



MySQL Enterprise Edition The Complete Guide

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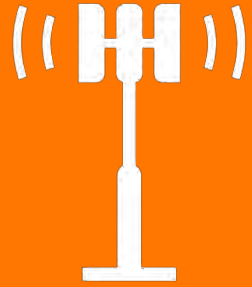
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MySQL Enterprise Edition : Agenda

- 1 ➤ Why MySQL Enterprise Edition?
- 2 ➤ Management Tools
- 3 ➤ Advanced Features
- 4 ➤ MySQL Cluster Carrier Grade Edition
- 5 ➤ Technical Support & Certifications

Why MySQL Enterprise Edition?



**Mobile Network
Supporting Over 800
Million Subscribers**



**2 Billion Events/Day for
Booking.com**



**IDs Processed for 1
Billion Citizens**

They Scale with MySQL



1.7 Billion Active Users



100 TB of User Data for PayPal



**850 Million Candy
Crush Game Plays/Day**

Why MySQL Enterprise Edition?

In Addition to all the MySQL Features you Love



Insure Your Deployments



Get the Best Results



Delight Customers



MySQL Enterprise Edition



Advanced Features

- Scalability
- High Availability
- Authentication
- Audit
- Encryption + TDE
- Firewall



Management Tools

- Monitoring
- Backup
- Development
- Administration
- Migration



Support

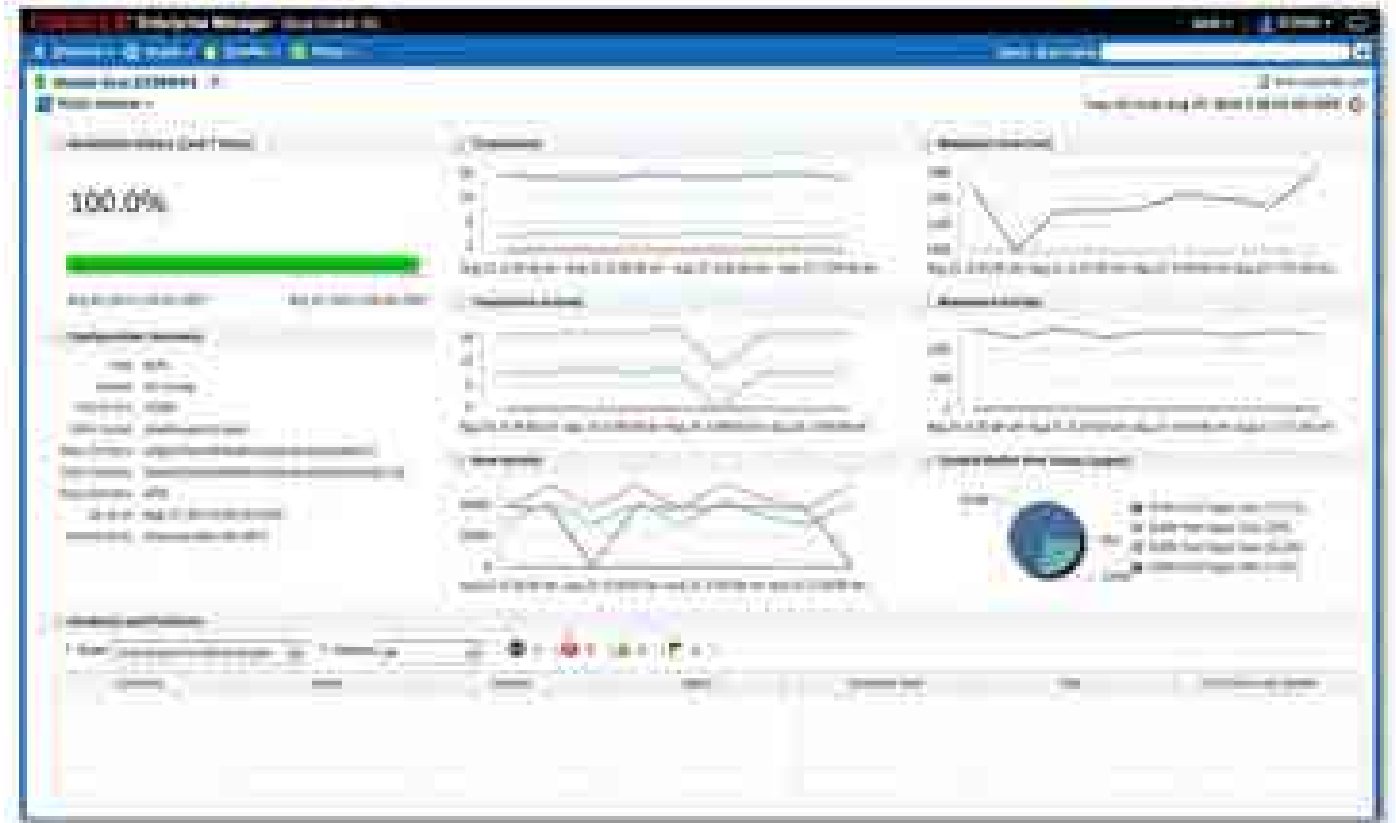
- Technical Support
- Consultative Support
- Oracle Certifications



MySQL Enterprise Edition: Management Tools

Oracle Enterprise Manager for MySQL

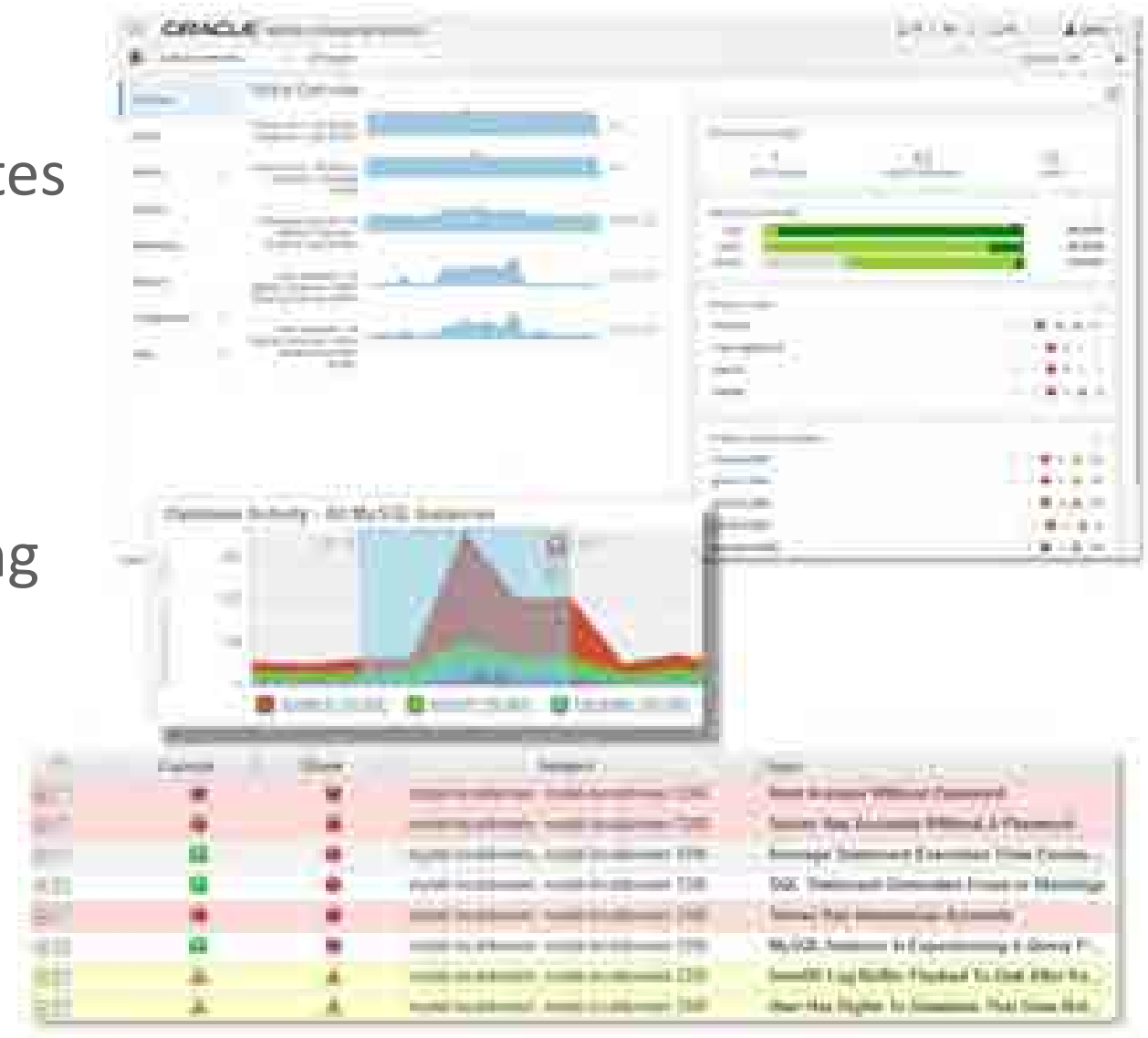
- Availability monitoring
- Performance monitoring
- Configuration monitoring
- All available metrics collected
 - Allowing for custom threshold based incident reports
- MySQL auto-detection
- MySQL 5.7 Support



ORACLE
ENTERPRISE MANAGER

MySQL Enterprise **Monitor**

- Start monitoring MySQL in 10 minutes
- Real-time MySQL performance and availability monitoring
- Visually find & fix problem queries
- Disk monitoring for capacity planning
- Cloud friendly architecture
 - No agents required
- Role based access controls



Enterprise **Monitor**: Dashboard

- SLA monitoring
- Real-time performance monitoring
- Alerts & notifications
- MySQL best practice advisors



"The MySQL Enterprise Monitor is an absolute must for any DBA who takes his work seriously."

