statement Generates Errors or Warnings
+	!	!	mylab.localdomain, mylab.localdomain:3306	Server Has Anonymous Accounts

Figure 4: MySQL Enterprise Monitor At-a-Glance Status and Alerts

- **Replication Monitoring**
 - Auto-discovers replication topology.
 - Monitors Master and Slave performance.
 - Replication advisor provides best practices advice.
- **MySQL Enterprise Backup Monitoring**
 - Monitors backup results and performance.
 - Ensures backups are up to date.

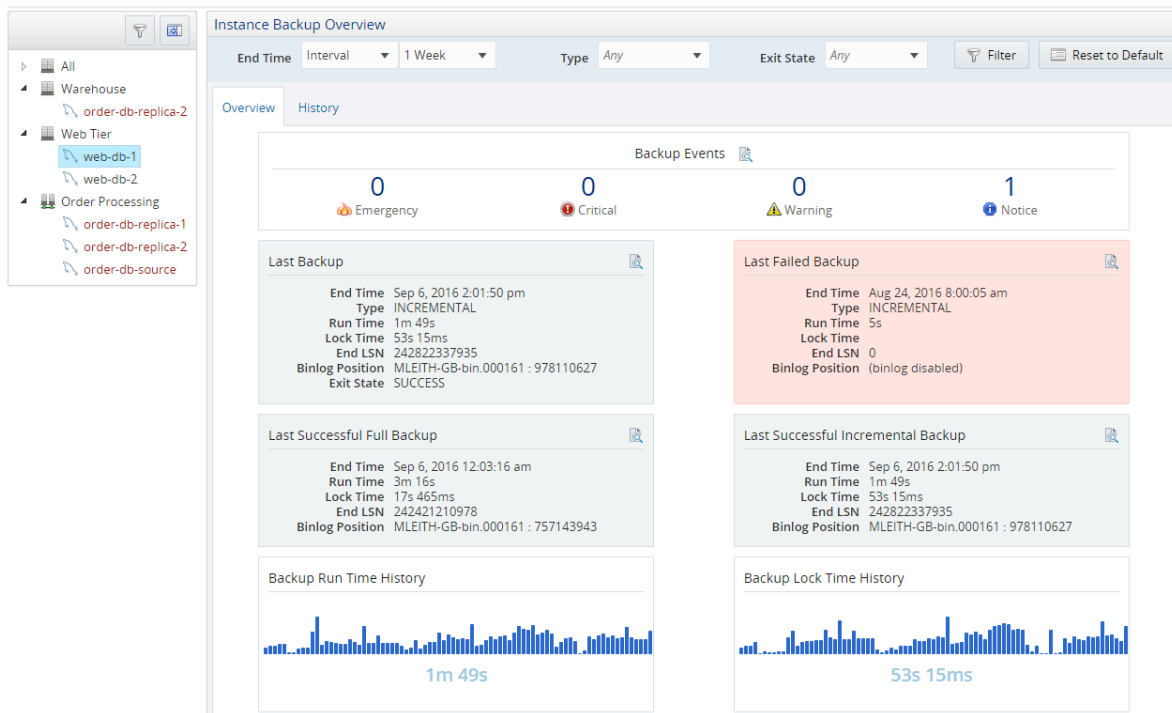


Figure 5: MySQL Enterprise Backup Dashboard

- **MySQL Configuration Management**
 - Provides centralized management, organized by topic
 - Options are grouped by feature
 - Displays host and network details



MySQL Query Analyzer

MySQL Query Analyzer monitors and provides a consolidated view of queries and their execution details allowing developers and DBAs to quickly find performance tuning opportunities. MySQL Query Analyzer identifies slow queries and allows you to trace their execution back to pinpoint and fix problematic code. It also allows you to filter for specific query problems, like full table scans and bad indexes using advanced global search options. The queries are graphically displayed on the Query Analyzer tab on the Enterprise Service Manager.

