



如何保护MySQL数据， 使MySQL更安全和稳定

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安全港声明

以下内容旨在阐明产品的整体方向。

该内容仅供参考，不可纳入任何合同。该信息不承诺提供任何资料、代码或功能，并且不应该作为制定购买决策的依据。

本文档所述的 Oracle 产品的任何特性或功能的开发、发行和时间规划均由 Oracle 自行决定。

稳定，数据安全

- 保护数据, 预防措施

- 加密 + TDE (透明数据加密)
- MySQL Enterprise Firewall
- 多份数据 - MySQL 复制, 备份/恢复
- 数据库的安全功能 (权限, 认证, 密码, SSL, ...)
- 数据审计

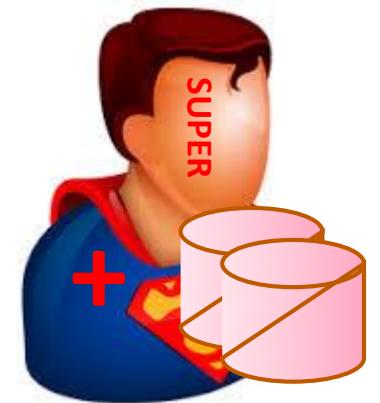
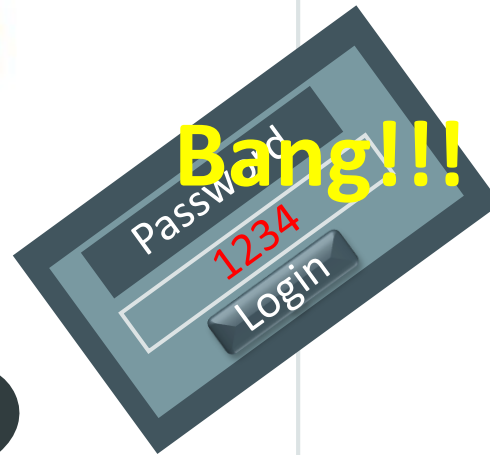
- 数据库的稳定

- 高可用, 多份数据, 没有数据丢失

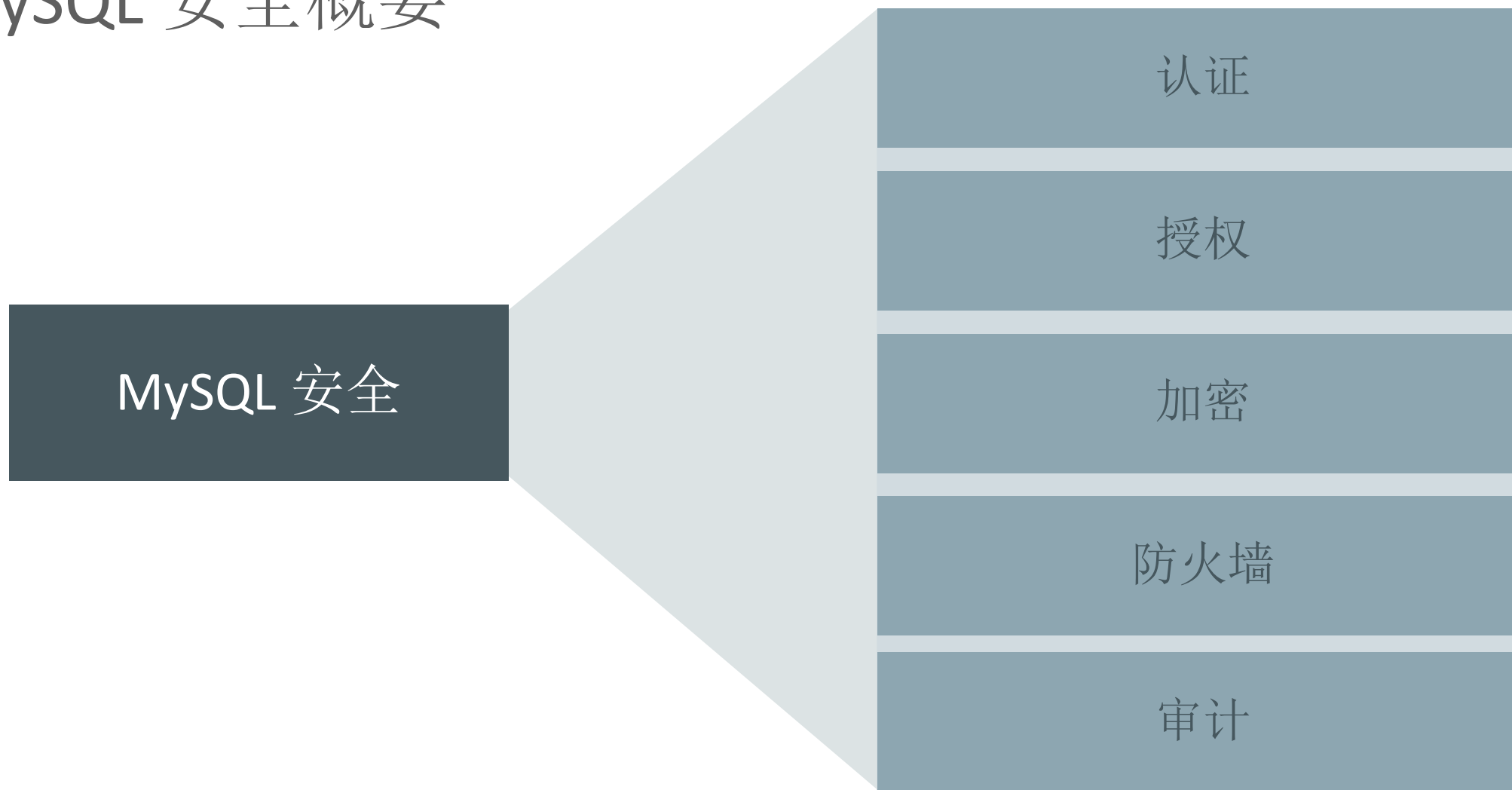
- MySQL 复制

- MySQL Replication – 异步 (异地场景)
- MySQL Replication – 半同步 MySQL 5.6 +
- MySQL Group Replication / MySQL InnoDB Cluster

数据库漏洞的原因 – 可能是。 。 。 。



MySQL 安全概要



MySQL权限

- 管理权限
- 数据库权限

[Login](#) | [Account Limits](#) | [Administrative Roles](#) | [Schema Privileges](#) | [Firewall Rules](#)

Role	Description
<input type="checkbox"/> DBA	grants the rights to perform all tasks
<input type="checkbox"/> MaintenanceAdmin	grants rights needed to maintain server
<input type="checkbox"/> ProcessAdmin	rights needed to assess, monitor, and kill any user proce...
<input type="checkbox"/> UserAdmin	grants rights to create users logins and reset passwords
<input type="checkbox"/> SecurityAdmin	rights to manage logins and grant and revoke server an...
<input type="checkbox"/> MonitorAdmin	minimum set of rights needed to monitor server
<input type="checkbox"/> DBManager	grants full rights on all databases
<input type="checkbox"/> DBDesigner	rights to create and reverse engineer any database sche...
<input type="checkbox"/> ReplicationAdmin	rights needed to setup and manage replication
<input type="checkbox"/> BackupAdmin	minimal rights needed to backup any database

Global Privileges

- ALTER
- ALTER ROUTINE
- CREATE
- CREATE ROUTINE
- CREATE TABLESPACE
- CREATE TEMPORARY TABLES
- CREATE USER
- CREATE VIEW
- DELETE
- DROP
- EVENT
- EXECUTE
- FILE
- GRANT OPTION
- INDEX
- INSERT
- LOCK TABLES
- PROCESS
- REFERENCES
- RELOAD
- REPLICATION CLIENT

MySQL 授权

- 管理权限
- 数据库权限
- 会话限制

DETAILS FOR ACCOUNT NEWUSER@70

Login Account Limits Administrative Roles Schema Privileges Firewall Rules

Max. Queries:	<input type="text" value="0"/>	Number of queries the account can execute within one hour.
Max. Updates:	<input type="text" value="0"/>	Number of updates the account can execute within one hour.
Max. Connections:	<input type="text" value="0"/>	The number of times the account can connect to the server per hour.
Concurrent Connections:	<input type="text" value="0"/>	The number of simultaneous connections to the server the account can have.