- Adrian Baumann, System Specialist
Federal Office of Information Technology &
Telecommunications



Enterprise **Monitor**: Query Analyzer

- Real-time query performance
- Visual correlation graphs
- Find & fix expensive queries
- Detailed query statistics
- Query Response Time index (QRTi)
 - “Quality of Service” (QoS) measurement for each query
 - QoS measurement for a server, group, or every instance
 - Single metric for query performance



“With the 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 taking weeks.”

Keith Souhrada
Software Development Engineer
Big Fish Games

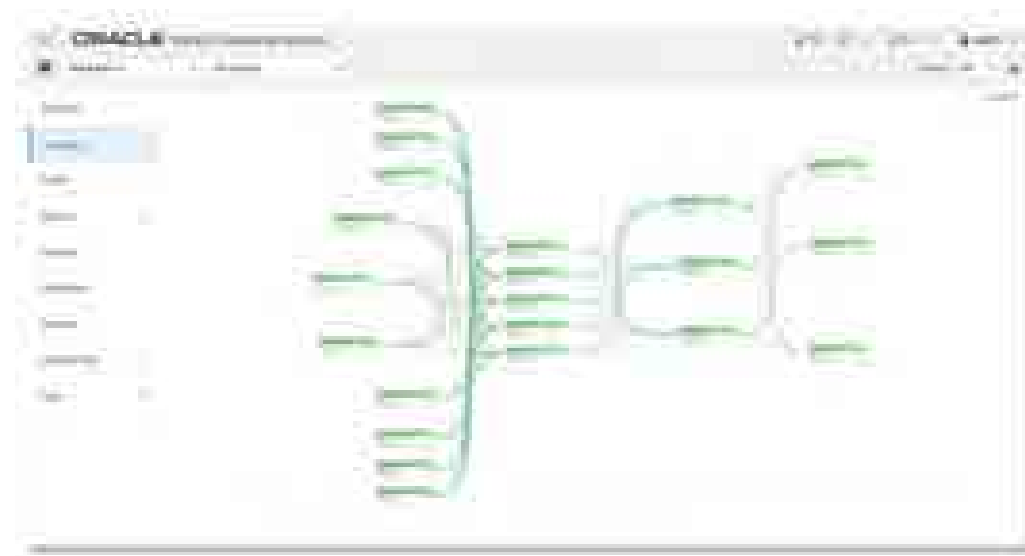
Enterprise **Monitor**: Replication Dashboard

- Master/Slave and Group Replication
- Auto-discovers replication topology
 - High level overviews of all instances
 - User centric views on individual sets
- Performance monitoring
- Replication advisors
- Best practice replication advice

"I use the MySQL Enterprise Monitor every day to monitor and keep tabs on our MySQL databases. Quick one stop shopping for keeping tabs on them."

-Wes Homer,
Sr System and Network Administrator

 **InsideView**[®]



NEW!

Enterprise **Monitor**: 4.0

- New and improved User Interface
 - Modern look-and-feel
 - Easier navigation
 - Better performance and scale
- Full NDB Cluster support
 - Auto discovery
 - Visual topology
 - Memory and CPU reports
 - New advisors
- User statistics report



NEW!

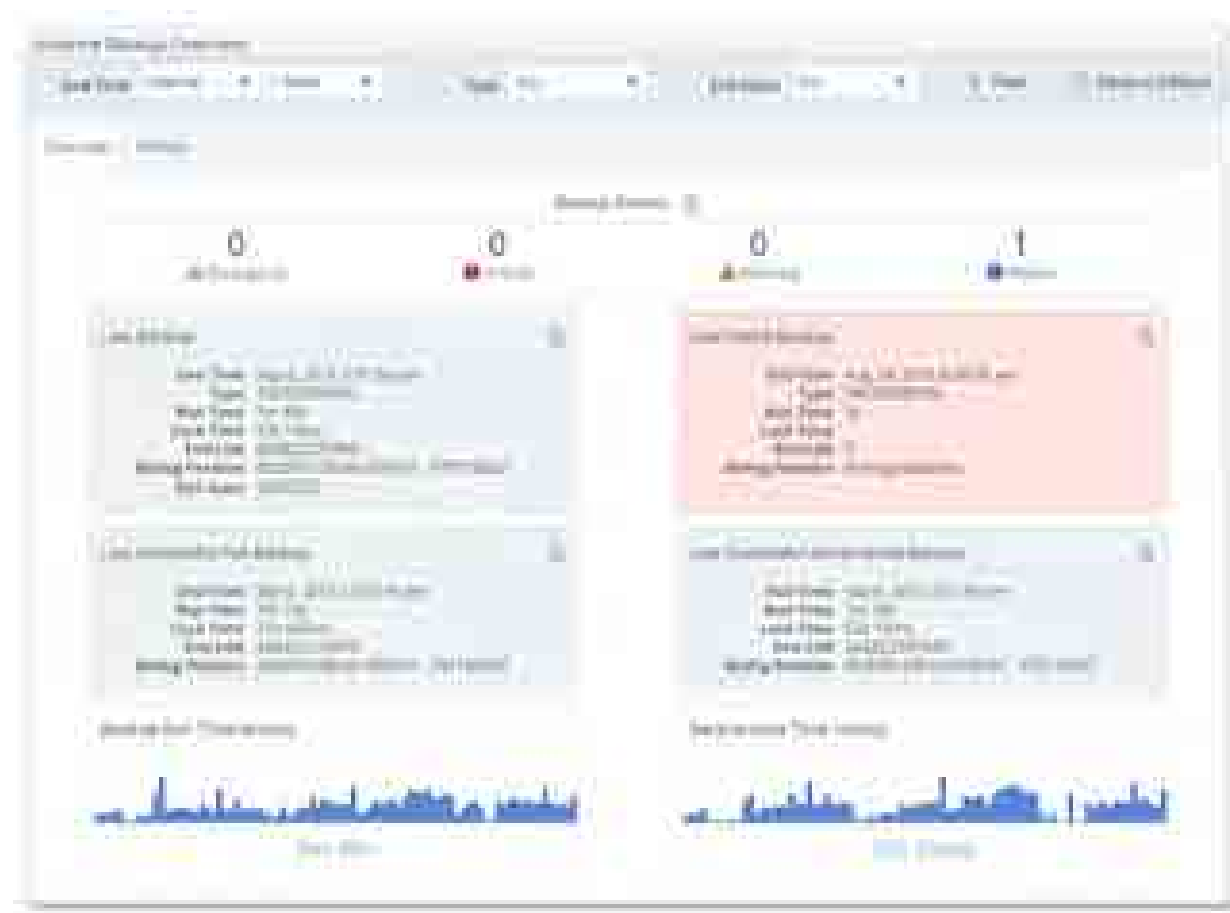
Enterprise **Monitor**: NDB Cluster Support

- Auto discovery and grouping of NDB processes
 - ndbapi
 - ndb_mgmd
 - ndbd/ndbmtd
- Visual cluster topology
- New reports and graphs
- New advisors



Enterprise **Monitor**: Backup Dashboard

- Monitor backup usage and health
 - Across your entire datacenter
- Drill into backup job details
 - Allowing for easy backup recovery
- Supports all backup types
- Alerting on significant events
 - Poor backup performance
 - Backup job failures
 - Out of date backups



Enterprise **Monitor**: Best Practice Advisors

- Enforce MySQL best practices
- 14 Advisor categories
- 250+ Advisors
- Threshold-based alerts
 - Exponential moving averages
 - Rate change detection
- Expert problem resolution advice



Advisor Category	Configuration Status
Administration	Configured: 25 of 25
Agent	Configured: 1 of 1
Availability	Configured: 4 of 4
Backup	Configured: 1 of 1
Cluster	Configured: 10 of 10
Grouping	Configured: 51 of 51
Memory Usage	Configured: 1 of 1
Monitoring and Support Services	Configured: 1 of 1
Operating System	Configured: 5 of 5
Performance	Configured: 22 of 22
Query Analysis	Configured: 8 of 8
Replication	Configured: 12 of 12
Schema	Configured: 11 of 11
Security	Configured: 26 of 26

