如何保护MySQL数据，使MySQL更安全和稳定

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安全港声明

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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

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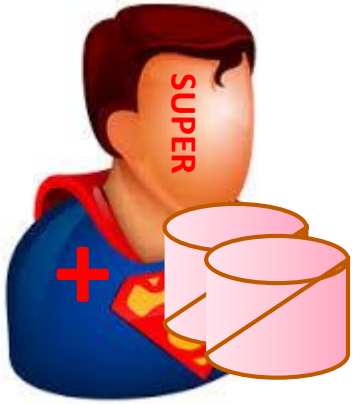
数据库漏洞的原因 – 可能是。。。。



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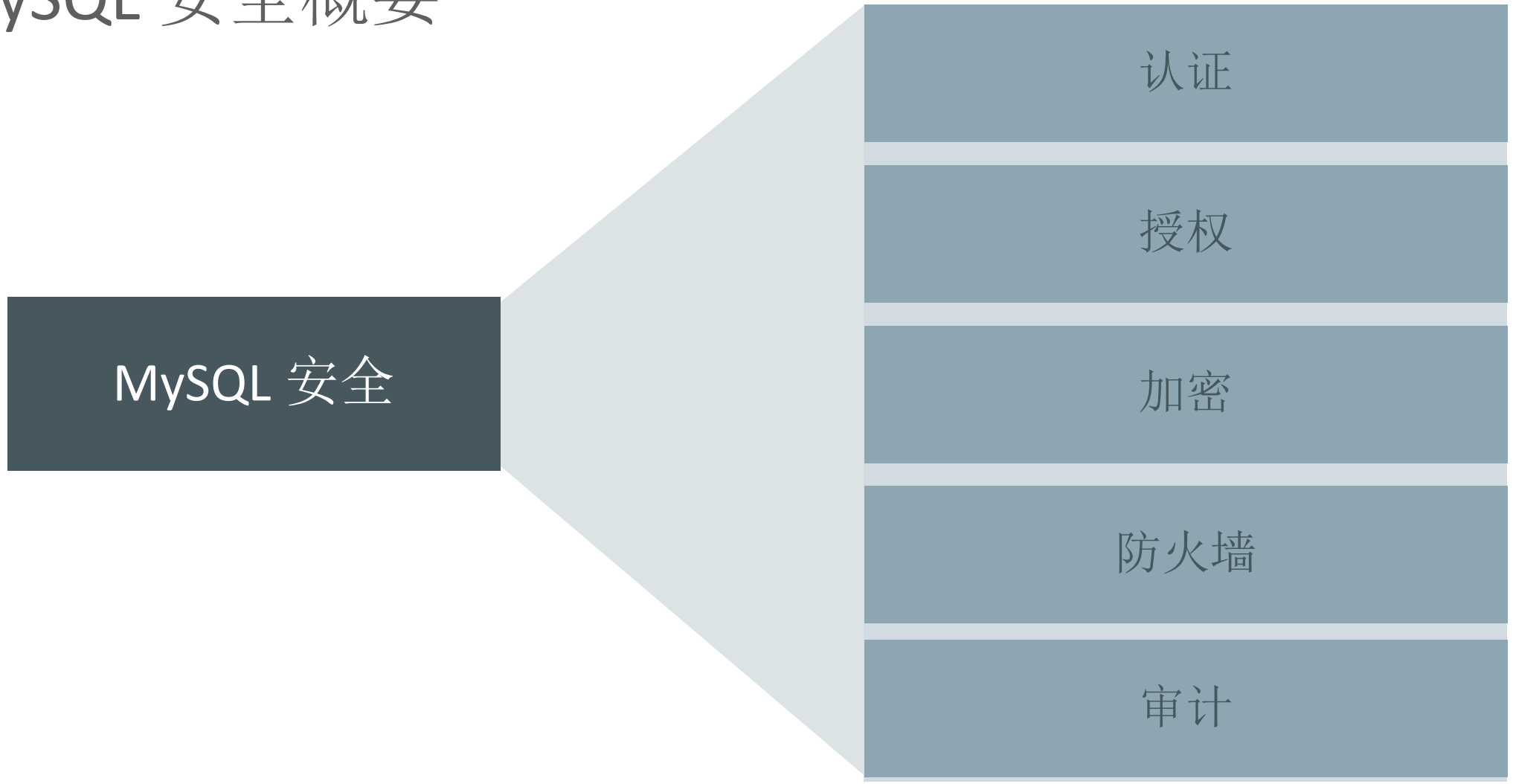
MySQL 安全概要