MySQL 授权

- 管理权限
- 数据库权限
- 会话限制
- 权限控制的精细化管理

Column privileges

User	Host	Scope	Select	Insert	Update	References
myuser2	localhost	tpcc.orders.o_id	Y	N	N	N

User	Host	Scope	Select	Insert	Update	Delete	Create	Drop	Grant	Refer...	Index	Alter	Creat...	Show...	Trigger
root	localhost	<global>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
mysqlbackup	localhost	<global>	Y	N	N	N	Y	N	N	N	N	Y	N	N	N
root	%	<global>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
tpcc	%	tpcc	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
tpcc	%	tpcc.orders	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y
myuser1	localhost	tpcc.orders	N	Y	N	N	N	N	N	N	N	N	N	N	N
myuser2	localhost	tpcc.orders	N	N	N	N	N	N	N	N	N	N	N	N	N

MySQL 授权

- 管理权限
- 数据库权限
- 会话限制
- 权限控制的精细化管理

The screenshot displays the MySQL Enterprise Configuration Manager interface. At the top, there are tabs for 'Login', 'Account Limits', 'Administrative Roles', 'Schema Privileges', and 'Firewall Rules'. The 'Administrative Roles' tab is active, showing a list of roles with checkboxes and descriptions. Below this, the 'DETAILS FOR ACCOUNT myuser1@70' window is open, showing the 'Account Limits' tab with fields for 'Max. Queries', 'Max. Updates', 'Max. Connections', and 'Concurrent Connections', each with a numeric input field and a descriptive text. Below the account limits, there are two tables: 'Column privileges' and 'Table privileges'.

Administrative Roles List:

Role	Description
<input type="checkbox"/> DBA	grants the rights to perform all tasks
<input type="checkbox"/> MaintenanceAdmin	grants rights needed to maintain server
<input type="checkbox"/> ProcessAdmin	rights needed to assess, monitor, and kill any user proce...
<input type="checkbox"/> UserAdmin	grants rights to create users logins and reset passwords
<input type="checkbox"/> SecurityAdmin	rights to manage logins and grant and revoke server an...
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<input type="checkbox"/> DBDesigner	rights to create and reverse engineer any database sche...
<input type="checkbox"/> ReplicationAdmin	rights needed to setup and manage replication
<input type="checkbox"/> BackupAdmin	minimal rights needed to backup any database

Account Limits for myuser1@70:

- Max. Queries: 0 (Number of queries the account can execute within one hour.)
- Max. Updates: 0 (Number of updates the account can execute within one hour.)
- Max. Connections: 0 (The number of times the account can connect to the server per hour.)
- Concurrent Connections: 0 (The number of simultaneous connections to the server the account can have.)

Column privileges:

User	Host	Scope	Select	Insert	Update	References
myuser2	localhost	tpcc.orders.o_id	Y	N	N	N

Table privileges:

User	Host	Scope	Select	Insert	Update	Delete	Create	Drop	Grant	Refer...	Index	Alter	Creat...	Show...	Trigger
root	localhost	<global>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
mysqlbackup	localhost	<global>	Y	N	N	N	Y	N	N	N	N	Y	N	N	N
root	%	<global>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
tpcc	%	tpcc	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
tpcc	%	tpcc.orders	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y
myuser1	localhost	tpcc.orders	N	Y	N	N	N	N	N	N	N	N	N	N	N
myuser2	localhost	tpcc.orders	N	N	N	N	N	N	N	N	N	N	N	N	N

MySQL 认证

- 内置认证
 - `mysql.user` 表记录用户和加密的密码
- MySQL Native, SHA 256 密码插件
 - `native` 使用 SHA1 或 SHA-256 插件通过散列为每个用户生成密码
- MySQL Enterprise Authentication
 - Microsoft Active Directory
 - Linux PAMs (Pluggable Authentication Modules)
 - 支持 LDAP 等等
- X.509
 - 服务器认证客户端证书

```

+-----+-----+-----+
| user      | plugin                | authentication_string |
+-----+-----+-----+
| root      | mysql_native_password | *1E97552497867D450D5C30F3441CD95BADF54751 |
| myproxy1  | mysql_no_login        | |
| root      | mysql_native_password | *1E97552497867D450D5C30F3441CD95BADF54751 |
| sha256user | sha256_password      | $5$R3yx~yCNF0d[N=gd$5P13/oobZ.iyx0QehsyRK.UIXo1hQX6m1JR8mBG/m89 |
+-----+-----+-----+
4 rows in set (0.00 sec)
    
```

MySQL 密码策略

- 无密码账户
 - 给每个账户设置密码防止越权使用
- 密码验证插件
 - 强制设置“强”密码
- 密码期限/轮换
 - 要求用户重设密码
- 锁定账户(v. 5.7)

MySQL Database 强化: 配置

- 审计行为
 - 使用 *Enterprise Audit*
 - 变更时暂时启动查询日志
 - 监控和定期检查
- 限制或禁用远程访问
 - 使用 “skip-networking” 或 bind-address=127.0.0.1
 - 远程访问限制主机IP
- 考虑更改默认端口
- 更改root用户名
- 禁用未授权读取本地文件
 - 禁用 LOAD DATA LOCAL INFILE
- 在非默认端口上运行 MySQL
 - 找到数据库更加困难
- 限制 MySQL OS 用户
- 连接加密
 - SSL /TLS 传送数据
 - 客户端和服务器的复制



MySQL 企业版

高级功能

- 可扩展性
- 高可用性
- 验证
- 审计
- 加密 + TDE
- 防火墙



管理工具

- 监控
- 备份
- 开发
- 管理
- 数据迁移



技术支持

- 技术支持
- 顾问支持
- Oracle 认证

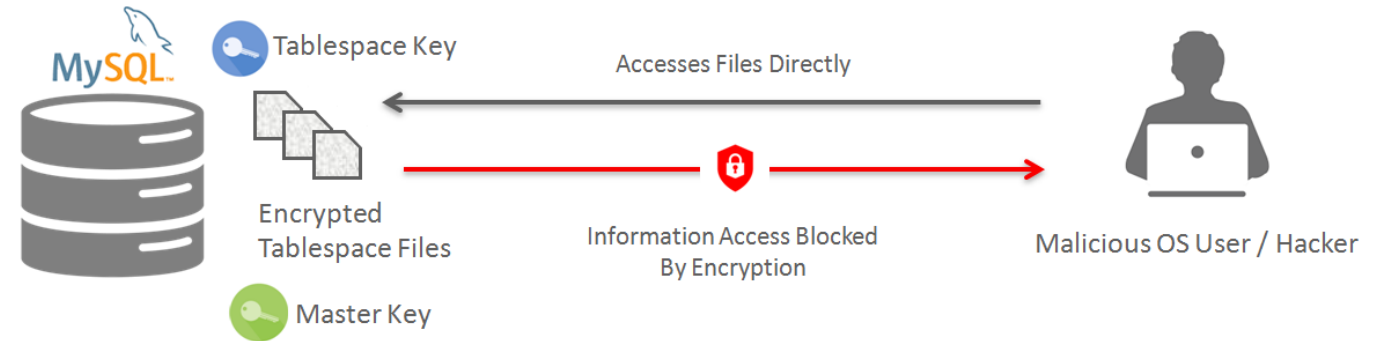


MySQL 企业版

- MySQL Enterprise **Authentication**
 - 外部认证模块
 - Microsoft AD, Linux PAMs
- MySQL Enterprise **Encryption**
 - 公钥/私钥加密
 - 非对称加密
 - 数字签名, 数据验证
- MySQL Enterprise **Firewall**
 - 阻止 SQL 注入攻击
 - 检测入侵
- MySQL Enterprise **Audit**
 - 审计用户行为, 合规审计
- MySQL Enterprise **Monitor**
 - 变更数据库设置, 用户权限, 数据库定义, 密码
- MySQL Enterprise **Backup**
 - 安全备份, AES 256 加密
- MySQL Enterprise **Transparent Data Encryption**
 - 据存储加密 – 对应用访问是透明
 - AES 256加密
 - 密钥管理