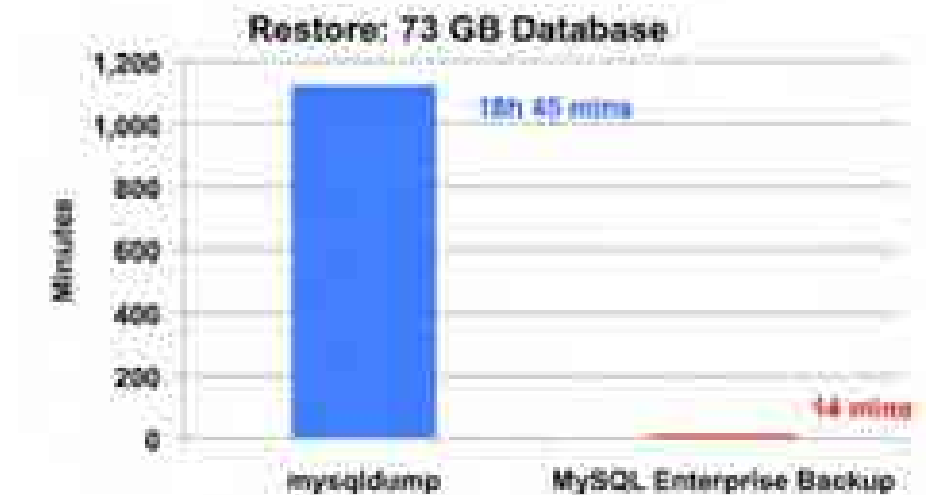
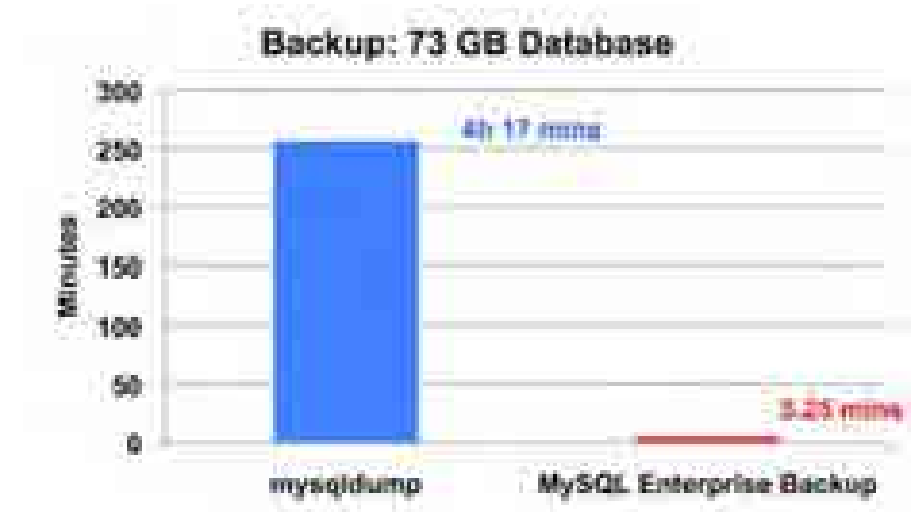
"I definitely recommend the MySQL Enterprise Monitor to DBAs who don't have a ton of MySQL experience. It makes monitoring MySQL security, performance and availability very easy to understand and to act on."

Sandi Barr
Sr. Software Engineer
Schneider Electric



MySQL Enterprise Backup

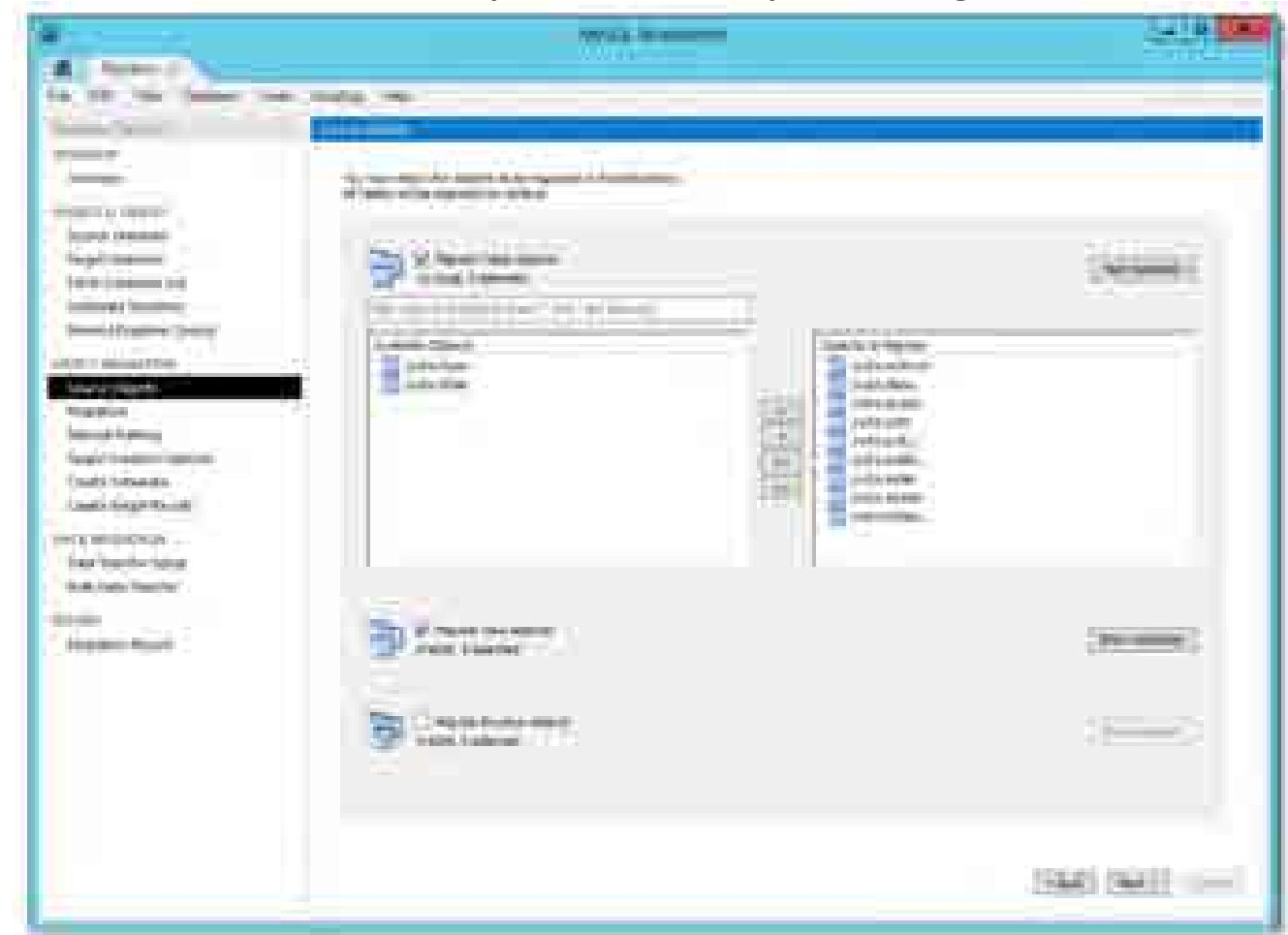
- Online, non-locking backup and recovery
 - Complete MySQL instance backup (data and config)
 - Partial backup and restore
- Direct Cloud storage backups
 - Oracle Storage Cloud, S3, etc.
- Incremental backups
- Point-in-time recovery
- Advanced compressed and encryption
- Backup to tape (SBT)
- Optimistic backups
- Cross-Platform (Windows, Linux, Unix)