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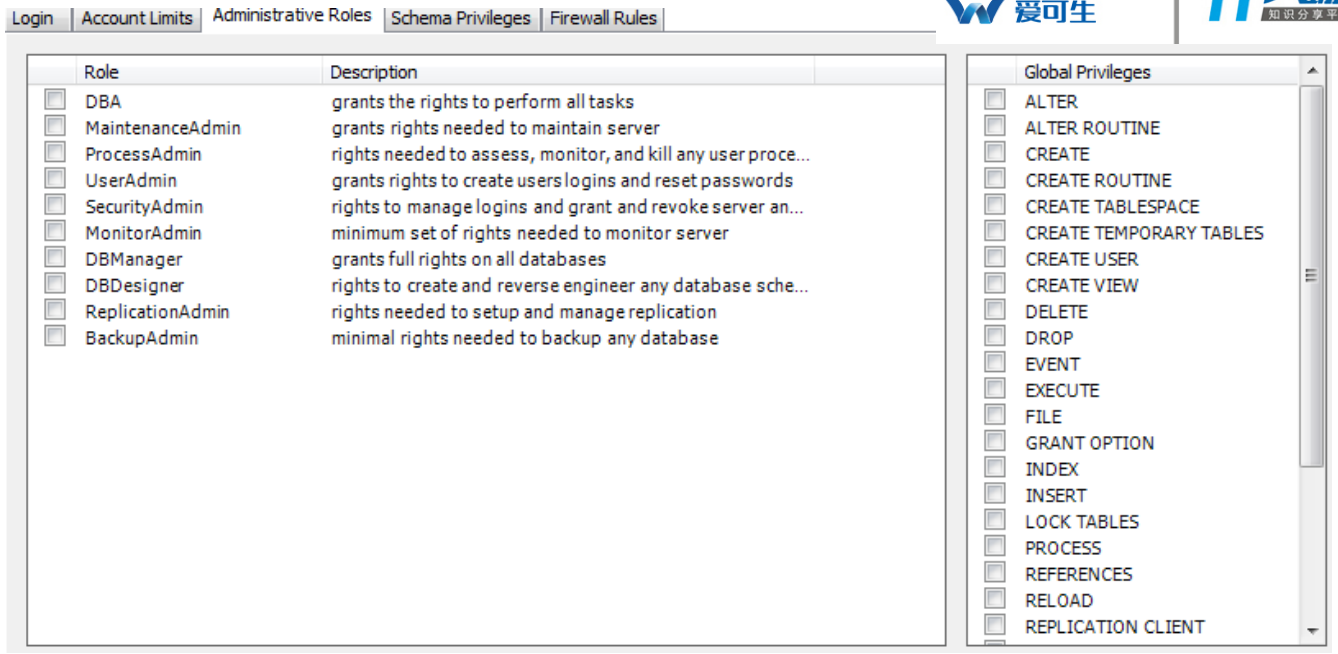
- 数据库权限



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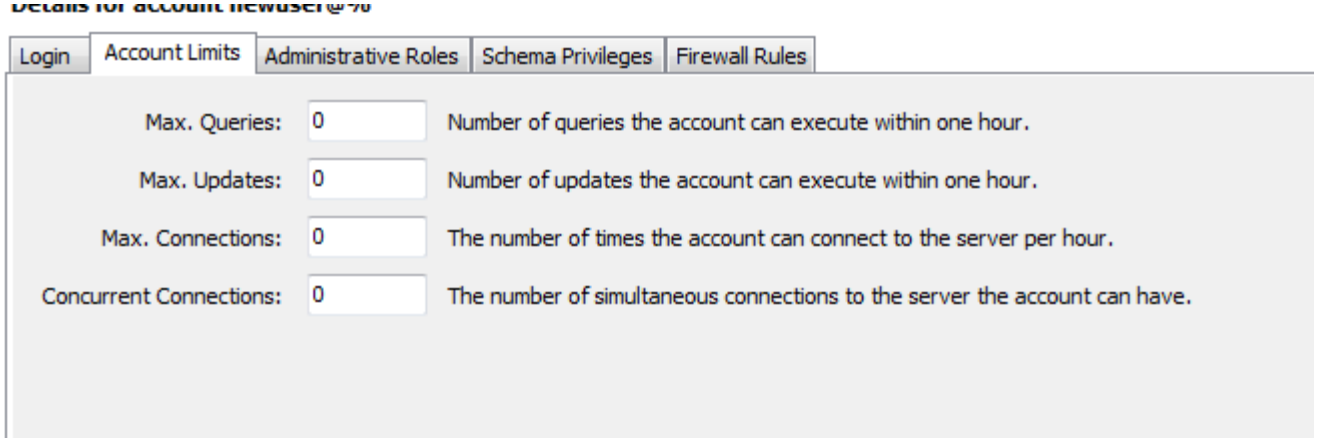

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MySQL 授权

- 管理权限
- 数据库权限
- 会话限制
- 权限控制的细化管理

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

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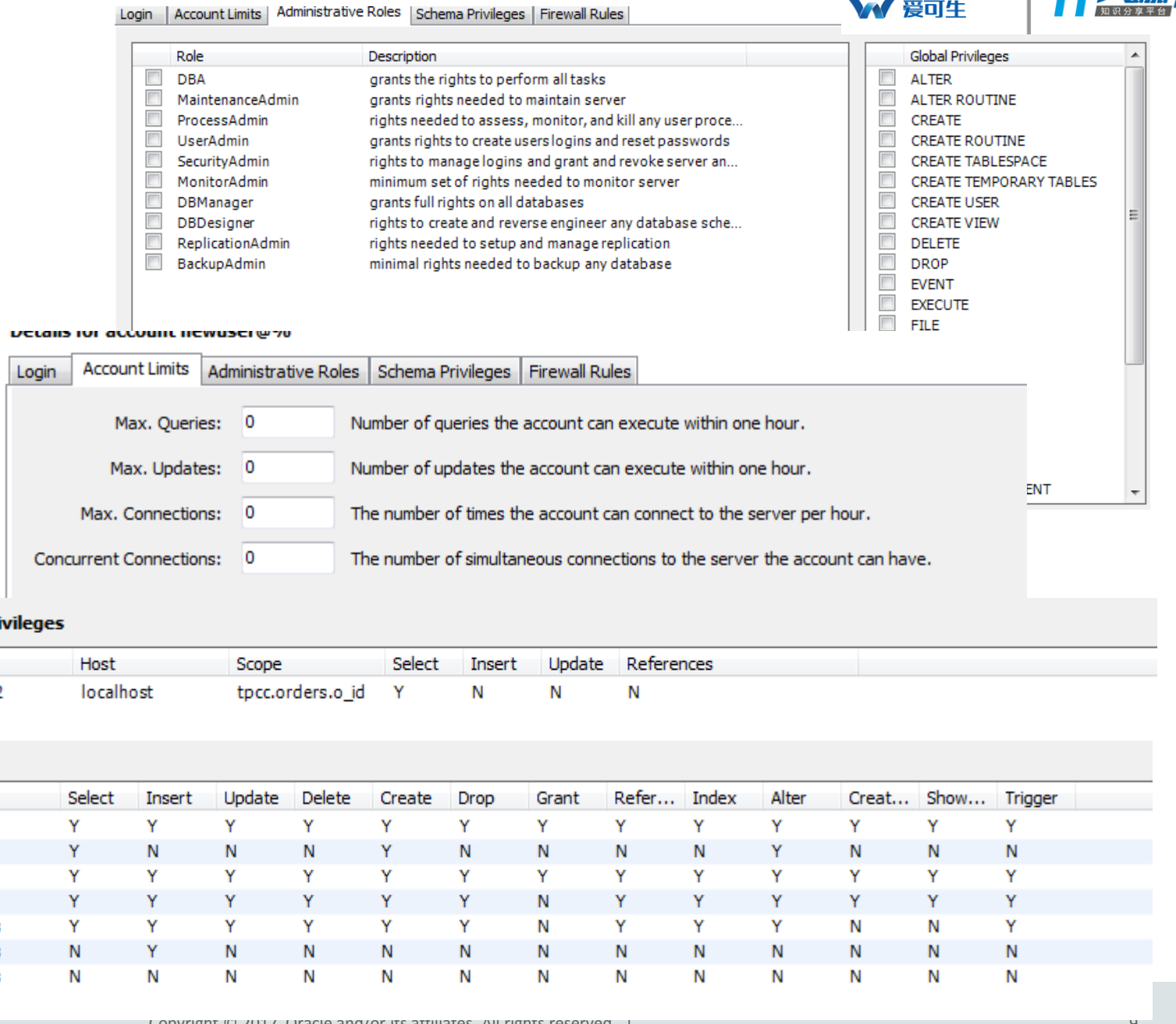