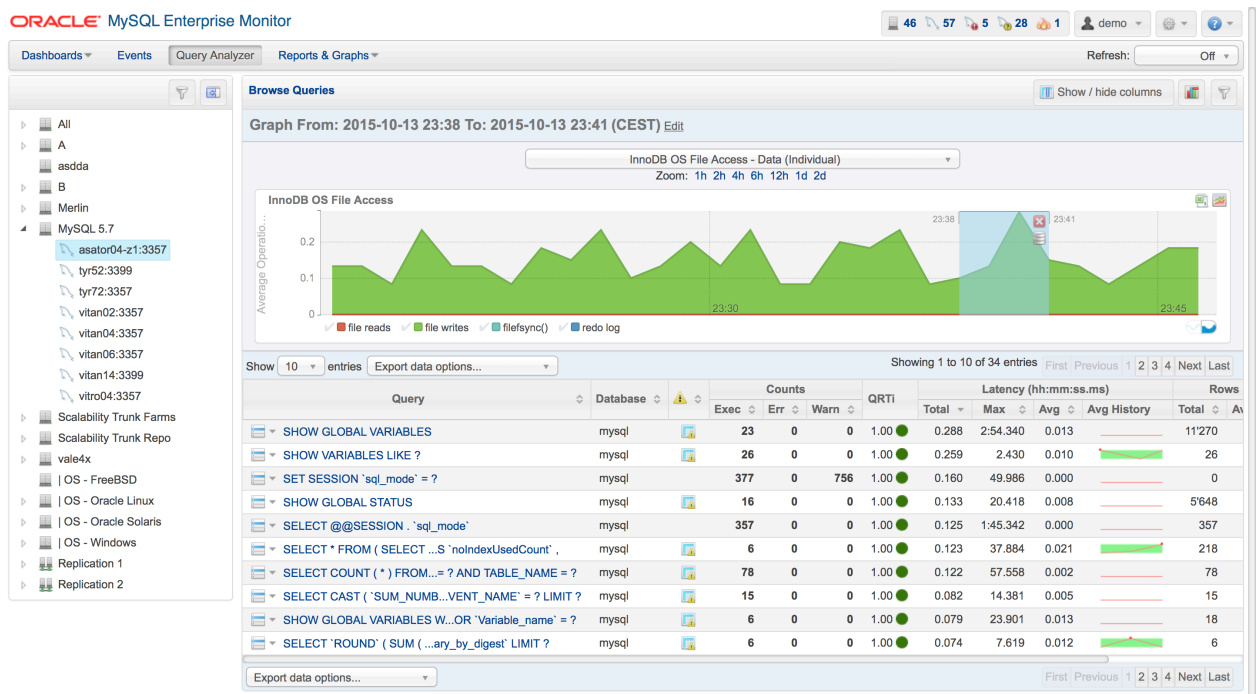


Figure 6: Query Analyzer Tab View

"Using MySQL Query Analyzer, we can easily see a query that's running too frequently and find a fix for performance bottlenecks in hours instead of days. This is something the big three [Oracle Database, Microsoft SQL Server, and MySQL] have. None of the others have this back layer visibility."

NetMotion Wireless





Fine-Grained Query Statistics

Query Analyzer provides detailed query data such as:

- **Query Response Time Index (QRTi)** provides a single Quality of Service metric for each query for a server, group or every instance (see below).

Query	Database	Counts			QRTi
		Exec	Err	Warn	
INSERT INTO sbtest1 (i...c , pad) VALUES (...)	test	161,133	0	0	1.00
INSERT INTO sbtest1 (k...LUES (...)'* , ... */	test	20	0	0	0.50
SELECT SUM (K) FROM s...id BETWEEN ? AND ? + ?	test	161,156	0	0	1.00
SELECT DISTINCTROW c FR...? AND ? + ? ORDER BY c	test	161,160	0	0	1.00
CREATE INDEX k_1 ON sbtest1 (k)	test	1	0	0	0.00
SELECT c FROM sbtest1 W...? AND ? + ? ORDER BY c	test	161,157	0	0	1.00
BEGIN	test	161,139	0	0	1.00
CREATE TABLE sbtest1 (... = innodb MAX_ROWS = ?	test	1	0	0	0.50
COMMIT	test	161,091	0	0	0.69
DROP TABLE sbtest1	test	1	0	0	0.50

Figure 7: Query Response Time Index (QRTi)

- **Query Analyzer Table** provides an aggregated summary of all executing queries.
- **Response Statistics** include Execution Time and Row Statistics, Time Span and First Seen.
- **Explain Query** shows the execution plan used for the query (see below).

Canonical Query Example Query Explain Query Graphs

Explain of a query that occurred during the Time Span (usually the slowest but not always).

Explain

id	select_type	table	type	possible_keys	key	key_len	ref	rows	extra
1	SIMPLE	employees	ALL	PRIMARY	null	0	null	299113	null
1	SIMPLE	titles	ref	PRIMARY,emp_no	PRIMARY	4	employees.employees.emp_no	1	null
1	SIMPLE	salaries	ref	PRIMARY,emp_no	PRIMARY	4	employees.employees.emp_no	1	null

Close

Figure 8: MySQL Query Analyzer EXPLAIN

- **Graphs** display key metrics such as Execution Time, Executions, Rows, and Kilobytes for a specific query in a given time period.

Correlate Query Execution with MySQL Server Activity

Correlated graphs provide a visual comparison of MySQL server activity with concurrently executing queries. You can:

- **Drag and select** to display the queries being executed during a specific time period.
- **Combine timeframes** with numerous filtering options such as Query Type, Execution Counts, First Seen and more to further target tuning opportunities.



Use of Performance Schema

Using Performance Schema in MySQL 5.6.14 and later, Query Analyzer is able to gather data directly from MySQL Server without any additional configuration or software (“agentless”). In addition, Performance Schema can provide data about what the statements do to generate their result sets such as:

- Table Lock time.
- Number of rows that were examined versus returned.
- Number of temporary tables created, and how many were created on disk.
- If range scans were done, and in what form they were done.
- If sorting happened, how many rows were sorted, and what form the sort took.