MySQL Enterprise Transparent Data Encryption

- 跟强的安全性
 - 强化OS对数据安全控制
 - 易于使用和管理
 - 对数据库用户/应用-透明访问
- 满足安全性和监管需求
 - 适合需要加密的场景
 - 医疗，财务服务，政府等等。
- 保护和管理密钥
 - 支持标准KMIP 1.2协议
 - 支持Oracle密钥库和其他密钥存储库



MySQL Enterprise Monitor

- 执行MySQL安全最佳实践
 - 识别漏洞
 - 评估当前的设置与安全性加强策略
- 监控 & 警告
 - 监控用户
 - 监控密码
 - 监控模式变更
 - 监控备份
 - 配置管理
 - 配置优化建议
- 集中用户管理

Item	Info	Coverage	Schedule	Event Handling	Parameters
Account Has An Overly Broad Host Specifier	?	100% (103/103)	5m	0 2 0	""
Account Has Global Privileges	?	100% (103/103)	5m	0 2 0	""
Account Has Old Insecure Password Hash	?	100% (103/103)	6h	0 2 0	""
Account Has Strong MySQL Privileges	?	100% (103/103)	5m	0 2 0	""
Account Requires Unavailable Authentication Plugins	?	100% (103/103)	6h	1 3 0	""
Insecure Password Authentication Option Is Enabled	?	100% (103/103)	6h	0 2 0	"ON"
Insecure Password Generation Option Is Enabled	?	100% (103/103)	6h	0 2 0	1
LOCAL Option Of LOAD DATA Statement Is Enabled	?	100% (103/103)	5m	0 2 0	"ON"
Non-Authorized User Has DB, Table, Or Index Privileges On All Databases	?				
Non-Authorized User Has GRANT Privileges On All Databases	?				
Non-Authorized User Has Server Admin Privileges	?				
Policy-Based Password Validation Does Not Perform Dictionary Checks	?				
Policy-Based Password Validation Is Weak	?				
Policy-Based Password Validation Not Enabled	?				
Privilege Alterations Detected: Privileges Granted	?				
Privilege Alterations Detected: Privileges Revoked	?				
Privilege Alterations Have Been Detected	?				
Root Account Can Login Remotely	?	100% (103/103)	5m	0 2 0	0
Root Account Without Password	?	100% (103/103)	5m	1 3 0	0
SHA-256 Password Authentication Not Enabled	?	100% (103/103)	6h	0 2 0	"ACTIVE"
Server Contains Default "test" Database	?	100% (103/103)	5m	0 3 0	"test"

Problem Description
 When users create weak passwords (e.g. 'password' or 'abcd') it compromises the security of the server, making it easier for unauthorized people to guess the password and gain access to the server. Starting with MySQL Server 5.6, MySQL offers the 'validate_password' plugin that can be used to test passwords and improve security. With this plugin you can implement and enforce a policy for password strength (e.g. passwords must be at least 8 characters long, have both lowercase and uppercase letters, and contain at least one special nonalphanumeric character).

Links and Further Reading
[MySQL Manual: The Password Validation Plugin](#)
[MySQL Manual: Keeping Passwords Secure](#)
[Blog: New 5.6 password verification plugin \(and impacts to PASSWORD\(\) function\)](#)
[Blog: Implementing a password policy in MySQL](#)

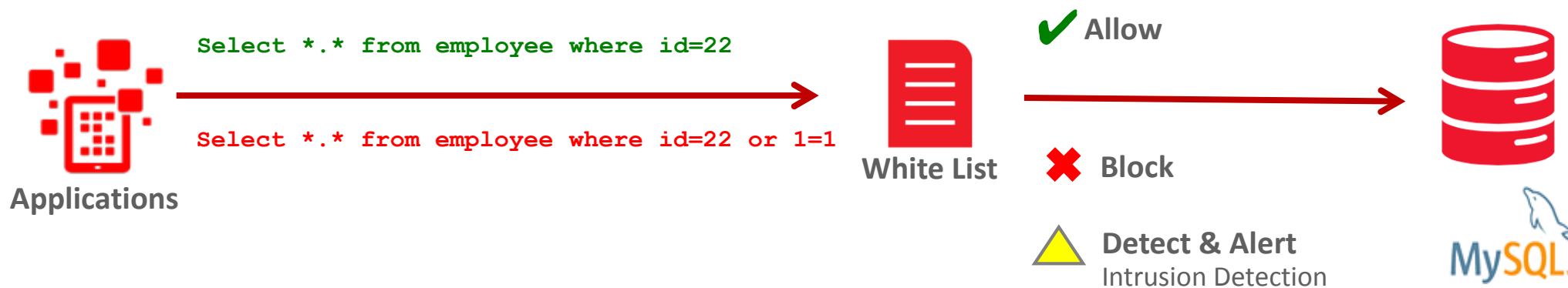
Expression
 %status% == "ACTIVE" && %validate_password_policy% == THRESHOLD

"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 Firewall

- 阻止 SQL 注入攻击
 - 允许: 匹配白名单的SQL语句
 - 阻止: 白名单中不存在的SQL语句
- 入侵检测系统
 - 检测: 白名单中不存在的SQL语句
 - 执行SQL语句并且发出警告



MySQL Enterprise Firewall 详细

- 防火墙操作作用于用户级别
- 每个用户的可设置状态如下

—RECORDING `call mysql.set_firewall_mode ('fwuser@localhost', 'RECORDING');`

—PROTECTING `call mysql.set_firewall_mode ('fwuser@localhost', 'PROTECTING');`

—DETECTING `call mysql.set_firewall_mode ('fwuser@localhost', 'DETECTING');`

—OFF `call mysql.set_firewall_mode ('fwuser@localhost', 'OFF');`

MySQL Enterprise Firewall: 每个用户的白名单

The screenshot shows the MySQL Enterprise Firewall Administration console. The 'Users and Privileges' section is active, displaying a list of user accounts on the left and detailed firewall rules for the 'jsmith@%' account on the right.