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MySQL 认证

- 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.UIXo1hQX6mlJR8mBG/m89  |
+------------+-----------------------+-------------------------------------------------------------------------+
4 rows in set (0.00 sec)
```

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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)

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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
  - 复制

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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

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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

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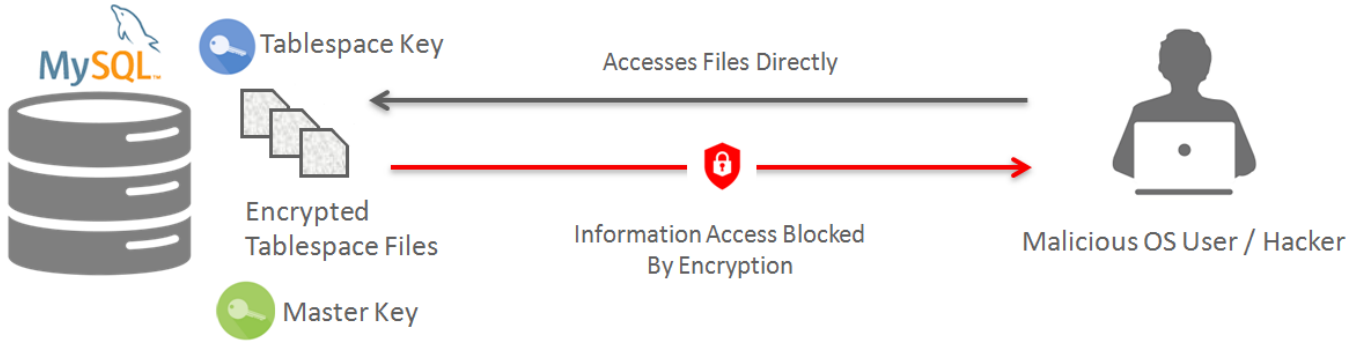
MySQL Enterprise Transparent Data Encryption

- 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



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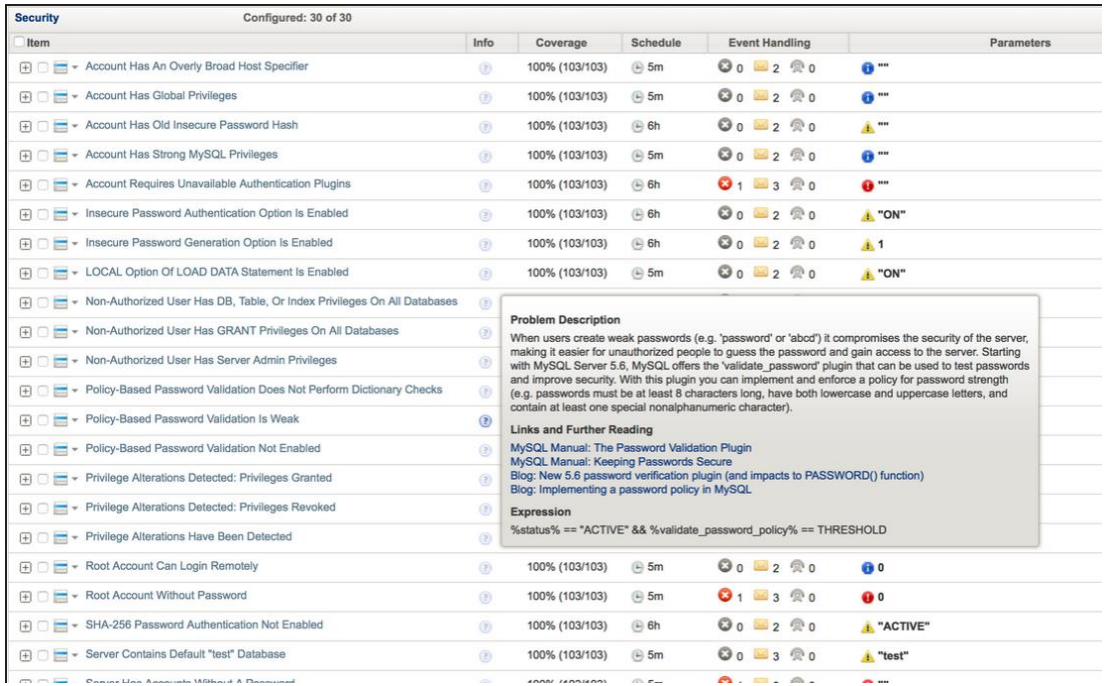
MySQL Enterprise Monitor

- 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



"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

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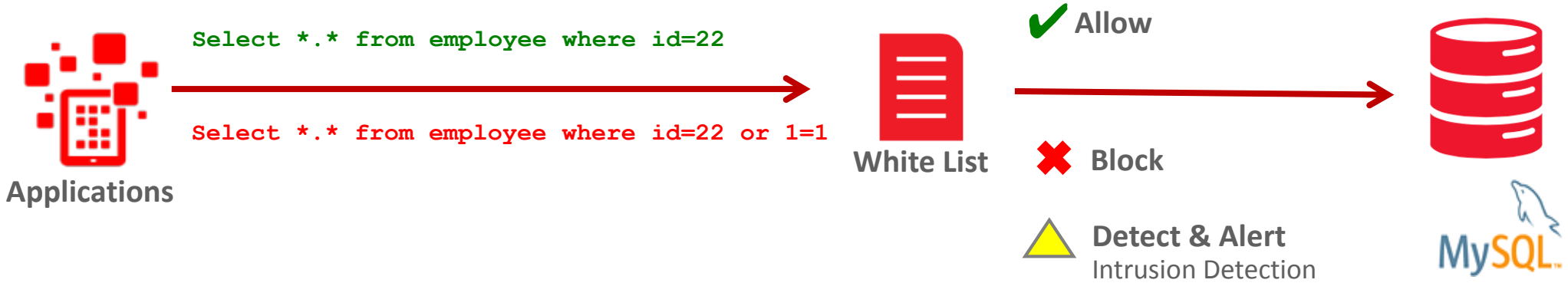
MySQL Enterprise Firewall

- 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



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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
  - PROTECTING
  - DETECTING
  - OFF