“MySQL Query Analyzer allows us to quickly identify and optimize our most expensive queries so that we can scale more efficiently to deliver 500+ million advertisements and 10+ million e-mails every month, and handle the over 10,000 queries per second that hit our MySQL databases. It also helps improve our hardware utilization and makes us more productive, which has direct, significant impact on our bottom line.”

Clickability

MySQL Advisors

Over 250 MySQL Advisors check your MySQL servers’ configuration, security, and performance levels against a set of best practice rules created by the MySQL developers. The advisors automatically identify problems and tuning opportunities, and provide you or your customers with specific corrective actions. Because Advisors use exponential moving averages and rate change detection, false positives from flapping or spikes are avoided.

There are 14 categories of MySQL Advisors

- **Administration:** Suggests improvements for smoother operations and better database management.
- **Agent:** Checks the status of each MySQL Enterprise Agent.
- **Availability:** Advisors related specifically to MySQL process and connection availability.
- **Backup:** Checks whether backup jobs succeed or fail, required resources, and information about MySQL Enterprise Backup specific tasks.
- **Cluster:** MySQL Cluster related Advisors.
- **Graphing:** Advisors that provide data for the graphs.
- **Memory Usage:** Indicate how efficiently you are using various memory caches, such as the InnoDB buffer pool, MyISAM key cache, query cache, table cache, and thread cache.
- **Monitoring and Support Services:** Advisors related to the MySQL Enterprise Monitoring services itself.
- **Operating System:** Advisors about Host (rather than MySQL Instance) Operating System performance.
- **Performance:** Identifies potential performance bottlenecks, and suggests optimizations.
- **Query Analysis:** Advisors related to queries and query analysis.



- **Replication:** Identifies replication bottlenecks, and suggests replication design improvements.
- **Schema:** Identifies schema changes.
- **Security:** Protects MySQL Servers and discovers security loopholes.

Advisors can analyze data across your entire MySQL topology to search for multiple problem conditions. For example, the Replication Advisors can scan an entire Replication topology to find common configuration errors like duplicate server IDs, a slave whose MySQL version is less than its master's, or a Group Replication member which has auto_increment configuration which could lead to unnecessary conflicts, as well as identifying performance outliers within the Replication topology. By generating only a single Event and notification, cascading errors are avoided.

Customizing Thresholds and Alerts

The MySQL Advisor rules can be customized for an individual MySQL Instance or a named monitoring collection of assets. You can

1. **Designate threshold** severity value as Informational, Severe or Critical
2. **Change threshold value** to better fit your application, environment, and requirements.
3. **Customize the Advisor's data collection schedule** – Both the Frequency, e.g. once every 5 minutes; and Type, "Fixed" or "Fixed Delay."
4. **Easily create new rules and evaluated expressions** using a provided template and the MySQL and OS variables and counters collected by the MySQL Enterprise Monitor.



Conclusion

An application performs as well as its database, which is why many thousands of customers have entrusted their businesses, their products, and their customers' experience to MySQL. Using MySQL Enterprise Monitor helps further ensure that your application performs at its peak level from beginning to end. Enterprise Monitor's single, consolidated view into the health, security, performance and availability of MySQL enables you to:

- **Optimize your database and application** during testing and when deployed with performance tuning, problem prevention, and faster resolution.
- **Lower your administration and support costs** through better database design and fast and effective monitoring, management and troubleshooting.
- **Gain new sources of revenue** by delivering higher levels of support services and SLAs to your customers, or offering Enterprise Monitor as value-added monitoring and management tool for your customers' use.
- **Solve the Top 10 Database Performance Issues:**
 - ✓ Identify the most expensive queries
 - ✓ Full table scans (no indexes)
 - ✓ Excessive temporary tables
 - ✓ Large and/or frequent filesorts
 - ✓ CPU usage overload
 - ✓ Disk I/O saturation
 - ✓ Hardware problems
 - ✓ Database and schema changes
 - ✓ New queries introduced
 - ✓ Poor MySQL configuration
 - ✓ Internal locking issues



Learn More

MySQL Enterprise Monitor

<http://www.mysql.com/products/enterprise/monitor.html>

MySQL Query Analyzer

<http://www.mysql.com/products/enterprise/query.html>

MySQL Enterprise Monitor Features and Benefits

<http://www.mysql.com/products/enterprise/monitor-features.html>

MySQL Enterprise Monitor Demos

<http://www.mysql.com/products/enterprise/demo.html>

Monitoring MySQL with MySQL Enterprise Monitor & Oracle Enterprise Manager

<https://www.mysql.com/news-and-events/web-seminars/monitoring-your-mysql-databases-with-mysql-enterprise-monitor-and-oracle-enterprise-manager/>

MySQL Resources (searchable by topic, type, and language) including:

- White Papers
- Presentations
- Case Studies
- On-Demand Webinars
- Articles
- User Forums
- Demos
- Conference & Events

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

MySQL Live Webinars

<http://www.mysql.com/news-and-events/web-seminars/>