User	From Host	FW
(!) <anonymous>	%	OF
janedoe	%	OF
jsmith	%	RE
mfrank	%	OF
mysqlbackup	localhost	OF
newuser	%	OF
robsmith	%	OF
root	%	OF
root	localhost	OF
root	::1	OF
root	127.0.0.1	OF
webuser	localhost	OF

Details for account jsmith@%

Mode: RECORDING

Active rules (64):

```
SHOW FIELDS FROM `sakila`.`category`
SHOW FULL TABLES FROM `sakila`
SELECT `st`, * FROM `performance_schema`.`events_stages_history_long` `st` WHERE `st`.`nesting_event_id` = ?
EXPLAIN `mysql`.`db`
SHOW FULL TABLES FROM `actor`
SHOW FIELDS FROM `sakila`.`actor_info`
SHOW SESSION VARIABLES LIKE ?
SHOW FIELDS FROM `sakila`.`city`
SHOW FIELDS FROM `sakila`.`film`
SHOW FIELDS FROM `sakila`.`language`
SHOW INDEXES FROM `sakila`.`address`
SHOW GLOBAL VARIABLES
SELECT NAME, TYPE FROM `mysql`.`proc` WHERE `Db` = ?
```

Rules being recorded (64):

```
SHOW FIELDS FROM `sakila`.`category`
SHOW FULL TABLES FROM `sakila`
SELECT `st`, * FROM `performance_schema`.`events_stages_history_long` `st` WHERE `st`.`nesting_event_id` = ?
EXPLAIN `mysql`.`db`
SHOW FULL TABLES FROM `actor`
SHOW FIELDS FROM `sakila`.`actor_info`
SHOW SESSION VARIABLES LIKE ?
SHOW FIELDS FROM `sakila`.`city`
SHOW FIELDS FROM `sakila`.`film`
SHOW FIELDS FROM `sakila`.`language`
SHOW INDEXES FROM `sakila`.`address`
SHOW GLOBAL VARIABLES
SELECT NAME, TYPE FROM `mysql`.`proc` WHERE `Db` = ?
SELECT * FROM `sakila`.`actor_info` LIMIT ?, ...
SHOW FIELDS FROM `sakila`.`customer_list`
SHOW FIELDS FROM `sakila`.`sales_by_film_category`
SHOW FIELDS FROM `sakila`.`actor`
SELECT `st`, * FROM `performance_schema`.`events_statements_current` `st` JOIN `performance_schema`.`threads` `thr` ON `thr`.`thread_id` = `st`.`thread_id` WHERE `thr`.``
SELECT CURRENT_USER ()
SHOW FIELDS FROM `sakila`.`sales_by_store`
```

MySQL Enterprise Firewall: 保护模式下，阻止SQL会发生什么？

- 客户端应用会发生错误

```
mysql> SELECT first_name, last_name FROM customer WHERE customer_id = 1 OR TRUE;
```

```
ERROR 1045 (28000): Statement was blocked by Firewall
```

```
mysql> SHOW DATABASES;
```

```
ERROR 1045 (28000): Statement was blocked by Firewall
```

```
mysql> TRUNCATE TABLE mysql.user;
```

```
ERROR 1045 (28000): Statement was blocked by Firewall
```

- 记录到错误日志
- 增量计数器

将 MySQL 集成在既有的女生基础设施

MySQL Enterprise Authentication

- 与集中认证架构集成
 - 集中账号管理
 - 密码策略管理
 - 群组& 角色
- PAM (Pluggable Authentication Modules)
 - 标准接口 (Unix, LDAP, Kerberos, others)
 - Windows
 - 使用原生 Windows 服务 - Windows Active Directory 或本地主机



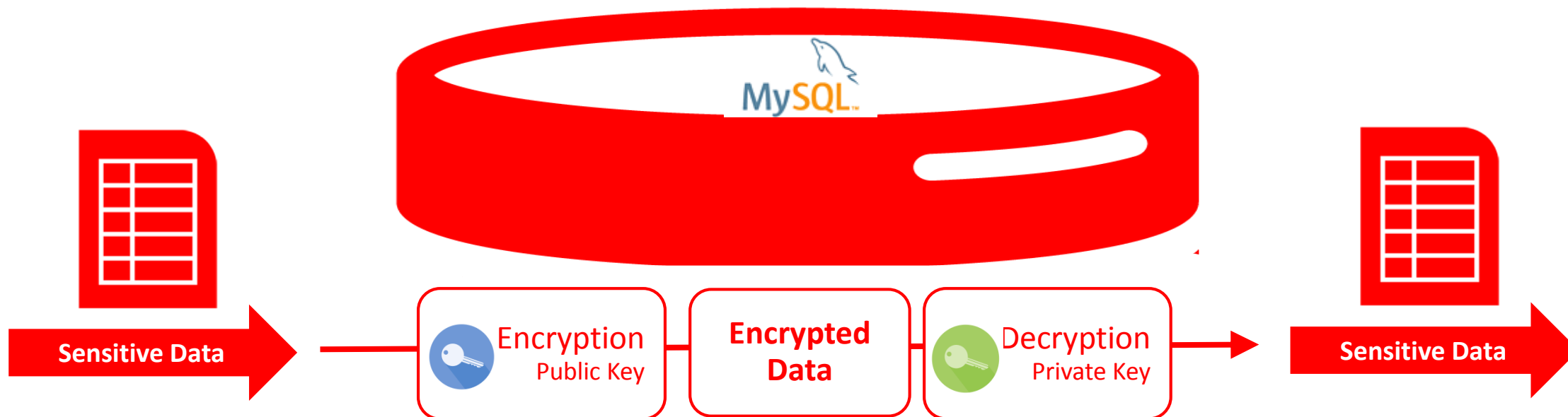
MySQL Enterprise Encryption

- MySQL 加密函数
 - 对称加密AES256 (所有版本)
 - 公钥 / 非对称加密 – RSA
- 密钥管理函数
 - 生成公钥和私钥
- 签名和数据验证函数
 - 密码散列数字签名, 验证&确认 – RSA, DSA



MySQL Enterprise Encryption

MySQL内加密解密



私钥公钥对

- 使用MySQL Enterprise Encryption 函数生成
- 使用外部生成(e.g. OpenSSL)

MySQL Enterprise Audit

```
mysql> INSTALL PLUGIN audit_log SONAME 'audit_log.so';
```

```
mysql> SHOW VARIABLES LIKE 'audit_log%';
```



audit_log_buffer_size	1048576
audit_log_connection_policy	ALL
audit_log_current_session	OFF
audit_log_exclude_accounts	
audit_log_file	audit.log
audit_log_flush	OFF
audit_log_format	NEW
audit_log_include_accounts	
audit_log_policy	ALL
audit_log_rotate_on_size	0
audit_log_statement_policy	ALL
audit_log_strategy	ASYNCHRONOUS

1. DBA enables Audit plugin

```
shell> mysql -h joeshost -u joe -p
Enter password: *****
```



```
mysql> SELECT * FROM joes_table;
```

FIRST_NAME	LAST_NAME
Joe	User

2. User Joe connects and runs a query



3. Joe's connection & query logged

```
<?xml version="1.0" encoding="UTF-8"?>
<AUDIT>
  <AUDIT_RECORD
    TIMESTAMP="2012-08-02T14:52:12"
    NAME="Audit"
    SERVER_ID="1"
    VERSION="1"
    STARTUP_OPTIONS="--port=3306"
    OS_VERSION="i686-Linux"
    MYSQL_VERSION="5.5.28-debug-log"/>
  <AUDIT_RECORD
    TIMESTAMP="2012-08-02T14:52:41"
    NAME="Connect"
    CONNECTION_ID="1"
    STATUS="0"
    USER="joe"
    PRIV_USER="root"
    OS_LOGIN=""
    PROXY_USER=""
    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>
```


新发布的功能 – 审计过滤

- 新加“Event” 模式
 - 更细化方法定义
- 简单，强大功能
 - 以 JSON 定义

Event class	Event subclass
GENERAL	STATUS
CONNECTION	CONNECT
	CHANGE_USER
	DISCONNECT
TABLE_ACCESS	READ
	INSERT
	UPDATE
	DELETE



JSON 定义- 对表的审计

对 bank_database.accounts 的DELETE/INSERT/UPDATE操作审计

```
{ "filter": {
  "class": {
    "name": "table_access",
    "event": {
      "name": [ "delete", "insert", "update" ],
      "log": {
        "and": [ { "field": { "name": "table_database.str",
                              "value": "bank_database" } },
                  { "field": { "name": "table_name.str",
                              "value": "accounts" } } ]
      }
    }
  }
}
```