MySQL Workbench EE

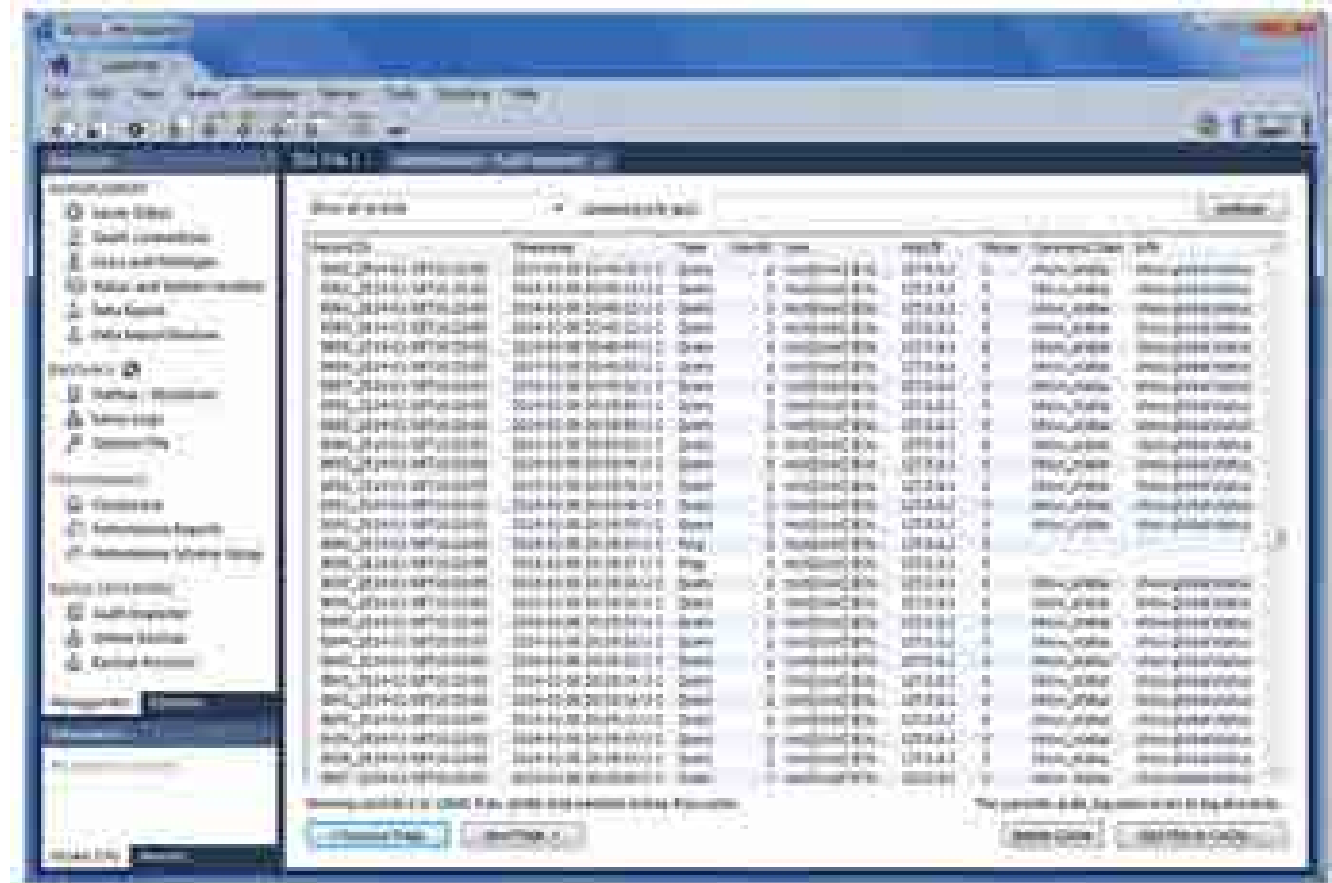
- Database migrations
 - From Microsoft SQL Server, PostgreSQL, Sybase ASE, Sybase SQL Anywhere, SQLite, Microsoft Access, and more
- Manage migration projects
- Source and target selection
- Object migration
- Data migration
- MySQL version upgrades

Database Migration Wizard
for SQL Server, Sybase, SQLite, SQL Anywhere & PostgreSQL



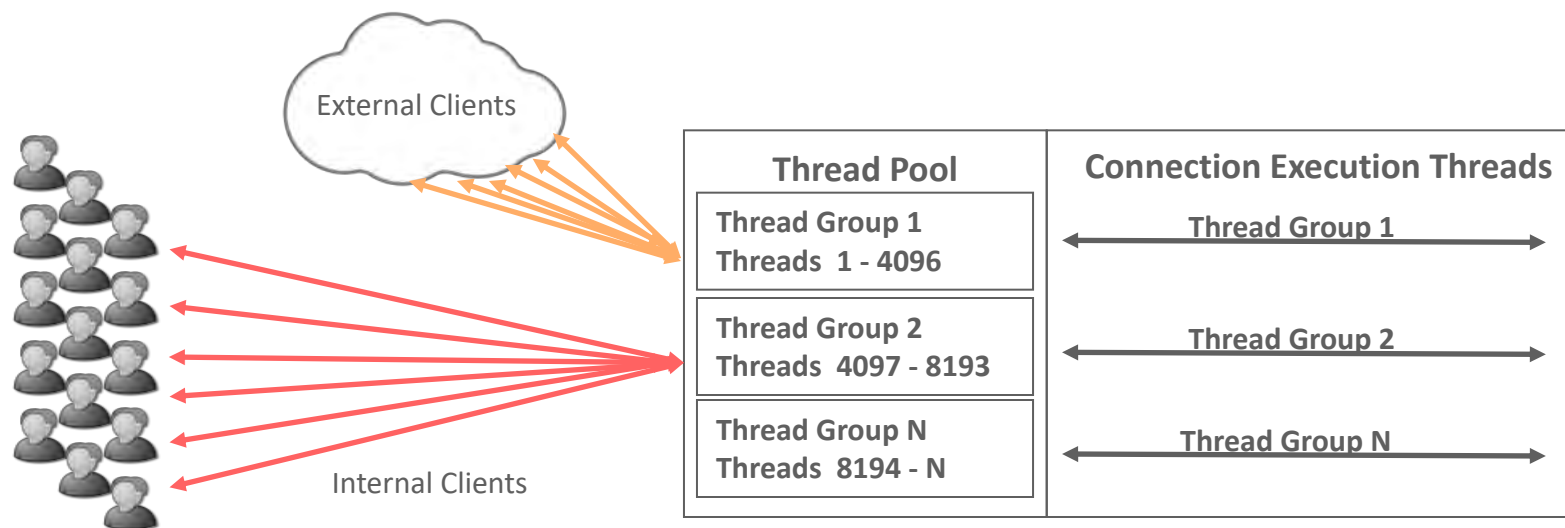
MySQL Workbench EE + Audit

- Fast and easy access to Audit events
- Indexed searches
 - Event type
 - User account
 - Date range
 - Text match



MySQL Enterprise Edition: Advanced Features

MySQL Enterprise **Scalability : Thread Pool**



- Threads are prioritized and statements queued
 - Improves scalability as concurrent connections grow, protection from DOS attacks
- Contains configurable number of thread groups (default = 16)
 - Each group manages up to 4096 re-usable threads
 - Each connection assigned to thread group via round robin

MySQL Enterprise Encryption

- MySQL encryption libraries
 - Symmetric encryption AES256
 - Public-key / asymmetric cryptography
- Key management
 - Generate public and private keys
 - Key exchange methods: RSA, DSA, DH
- Sign and verify data
 - Cryptographic hashing for digital signing, verification, & validation

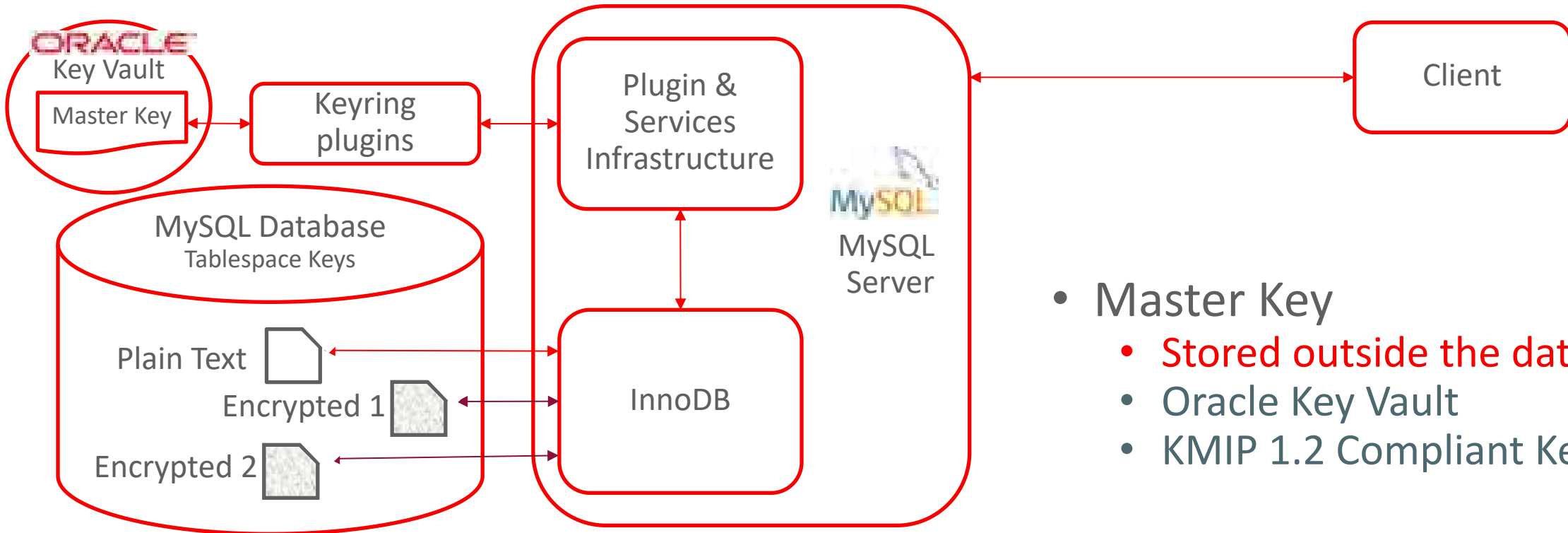


MySQL Enterprise **Transparent Data Encryption**

- Improves Security
 - Added Layer enforces access controls
 - Simple to use and manage
- Meets Security and Regulatory Requirements
 - Fit for cases where encryption is required
 - Healthcare, FiServ, Government, etc.
- Secures and Manages Keys
 - Supports Standard KMIP 1.2 protocols
 - Supports Oracle Key Vault and other Key Stores

MySQL Enterprise Transparent Data Encryption

2 Tier Architecture



- Master Key
 - Stored outside the database
 - Oracle Key Vault
 - KMIP 1.2 Compliant Key Vault
- Tablespace Key
 - Protected by master key

MySQL Enterprise **Audit**

- Out-of-the-box logging of connections, logins, and query
- Simple to fine grained policies for filtering, and log rotation
- Dynamically enabled, disabled: no server restart
- Send data to a remote server / audit data vault
 - Oracle Audit Vault, Splunk, etc.
- Custom Settings
 - XML and **New!** JSON audit stream formatting options
 - **New!** Compression (5.7.21)
 - **New!** Encryption (5.7.21)

Adds regulatory compliance to
MySQL applications
(HIPAA, Sarbanes-Oxley, PCI, etc.)