```
call mysql.set_firewall_mode ('fwuser@localhost', 'RECORDING');
call mysql.set_firewall_mode ('fwuser@localhost', 'PROTECTING');
call mysql.set_firewall_mode ('fwuser@localhost', 'DETECTING');
call mysql.set_firewall_mode ('fwuser@localhost', 'OFF');
```

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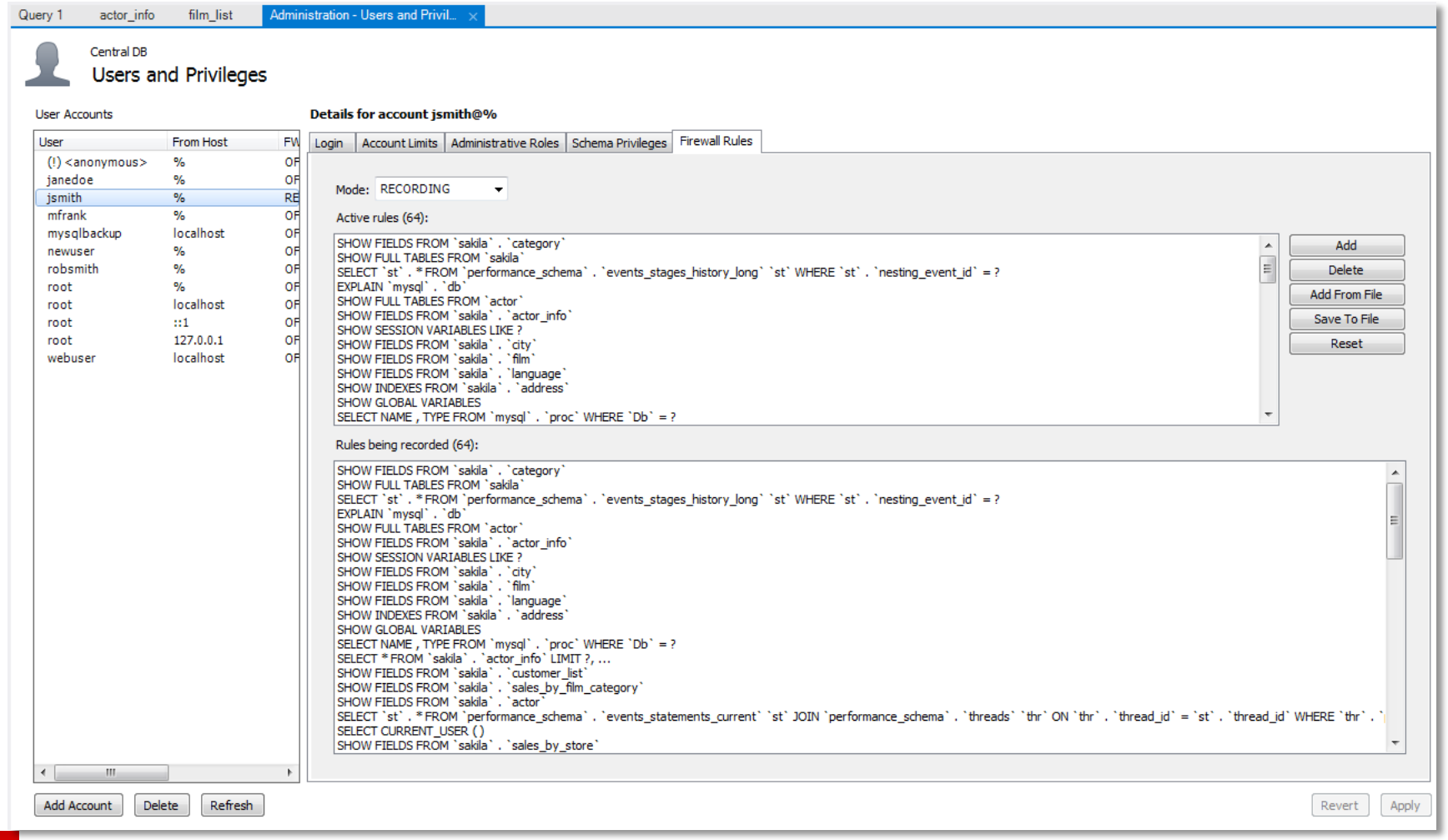
MySQL Enterprise Firewall: 每个用户的白名单



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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

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MySQL Enterprise Authentication

将 MySQL 集成在既存的安全基础设施

- 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

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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
- 秘钥管理函数
  - 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

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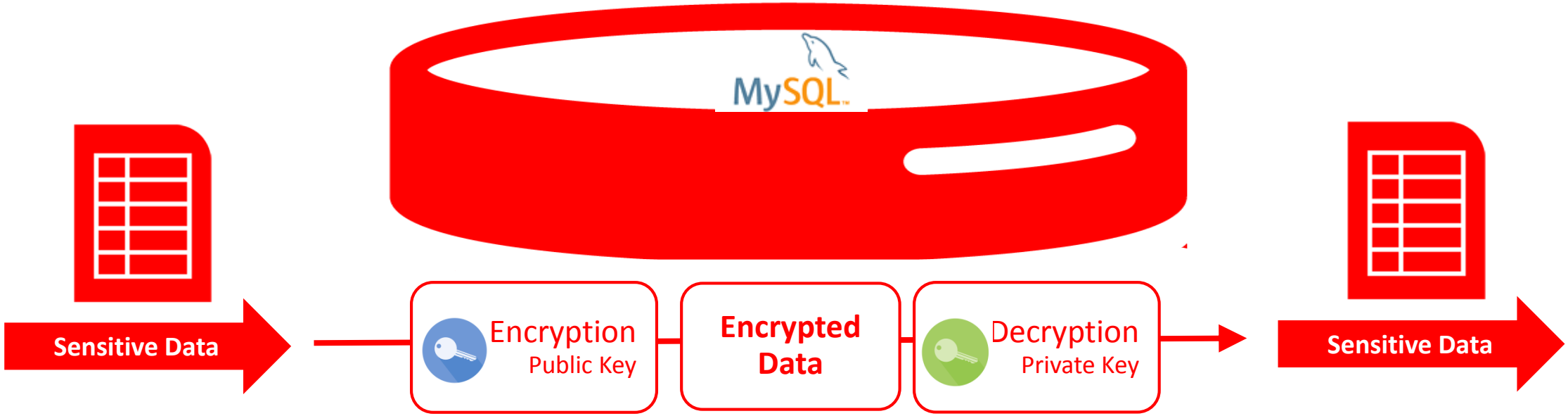
MySQL Enterprise Encryption

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)

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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>
```