场景1：

对app_user01 停用审计，其他用户打开审计

```
Mysql>create user app_user01 identified by 'Mysql@1234';  
Mysql>grant all on *.* to 'app_user01';
```

```
Mysql>SELECT audit_log_filter_set_filter('all_enabled', '{"filter": {"log": true } }') AS 'Result';
```

```
Mysql>SELECT audit_log_filter_set_filter('all_disabled', '{"filter": {"log": false } }') AS 'Result';
```

```
Mysql>SELECT audit_log_filter_set_user('%', 'all_enabled') AS 'Result';
```

```
Mysql> SELECT audit_log_filter_set_user('app_user01@%', 'all_disabled') AS 'Result';
```

场景2： 对appdb停用审计

```
select audit_log_filter_set_filter ('log_appdb', ' "filter": {  
  "class": [ {  
    "name": "table_access",  
    "event": { "name" : ["insert", "update", "delete", "read"],  
      "log" : { "field" : {  
        "name": "table_database.str", "value": "appdb"  
      } } } },  
    { "name": "general", "log": false }  
  ] } } ');
```

```
SELECT audit_log_filter_set_user('%', 'log_appdb') AS 'Result';
```

MySQL Enterprise Backup

- InnoDB在线备份 (可编辑脚本接口)
- 全备, 增量, 部分备份(包含压缩)
- 加密 (AES 256)
- 时间点, 完整, 部分恢复
- 状态元数据, 进度, 历史记录
- 扩展 – 高性能/无限制的数据库容量
- Windows, Linux, Unix
- Oracle认证的Oracle Secure Backup , NetBackup, Tivoli, 等等

MySQL Workbench

MySQL57-3357 x

File Edit View Query Database Server Tools Scripting Help

Navigator

- MANAGEMENT
 - Server Status
 - Client Connections
 - Users and Privileges
 - Status and System Variables
 - Data Export
 - Data Import/Restore
- INSTANCE
 - Startup / Shutdown
 - Server Logs
 - Options File
- PERFORMANCE
 - Dashboard
 - Performance Reports
 - Performance Schema Setup
- MYSQL ENTERPRISE
 - Audit Inspector
 - Firewall
 - Online Backup**
 - Restore

Query 1 Administration - Online Backup x

MySQL Enterprise

MySQL Enterprise Backup

Backup Profile Name: Full Data / Not Scheduled

Comments:

Schedule Contents Options **Advanced**

Manually specify additional options to be passed directly to the MySQL Enterprise Backup command.
NOTE: configured values are not validated in any way.

```
encrypt
key=23D987F3A047B475C900127148F9E0394857983645192874A2B3049570C12A34
```

Management Schemas

Information

MySQL Workbench

MySQL57-3357 x

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MYSQL ENTERPRISE

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Query 1 Administration - Online Backup x

MySQL Enterprise Backup

Backup Jobs configured for this MySQL Instance Backup Job Details

Use right-click context menu for more options

Backup Job	Latest Backup	Next Full Backup
backup (full data)	in the last hour	2017-05-10 10:00:00
backup2 (full data)	n/a	

Target Host: CHOMA 4.1.0

Directory: C:\Program Files\MySQL\MySQL Enterprise Backup\bin

Repository: C:\MySQL\Backup

Size: 22.95 GB

Backup Frequency: Never

Backup Type: Never

Backup Schedule: not scheduled

Backup Location: not scheduled

New Job Configure Job

Context Menu:

- New Job
- Configure Job...
- Delete Job
- Execute Backup
- Execute Incremental Backup
- Execute Backup to Image File...
- Copy Backup Command to Clipboard

Management Schemas

Information



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MYSQL ENTERPRISE

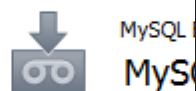
- Audit Inspector
- Firewall
- Online Backup
- Restore

Management Schemas

Information

Query 1

Admini



MySQL

MyS

Backup Profile Nam

Comments:

Schedule Conte

Manually spec
NOTE: configencrypt
key=23D987

Backup log for C:\MySQLBackupHome\backup\2017-04-16\my3357.img.log

MySQL Enterprise Backup version 4.1.0 Windows-6.2-AMD64 [Wed 03/01/2017]
Copyright (c) 2003, 2017, Oracle and/or its affiliates. All Rights Reserved.

```
170406 16:03:11 MAIN  INFO: A thread created with Id '436'
170406 16:03:11 MAIN  INFO: Starting with following command line ...
C:\Program Files\MySQL\MySQL Enterprise Backup 4.1\mysqlbackup.exe
--defaults-file=C:\MySQLBackupHome\2b779930-1a9f-11e7-95d9-b86b2334ab78.cnf
--backup-dir=C:\MySQLBackupHome\backup\2017-04-16\my3357.img
--backup-image=C:\MySQLBackupHome\backup\2017-04-16\my3357.img.mbi
--show-progress=stdout backup-to-image
```

```
170406 16:03:11 MAIN  INFO:
170406 16:03:11 MAIN  INFO: MySQL server version is '5.7.17-enterprise-commercial-advanced-log'
170406 16:03:11 MAIN  INFO: MySQL server compile os version is 'Win64'
170406 16:03:11 MAIN  INFO: Got some server configuration information from running server.
```

```
170406 16:03:11 MAIN  INFO: Server system variable 'old_alter_table' was set to '0'. Setting it to '1'.
IMPORTANT: Please check that mysqlbackup run completes successfully.
At the end of a successful 'backup-to-image' run mysqlbackup
prints "mysqlbackup completed OK!".
```

```
170406 16:03:11 MAIN  INFO: MEB logfile created at C:\MySQLBackupHome\backup\2017-04-16\my3357.img\meta\MEB_2017-04-06.16-03-11_image_backup.log
```

Server Repository Options:

```
datadir                = C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\
innodb_data_home_dir   =
innodb_data_file_path  = ibdata1:12M:autoextend
innodb_log_group_home_dir = C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\
innodb_log_files_in_group = 2
innodb_log_file_size   = 50331648
innodb_undo_directory  = C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\
innodb_undo_tablespaces = 0
innodb_undo_logs        = 128
innodb_buffer_pool_filename = ib_buffer_pool
innodb_page_size        = 16384
```

Close

Backup : MySQL Enterprise... x

https://localhost:18443/Backup.action?_x=x&assetSelection=[{"assetClass":"%3A"com.mysql.eto

ORACLE MySQL Enterprise Monitor

1 3 0 0 13 admin 9

Dashboards Events Query Analyzer Reports & Graphs Refresh: Off

Instance Backup Overview

All Current Status History Apr 6, 2017 2:27:56 pm x

Instance: CHOMA-HK2:3357, Backup ID: 14914600516869295

Backup Status

Backup Type: FULL	Exit State: SUCCESS
Start Time: Apr 6, 2017 2:27:31 pm (an hour ago)	End Time: Apr 6, 2017 2:27:56 pm (an hour ago)
Start LSN: 3637416960	End LSN: 3637417429
Binlog File: CHOMA-HK2-bin.000009	Binlog Position: -1
Backup Destination: C:\MySQLBackupHome\backup\2017-04-16	

Backup Configuration

Backup Format: IMAGE	MySQL Data Dir: C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\
Compression Level: 1	Engines: CSV:InnoDB:MEMORY:MyISAM:PERFORMANCE

InnoDB Configuration

Data File Path: ibdata1:12M:autoextend	File Format: Barracuda
Log Files in Group: 2	Log File Size: 48 MiB
Data Home Directory:	Log Group Home Directory: C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\

Backup Command

```
mysqlbackup --defaults-file=c:\MySQLBackupHome\e7d5404f-0947-11e7-86bf-b86b2334ab78.cnf --skip-unused-pages --backup-image=c:\MySQLBackupHome\backup\2017-04-16\2017-04-16.img --backup-dir=C:\MySQLBackupHome\backup\2017-04-16 --compress --skip-unused-pages --no-locking backup-to-image
```