MySQL Enterprise Audit: Work Flow



1. DBA Enables Audit Plugin
- Defines Filters and Options
 - Who, What, Where, When, How



2. User Connects from a Host
- Authenticates
 - Runs Queries
 - Alters Tables, etc.

MySQL Enterprise Audit



3. DBA Reviews Local Audit Events
- MySQL Enterprise Edition
 - MySQL Workbench



```
<SQL_TEXT="SELECT * FROM joes_table"/>
</SQL>
<AUDIT_RECORD
TIMESTAMP="2012-08-02T14:52:11"
NAME="Audit"
SERVER_ID="1"
VERSION="1"
STARTUP_OPTIONS="--port=3306"
OF_VERSION="100-1000"
MYSQL_VERSION="5.5.28-debug-Log"/>
<AUDIT_RECORD
TIMESTAMP="2012-08-02T14:52:41"
NAME="CONNECTION"
CONNECTION_ID="1"
STATUS="0"
USER="joe"
SYS_USER="root"
OS_USER="joe"
HOST="SERVER1"
IP="127.0.0.1"
DB="joes_db"/>
<AUDIT_RECORD
TIMESTAMP="2012-08-02T14:53:45"
NAME="Query"
CONNECTION_ID="1"
STATUS="0"
SQLTEXT="SELECT * FROM joes_table"/>
</AUDIT>
```

Audit File



4. IT Sec Archives to Audit Vault
- Globally Assesses Audit Trail



MySQL Enterprise **Authentication**

- PAM (Pluggable Authentication Modules)
 - Access external authentication methods
 - Standard interface
 - Linux PAM
 - **New! Native** LDAP – Username/Password or SASL
 - Proxied and non-proxied users
- Windows
 - Access native Windows services
 - Authenticate users already logged into Windows
 - Typically using Windows Active Directory



Integrates MySQL with existing security infrastructures and SOPs

MySQL Enterprise Firewall

- Real Time Protection
 - Queries analyzed and matched against White List
- Blocks SQL Injection Attacks
 - Positive Security Model
- Block Suspicious Traffic
 - Out of Policy Transactions detected & blocked
- Learns White List
 - Automated creation of approved list of SQL command patterns on a per user basis
- Transparent
 - No changes to application required



The screenshot displays the MySQL Enterprise Firewall monitoring interface. At the top, it shows 'Enterprise Firewall' and 'Configured: 8 of 8'. Below this is a table with columns for 'Item' and 'Info'. The table lists several rules, each with a status icon (green for enabled, red for disabled) and a description. The rules include:

Item	Info
Account that overly Permissive White List	
Account Setting Excessive Percentage of Blocked Queries	
Account without Firewall Protection	
Excessive Number of Queries Blocked by Firewall	
Firewall Max Query Size Too Small	
Firewall Not Enabled	
Firewall Not Enabled	
Firewall Timeout Has Been Exceeded	

MySQL Enterprise Firewall monitoring

MySQL Enterprise Firewall

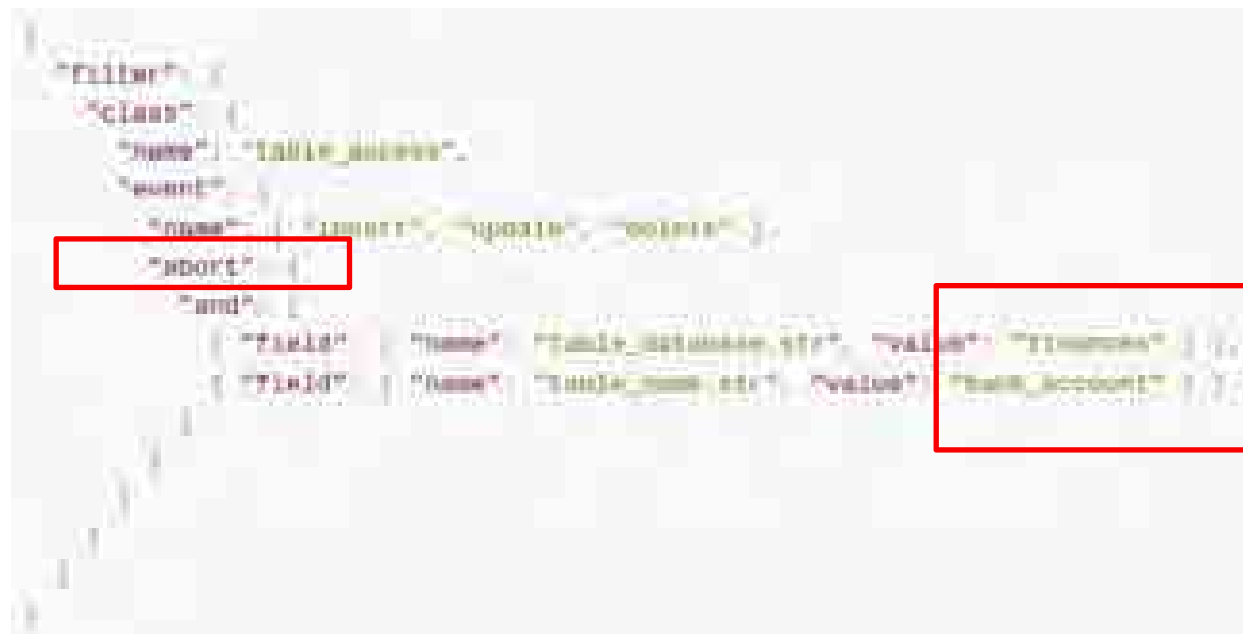
- **New! Feature in 5.7.20** – Combined Firewall/Audit Rules
 - Create more general allow/deny firewall rules using JSON syntax – using **abort=on**

Example - block execution of specific

- SQL statements (insert, update, delete)
- For a specific table (finances.bank_account)

Test rules

- By writing to audit log
- If data as expected change to firewall
 - add **“abort”**