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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

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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" }}]}}}}
```

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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‘;
```

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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';
```

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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

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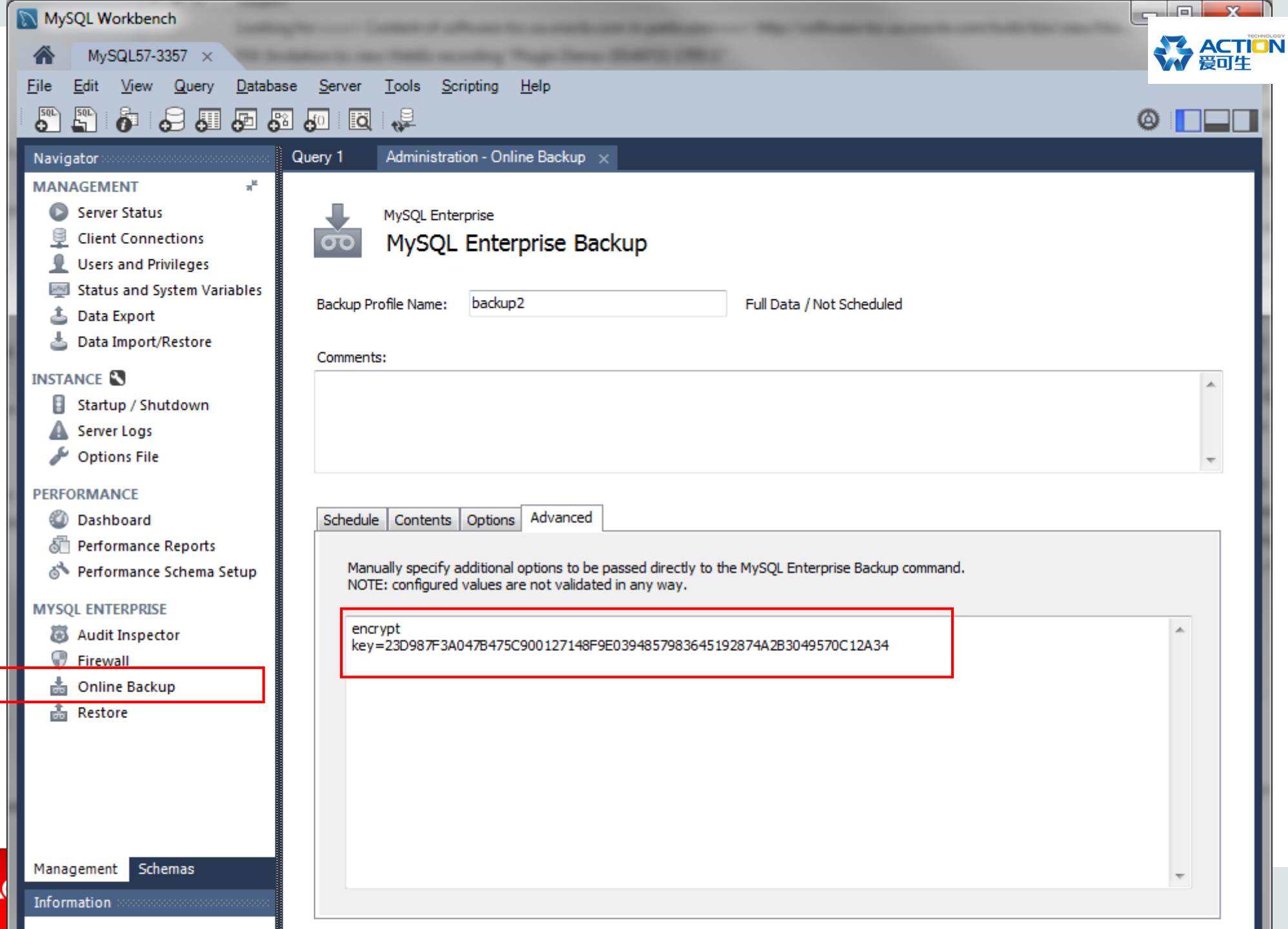
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MySQL57-3357
File Edit View Query Database Server Tools Scripting Help
Navigator
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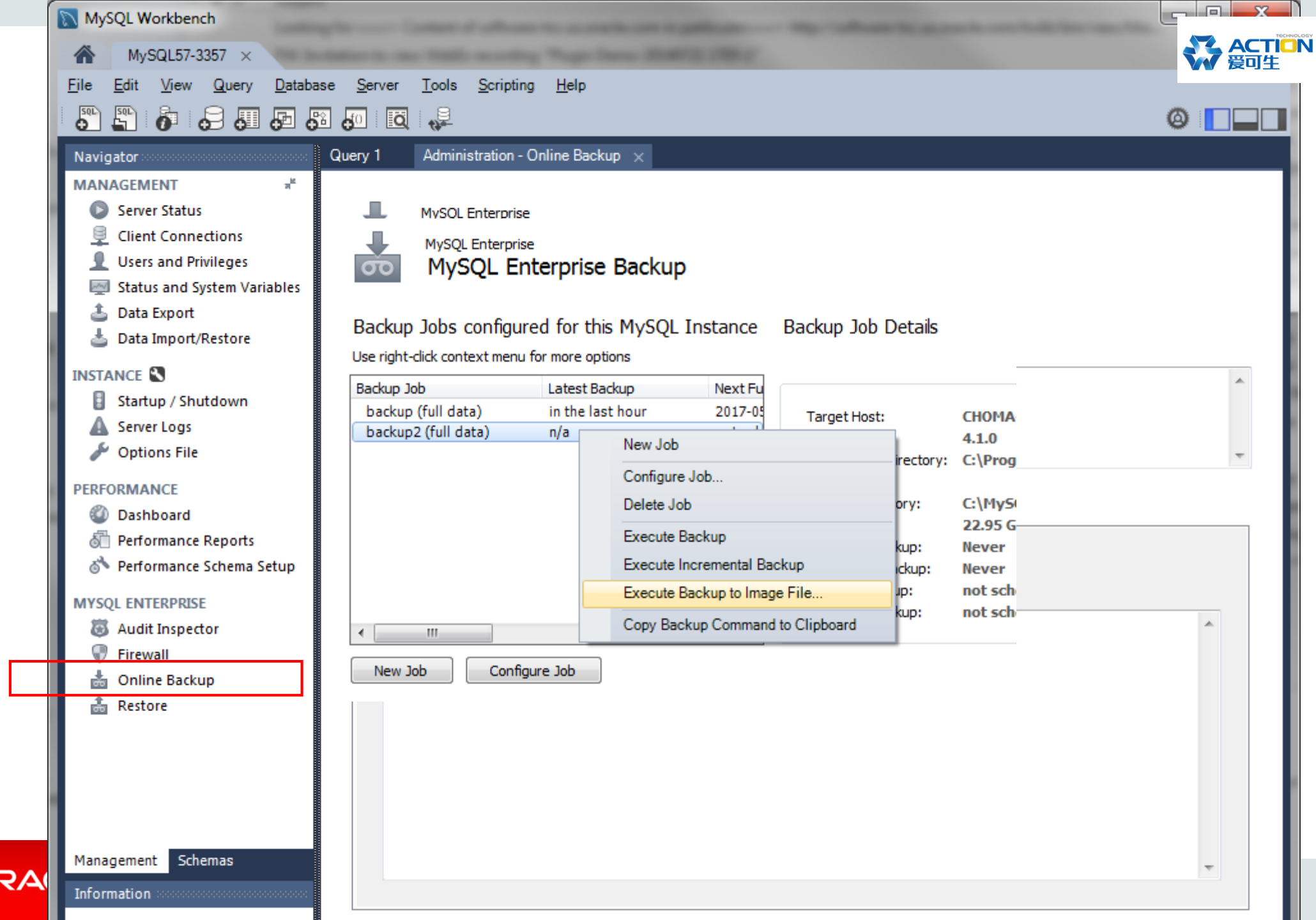