Progress Log

Copyright © 2005, 2017, Oracle and/or its affiliates. All rights reserved. 3.3.3.1199 - CHOMA-HK2 () - Apr 6, 2017 3:53:29 pm HKT (Up Since: 1 hour, 36 minutes ago) - About

```
[mysqld]
datadir = C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\

[mysqlbackup]
datadir = C:\ProgramData\MySQL\MySQL Server 5.7\Data57a\
innodb_data_home_dir =
backup_dir = C:\MySQLBackupHome\backup
incremental_backup_dir = C:\MySQLBackupHome\backup\inc
incremental_base = history:last_backup
comments =

encrypt
key=23D987F3A047B475C900127148F9E0394857983645192874A2B3049570C12A34
```



更安全的数据库

采用MySQL 企业版

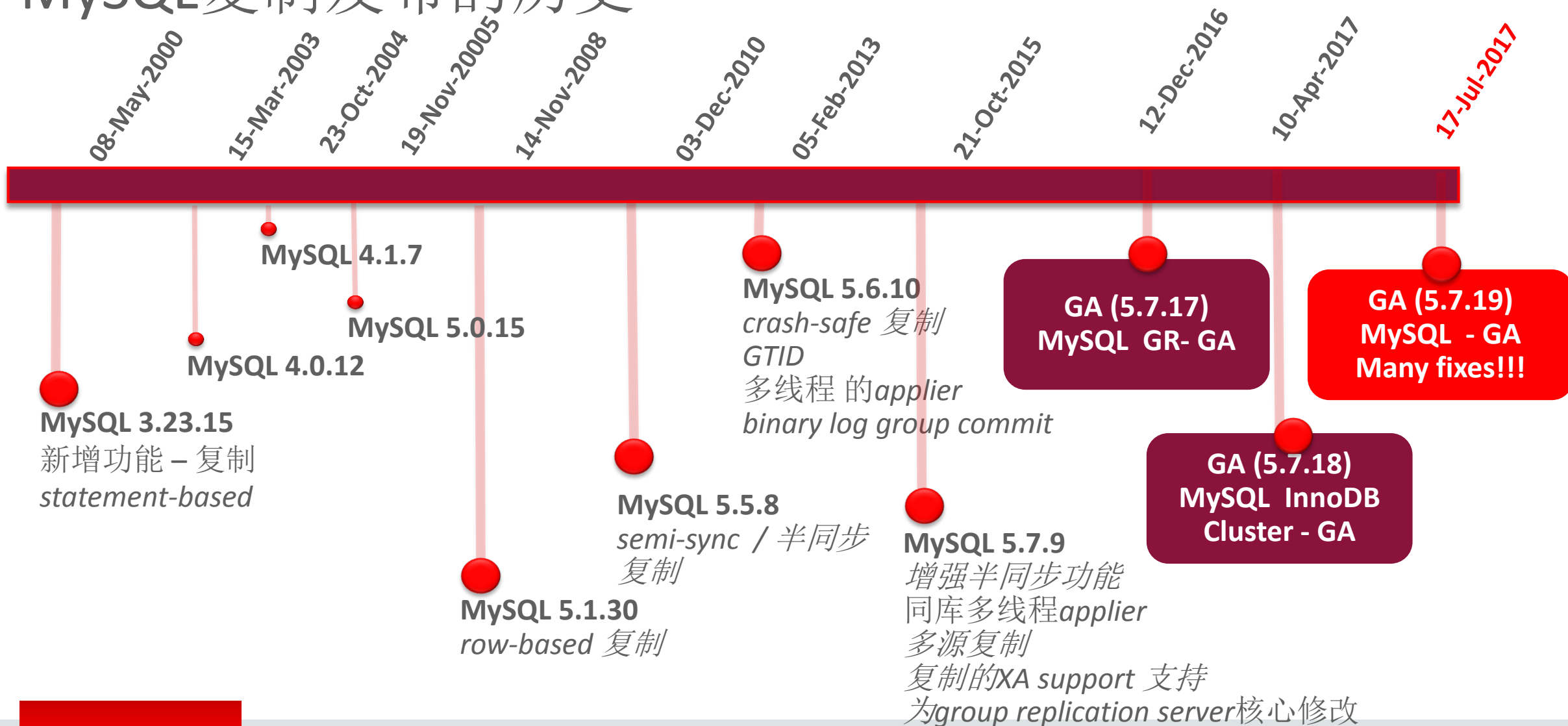
- MySQL Enterprise **Authentication**
 - 验证模块插件
Microsoft AD, Linux PAM, LDAP
- MySQL Enterprise **Encryption**
 - 公共/私人密钥加密
 - 非对称加密
 - 数码签名, 数据验证
- MySQL Enterprise **Firewall**
 - 阻止SQL注入攻击
 - 入侵检测
- MySQL Enterprise **Audit**
 - 用户活动审计, 合规性
- MySQL Enterprise **Monitor**
 - 数据库配置, 用户权限, 数据库架构, 空密码通知
- MySQL Enterprise **Backup**
 - 以AES 256加密- 保护备份数据
- MySQL Enterprise **TDE**
 - AES 256 加密
 - 密钥管理



稳定，数据安全

- 保护数据, 预防措施
 - 加密 + TDE (透明数据加密)
 - MySQL Enterprise Firewall
 - 多份数据 - MySQL 复制, 备份/恢复
- 数据库的稳定
 - 高可用, 多份数据, 没有数据丢失
 - 路由负载
 - MySQL 复制
 - MySQL Replication – 异步 (异地场景)
 - MySQL Replication – 半同步 MySQL 5.6 +
 - **MySQL Group Replication / MySQL InnoDB Cluster**

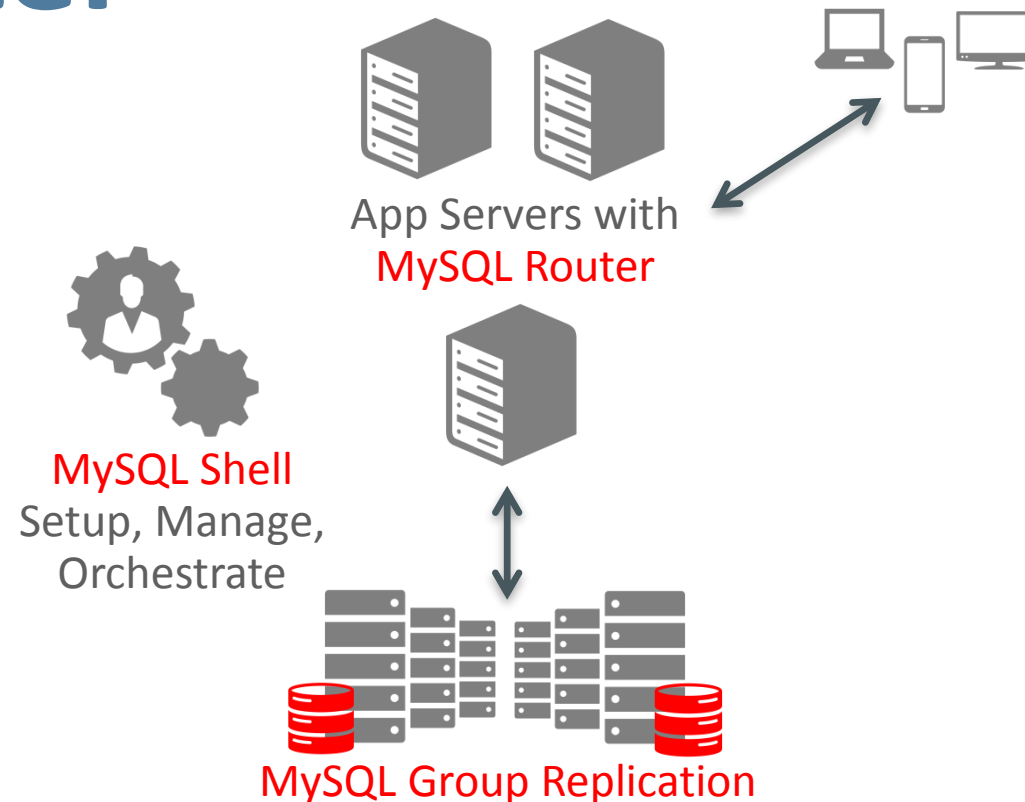
MySQL复制发布的历史



MySQL InnoDB Cluster

“第一级别的MySQL 高可用功能”

High Availability becomes a core first class feature of MySQL!