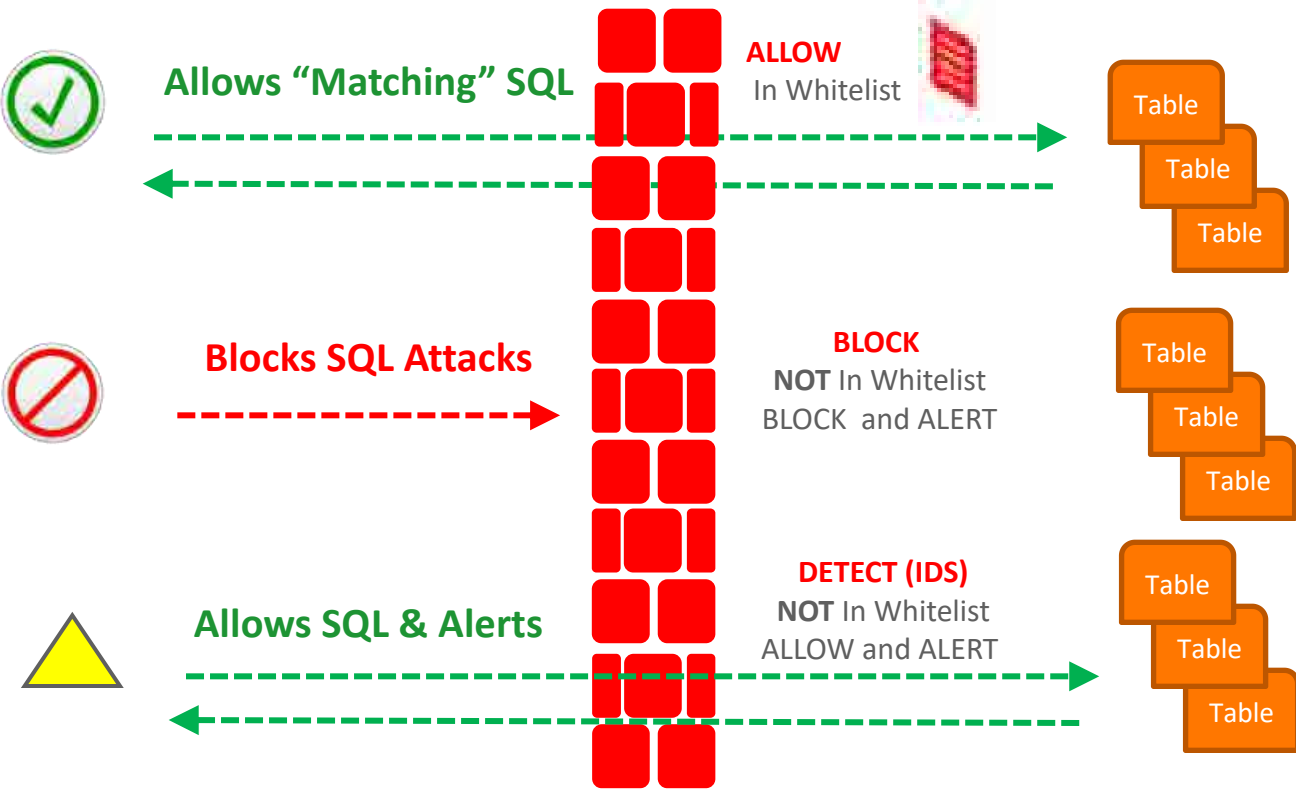


MySQL Enterprise Firewall: Operating Modes

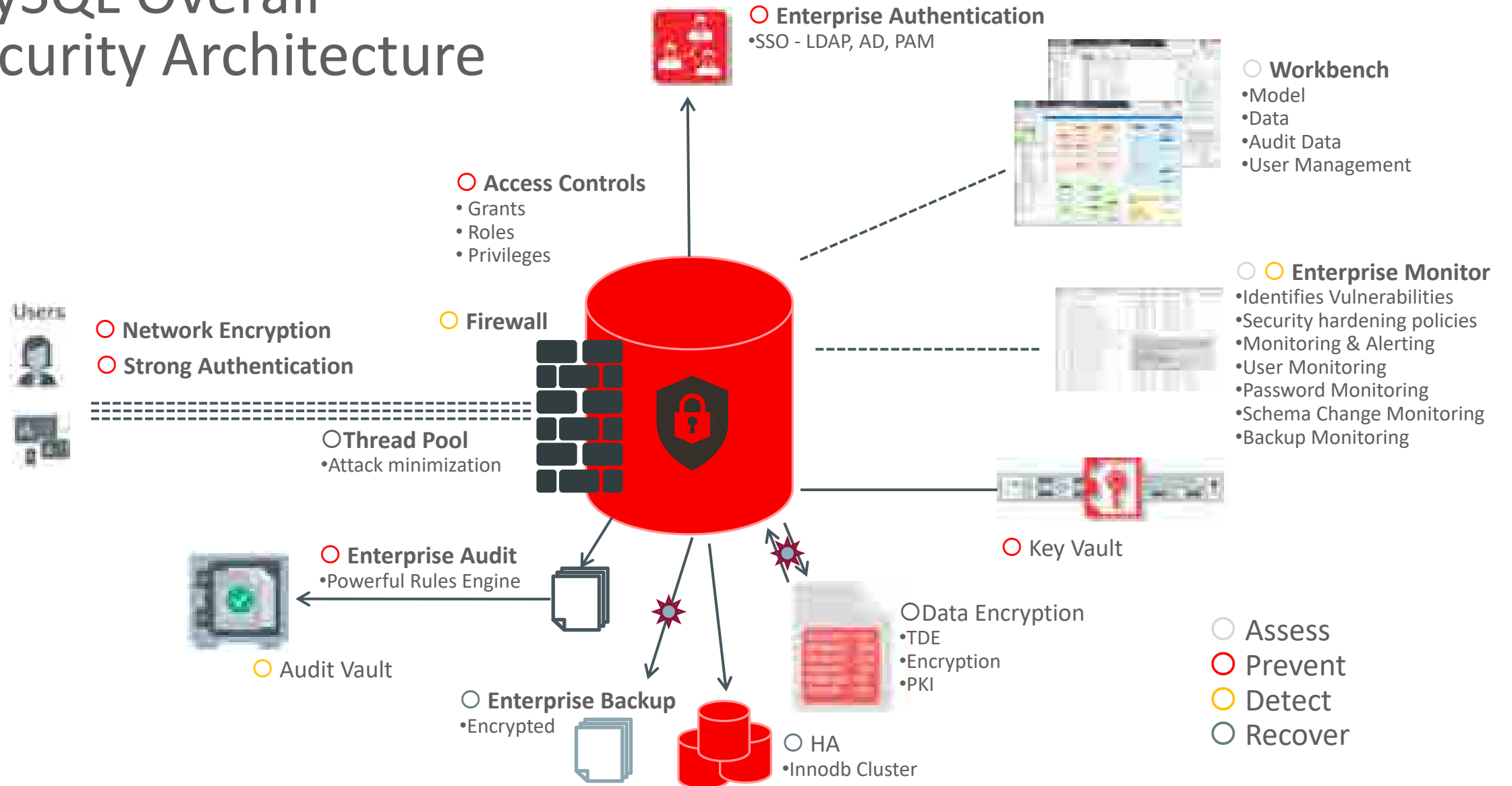
- 1** ALLOW – Execute SQL
- SQL Matches Whitelist