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
MYSQL ENTERPRISE
Audit Inspector
Firewall
Online Backup
Restore
Management Schemas
Information
Query 1
Administration - Online Backup
MySQL Enterprise
MySQL Enterprise Backup
Backup Profile Name: backup2
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=23D987F3A047B475C900127148F9E039485798364519287 4A2B3049570C12A34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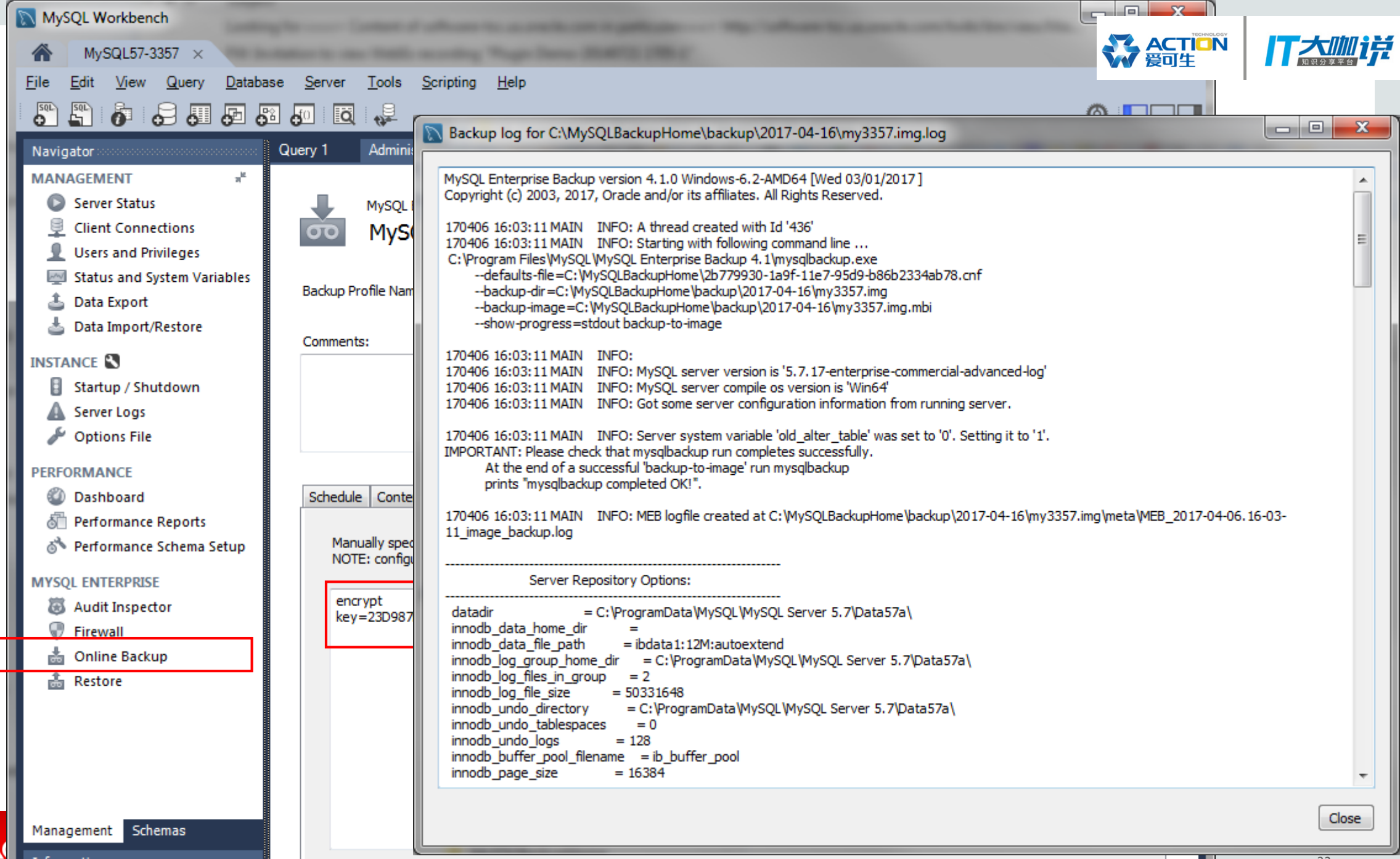
Online Backup
Restore
Management Schemas
Information
Query 1
Administration - Online Backup
MySQL Enterprise
MySQL Enterprise
MySQL Enterprise Backup
Backup Jobs configured for this MySQL Instance
Use right-click context menu for more options
Backup Job
Latest Backup
Next Fu
backup (full data)
in the last hour
2017-05
backup2 (full data)
n/a
New Job
Configure Job...
Delete Job
Execute Backup