易用

Built-in HA

MySQL
InnoDB
cluster

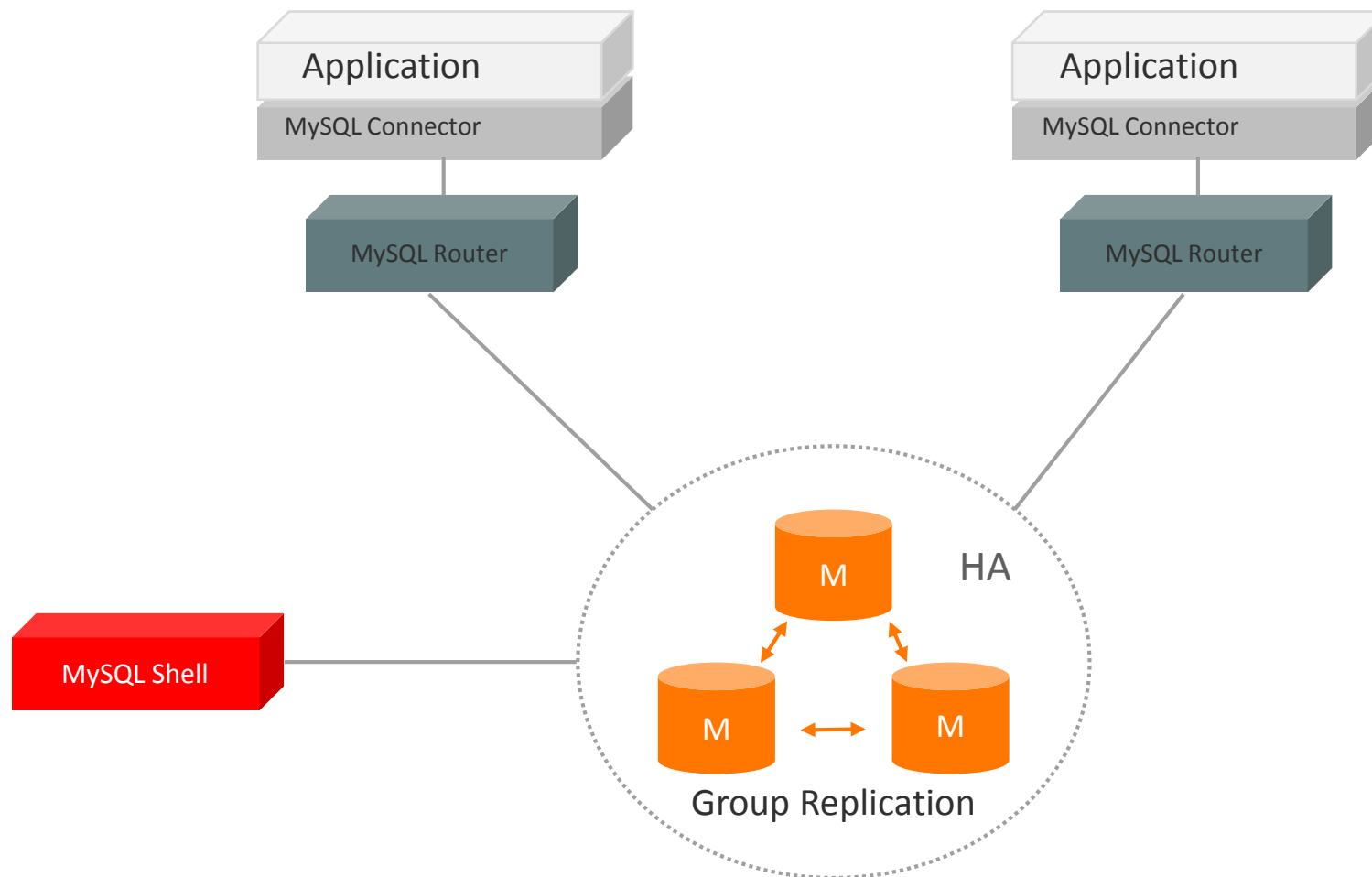
一体方案

Everything Integrated

扩展

高性能

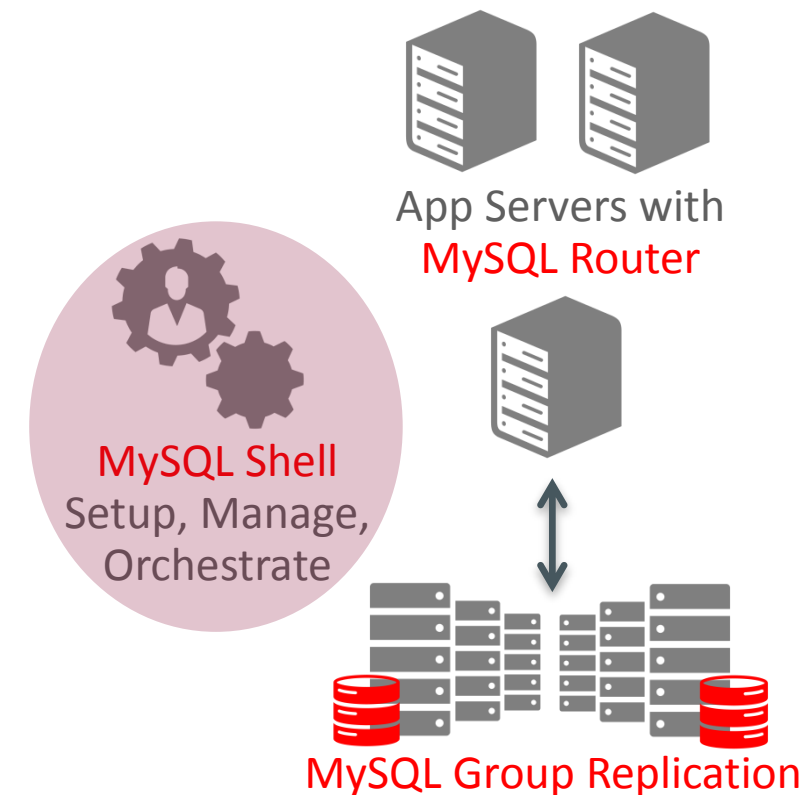
MySQL InnoDB Cluster: 架构



MySQL Shell: 管理 API

Database Administration Interface

- `mysql-js > dba.help()`
- 预载变量- 'dba' 提供 MySQL AdminAPI
- Perform DBA operations
 - Manage MySQL InnoDB clusters
 - 创建 - Create clusters
 - 检查 - Validate MySQL instances
 - 配置 - Configure MySQL instances
 - 信息 - Get cluster info
 - 变更 - Modify clusters



MySQL Shell: 创建 InnoDB Cluster

```
mysql-js> cluster = dba.createCluster('NewAppCluster')
```

```
mysql-js> cluster.addInstance('root@hanode1:3306')
```

```
mysql-js> cluster.addInstance('root@hanode2:3306')
```

```
mysql-js> cluster.addInstance('root@hanode3:3306')
```

to persist the config changes on each machine

```
shell> mysqlsh root@localhost
```