- 2** BLOCK – Block the request
- Not in Whitelist

- 3** DETECT – Execute SQL & Alert
- Not in Whitelist

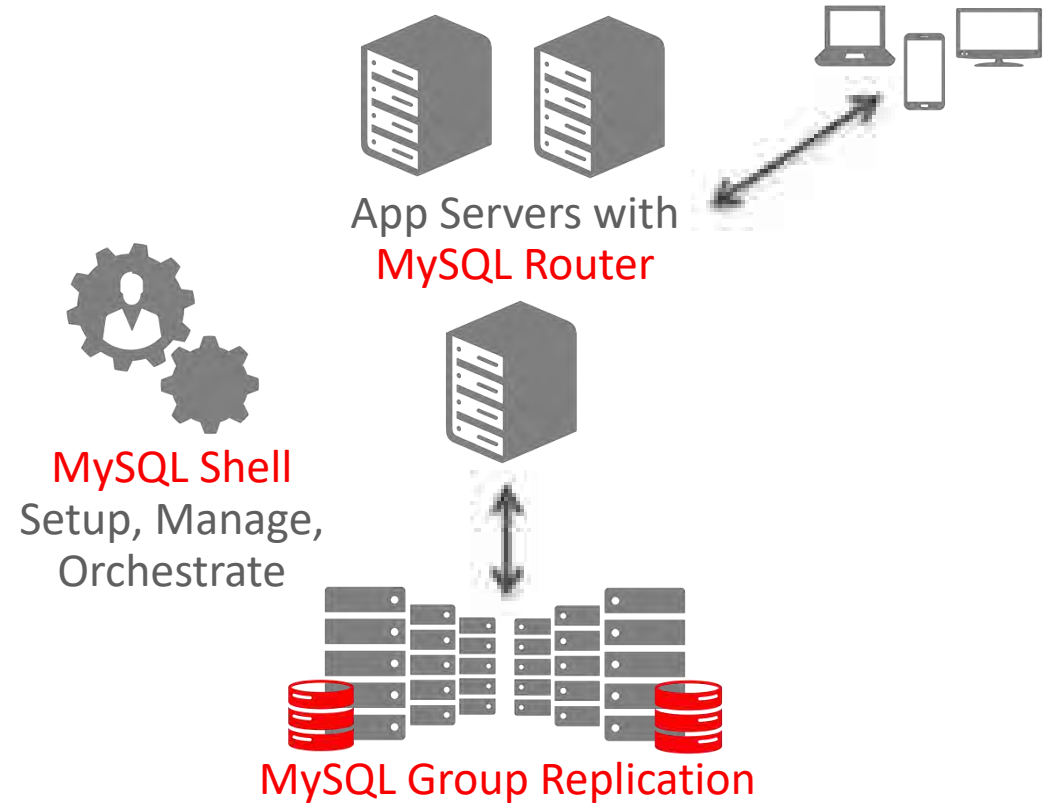


MySQL Overall Security Architecture



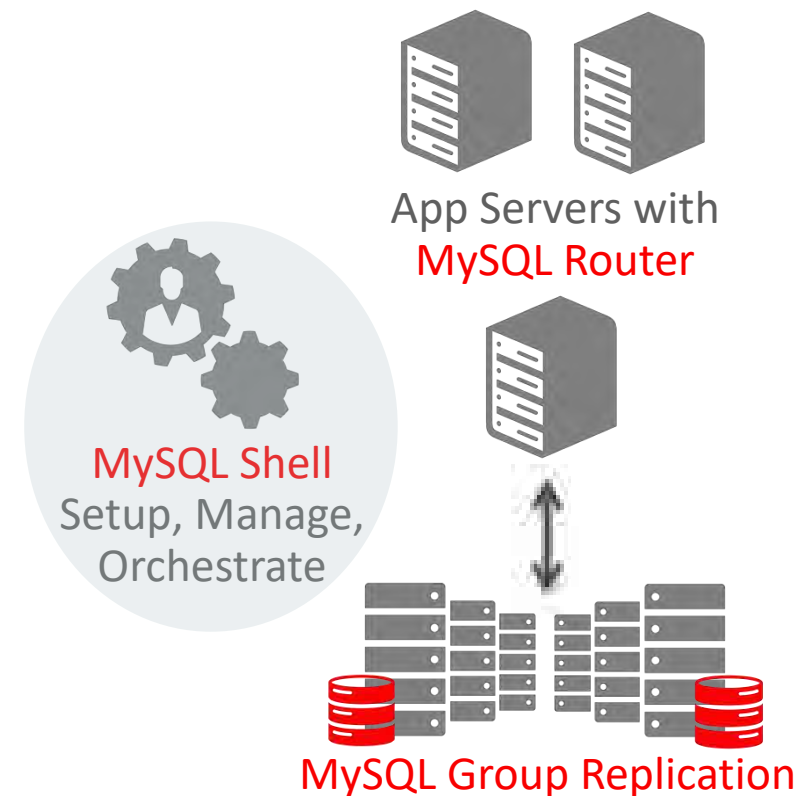
MySQL InnoDB Cluster

“High Availability becomes a core first class feature of MySQL!”



MySQL Shell: DBA Admin API

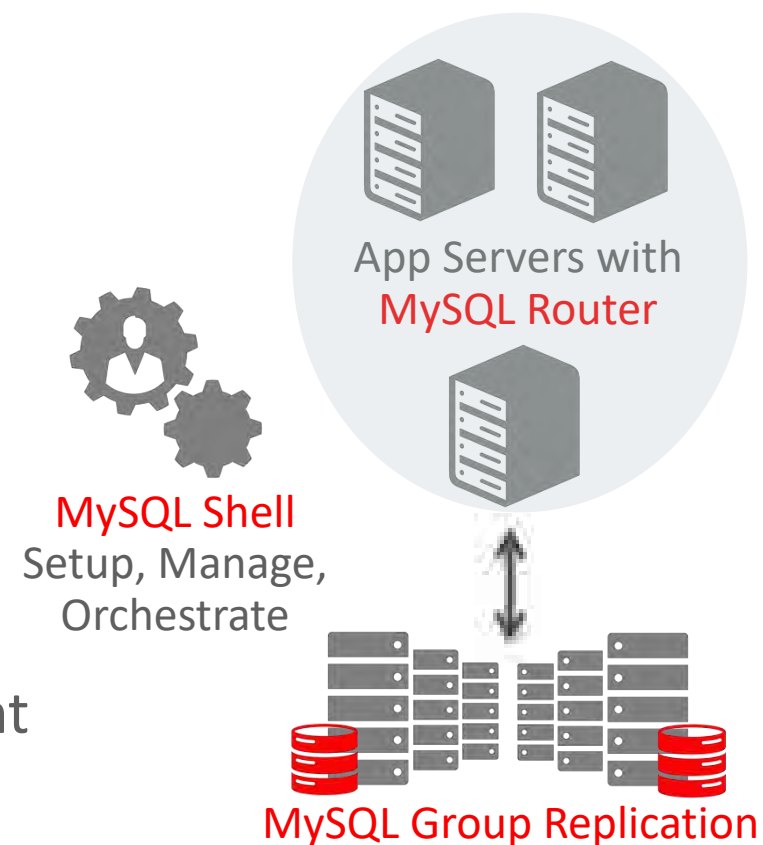
- The global variable 'dba' is used to access the MySQL AdminAPI
- `mysql-js> dba.help()`
- Perform DBA operations
 - Manage MySQL InnoDB clusters
 - Create clusters
 - Validate MySQL instances
 - Configure MySQL instances
 - Get cluster info
 - Modify clusters
 - and much more ...



MySQL Router: Client Routing and HA

- Native support for InnoDB clusters
 - Understands Group Replication topology
 - Utilizes metadata schema stored on each member
 - Bootstraps itself and sets up client routing for the InnoDB cluster
 - Allows for intelligent client routing into the InnoDB cluster
 - Supports multi-master and single primary modes
- Core improvements
 - Built-in keyring for easy and secure password management

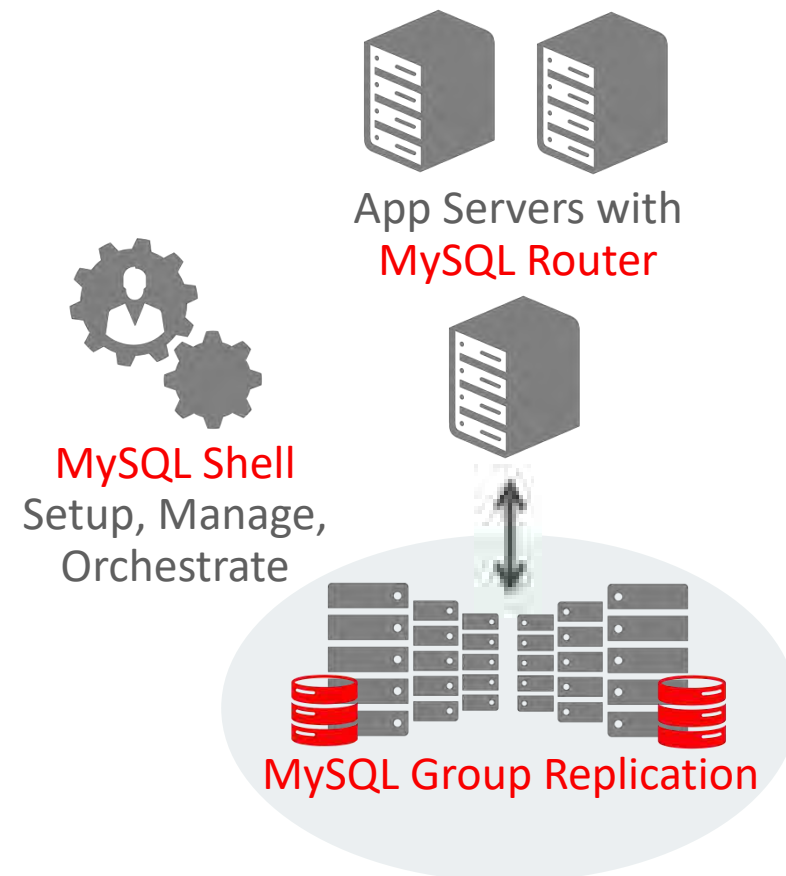
*“MySQL Router 2.1, with the new metadata_cache plugin, provides **transparent client connection routing and failover** into your InnoDB clusters!”*