Execute Incremental Backup
Execute Backup to Image File...
Copy Backup Command to Clipboard
Backup Job Details
Target Host:
CHOMA
4.1.0
C:\Prog
C:\MyS
22.95 G
Never
Never
not sch
not sch
New Job
Configure Job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Restore
Management Schemas
Information
Query 1
Backup Profile Nam
Comments:
Schedule
encrypt
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]
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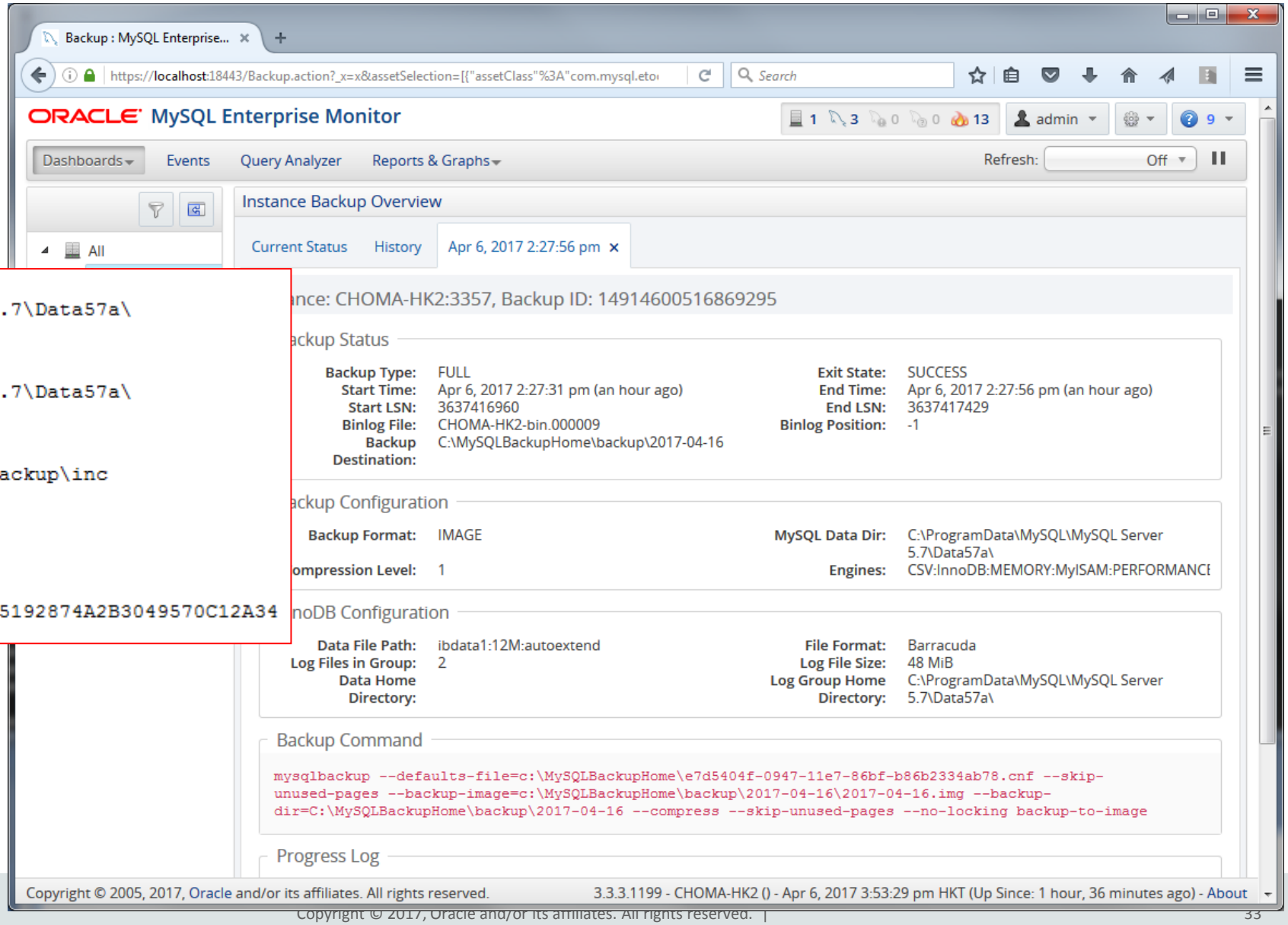
170406 16:03:11 MAIN INFO: A thread created with Id '436'
170406 16:03:11 MAIN INFO: Starting with following command line ...
C:\Program Files\MySQL\MySQL Enterprise Backup 4.1\mysqlbackup.exe
--defaults-file=C:\MySQLBackupHome\2b779930-1a9f-11e7-95d9-b86b2334ab78.cnf
--backup-dir=C:\MySQLBackupHome\backup\2017-04-16\my3357.img
--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