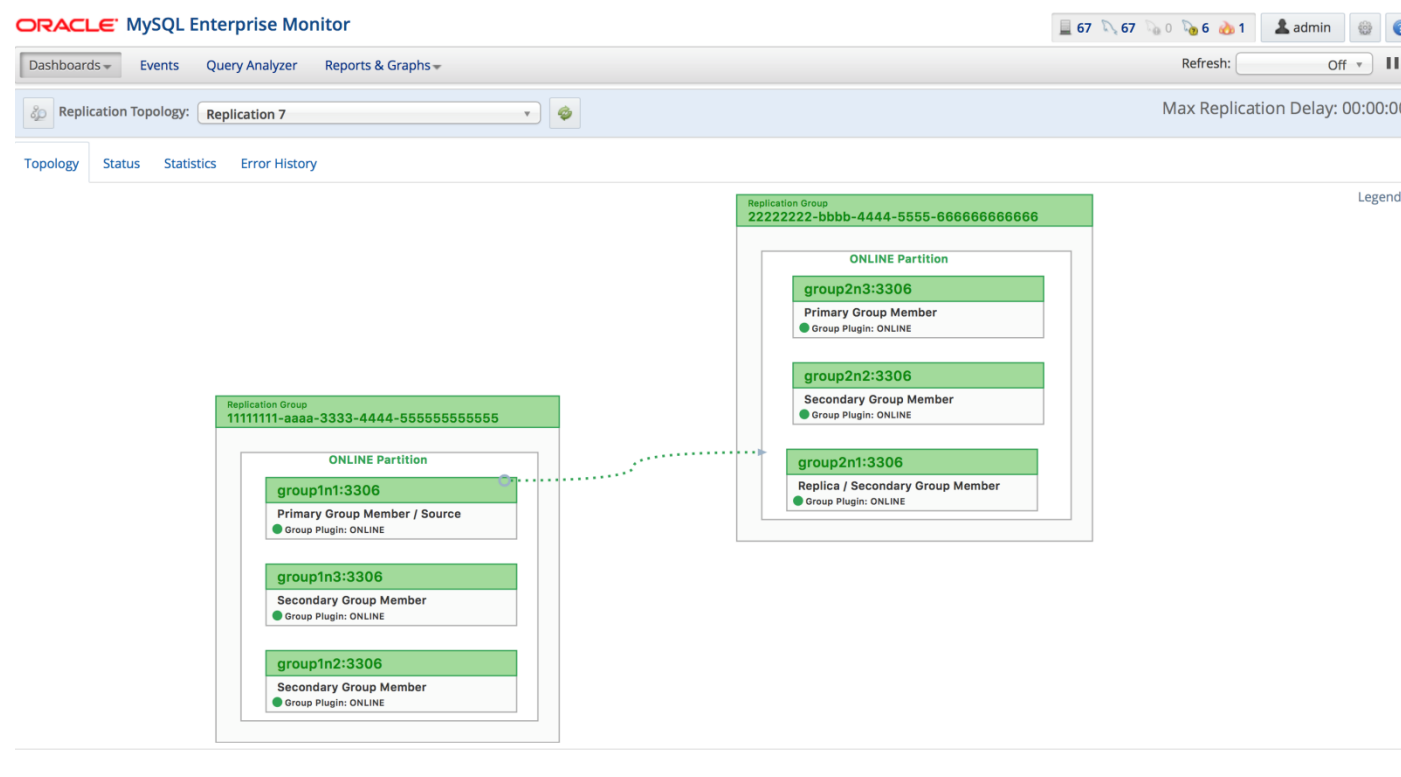
```
mysql-js> dba.configureLocalInstance('localhost:3306')
```

MySQL Shell:状态检查

```
mysql-js> cluster.status()
{
  "clusterName": "mylabcluster",
  "defaultReplicaSet": {
    "name": "default",
    "status": "OK",
    "statusText": "Cluster is ONLINE and can tolerate up to ONE failure.",
    "topology": {
      "hanode1:3306": {
        "address": "hanode1:3306",
        "mode": "R/W",
        "readReplicas": {},
        "role": "HA",
        "status": "ONLINE"
      },
      ...
    }
  }
}
```

MySQL Enterprise Monitor

- 对 Group Replication / InnoDB clusters - 全局监控 (**GA in 3.4!**)
 - 拓卜图
 - 详细指标 / 图表
 - Best Practice advice



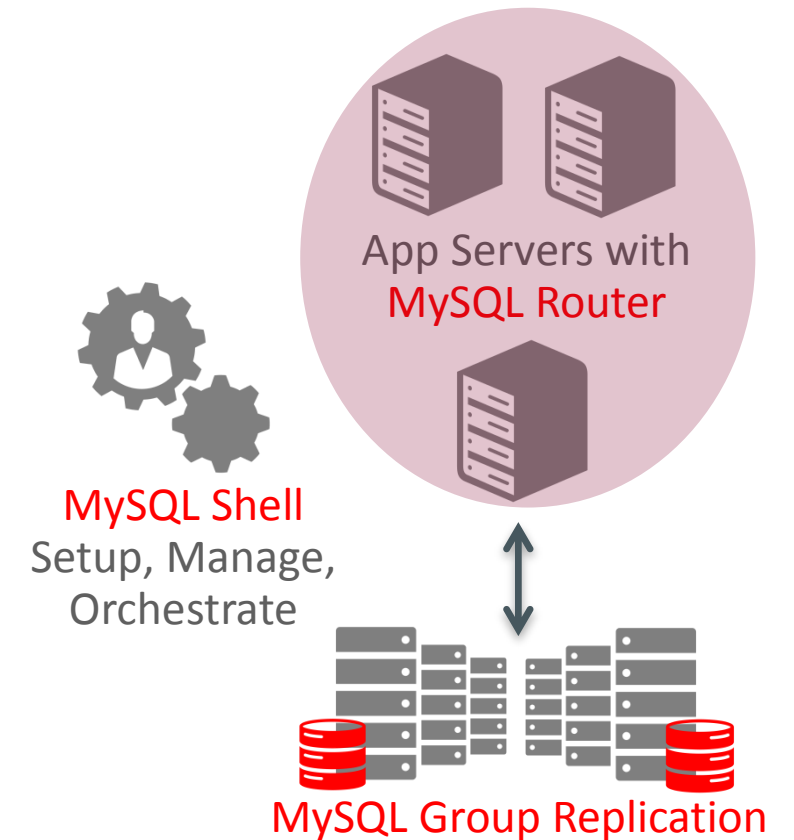
MySQL Router

应用连接透明路由

MySQL Router

对HA – MySQL 数据库提供透明连接

- 连接路由
 - 负载
 - 应用连接切换
- 设计简单和无状态，提供客户端的HA路由
 - 跟应用绑在一起



"MySQL Router allows you to easily migrate your standalone MySQL instances to natively distributed and highly available InnoDB clusters without affecting existing applications!"

MySQL InnoDB Cluster 演示

MySQL InnoDB Cluster

2 machines, 3 nodes configuration

MySQL Shell + MySQL Group Replication

Machine 1 : primary (2 nodes) + Machine 2 : secondary(1 node)

Ivan Ma

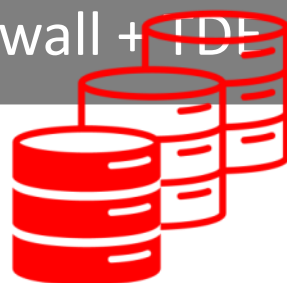
Principal Sales Consultant, MySQL



MySQL 企业版

高级功能

- 可扩展性
- 高可用性
- 安全性
- 审计
- 加密
- Firewall + TDE



管理工具

- 监控
- 备份
- 开发
- 管理
- 迁移



支持

- 技术支持
- 咨询支持
- Oracle 认证



谢谢!