MySQL Group Replication: Database HA

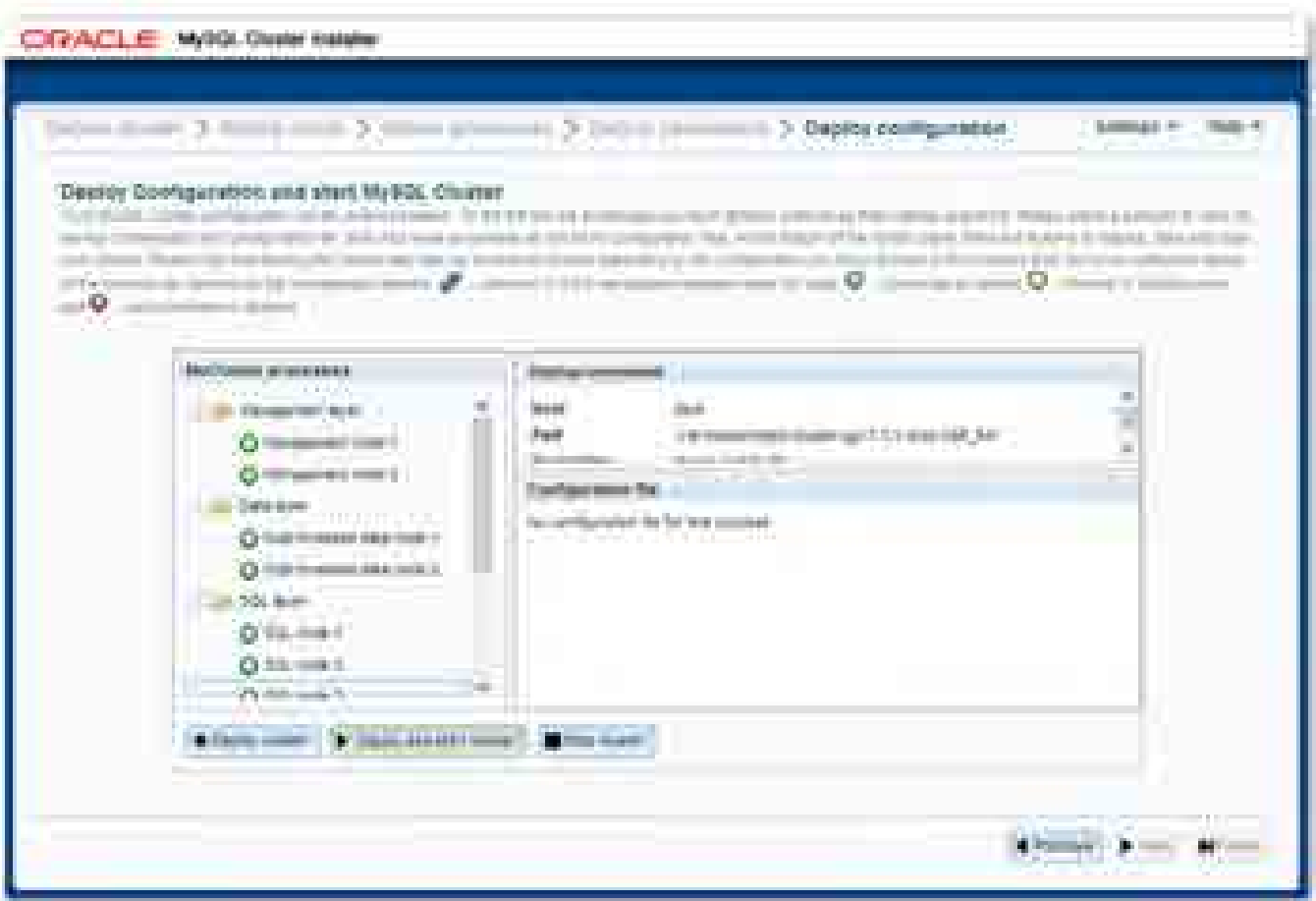
- Group Replication library
 - Implementation of [Replicated Database State Machine](#)
 - MySQL GCS is based on our home-grown [Paxos](#) implementation
 - Provides *virtually* synchronous replication for MySQL 5.7+
 - Guarantees eventual consistency
 - Automates operations
 - Conflict detection and resolution
 - Failure detection, fail-over, recovery
 - Group membership management and reconfiguration

*“Multi-master **update anywhere** replication plugin for MySQL with built-in **conflict detection and resolution**, **automatic distributed recovery**, and **group membership**.”*



MySQL Cluster Carrier Grade Edition

MySQL Cluster Auto-Installer



Enhancing DevOps Agility, Reducing Downtime



Automated Management

- Start / stop node or whole Cluster
- Online scaling
- Online reconfiguration
- Online upgrades
- Online backup & restore
- Import running Cluster
- Automatically tune and optimize the Cluster

Self-Healing

- Node monitoring
- Auto-recovery extended to SQL + mgmt nodes

HA Operations

- Cluster-wide configuration consistency
- Persistent configurations
- HA Agents

MySQL Cluster Manager – Installs Made Easy!

1. Download a single MCM and Cluster bundle from edelivery.oracle.com
2. Bootstrap and start the Cluster:

```
shell# mcmd --bootstrap
```

```
MySQL Cluster Manager 1.4.3 started
Connect to MySQL Cluster Manager by running "/opt/mcm/bin/mcm" -a NOVA:1862
Configuring default cluster 'mycluster'...
Starting default cluster 'mycluster'...
Cluster 'mycluster' started successfully
  ndb_mgmd NOVA:1186
  ndbmta NOVA
  ndbmtb NOVA
  mysqld NOVA:3306
  mysqld NOVA:3307
  ndbapi *
Connect to the database by running "/usr/bin/mysql" -h NOVA -P 3306 -u root
```


MySQL Cluster Manager – Upgrades Made Easy!

Without MySQL Cluster Manager

- 1 x preliminary check of cluster state
- 8 x ssh commands per server
- 8 x per-process stop commands
- 4 x scp of config files (2 x mgmd & 2 x mysqld)
- 8 x per-process start commands
- 8 x checks for started and re-joined processes
- 8 x process completion verifications
- 1 x verify completion of the whole cluster
- Excludes manual editing of each configuration file
- Total: **46 commands**
 - 2.5 hours of attended operation

With MySQL Cluster Manager



```
mcm> upgrade cluster  
      --package=7.5 mycluster;
```

- Total: **1 command**
 - Unattended Operation

Technical Support & MySQL Enterprise Oracle Certifications

MySQL Enterprise **Support**

- Largest MySQL engineering and support organization
- Backed by the MySQL developers
- World-class support, in 29 languages
- Hot fixes & maintenance releases
- 24x7x365
- Unlimited incidents
- Consultative support
- Global scale and reach

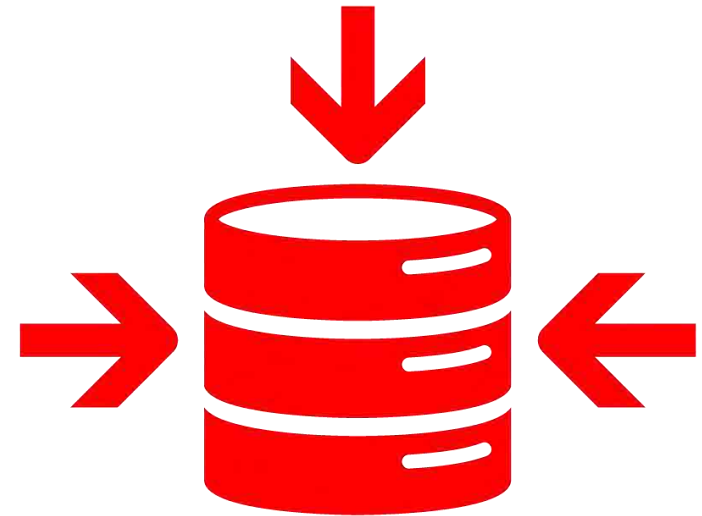


Get immediate help for any MySQL issue, plus expert advice

MySQL Consultative Support

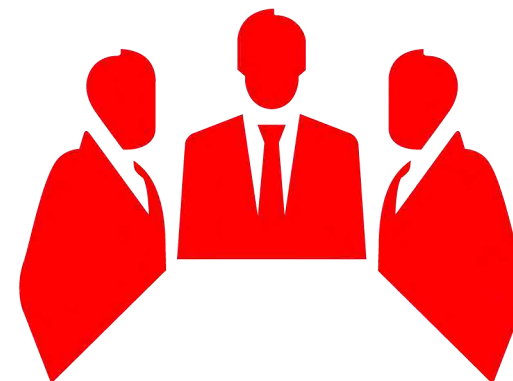
Make the Most of your Deployments

- Remote troubleshooting
- Replication review
- Partitioning review
- Schema review
- Query review
- Performance tuning
- ...and more



Work Directly with MySQL Engineering

- A direct relationship with the MySQL team
- The ability to participate in:
 - Product roadmaps
 - Product betas
 - Customer advisory boards
- Work closely with Support Engineers
 - Resolve issues faster
 - Request bug and feature request escalations



MySQL Enterprise **Oracle Certifications**

- Oracle Enterprise Manager
- Oracle Linux & Oracle VM
- Oracle Solaris
- Oracle Solaris Clustering
- Oracle Clusterware
- Oracle OpenStack
- My Oracle Support
- Oracle Fusion Middleware
- Oracle GoldenGate
- Oracle Audit Vault
- Oracle Database Firewall
- Oracle Secure Backup

MySQL integrates into your Oracle environment



The Bottom Line

Performance

- Performance at scale
- Monitoring and tuning

Peace of Mind

- Insurance
- Immediate help if/when needed

TCO

- Reduced risk of downtime
- Improved Productivity

Risks

- Security & regulatory compliance
- Contact with MySQL team

DevOps Agility

- Automated scaling & management
- Flexible, real-time backups

Customer Satisfaction

- Application performance
- Application uptime

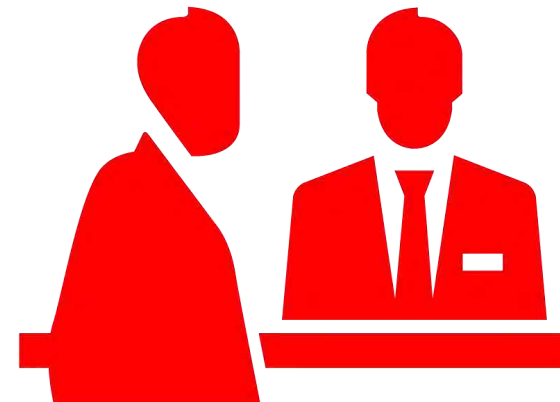
Get Started Today!

MySQL Enterprise Edition Trial



<http://www.mysql.com/trials/>

Contact a MySQL Sales Rep



<http://www.mysql.com/about/contact/>

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