```
[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=23D987F3A047B475C900127148F9E03948579836451928 74A2B3049570C12A34
```



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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

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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

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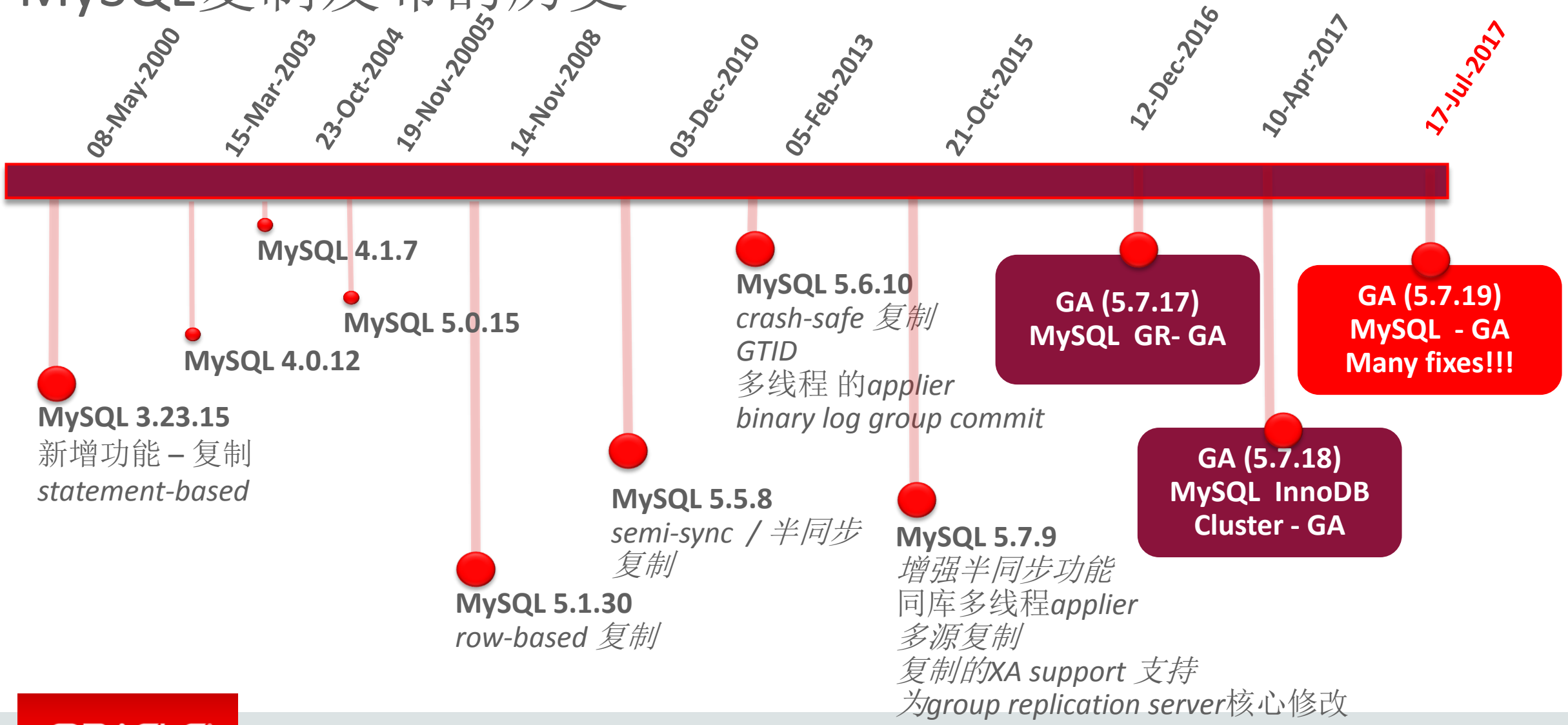
MySQL复制发布的历史



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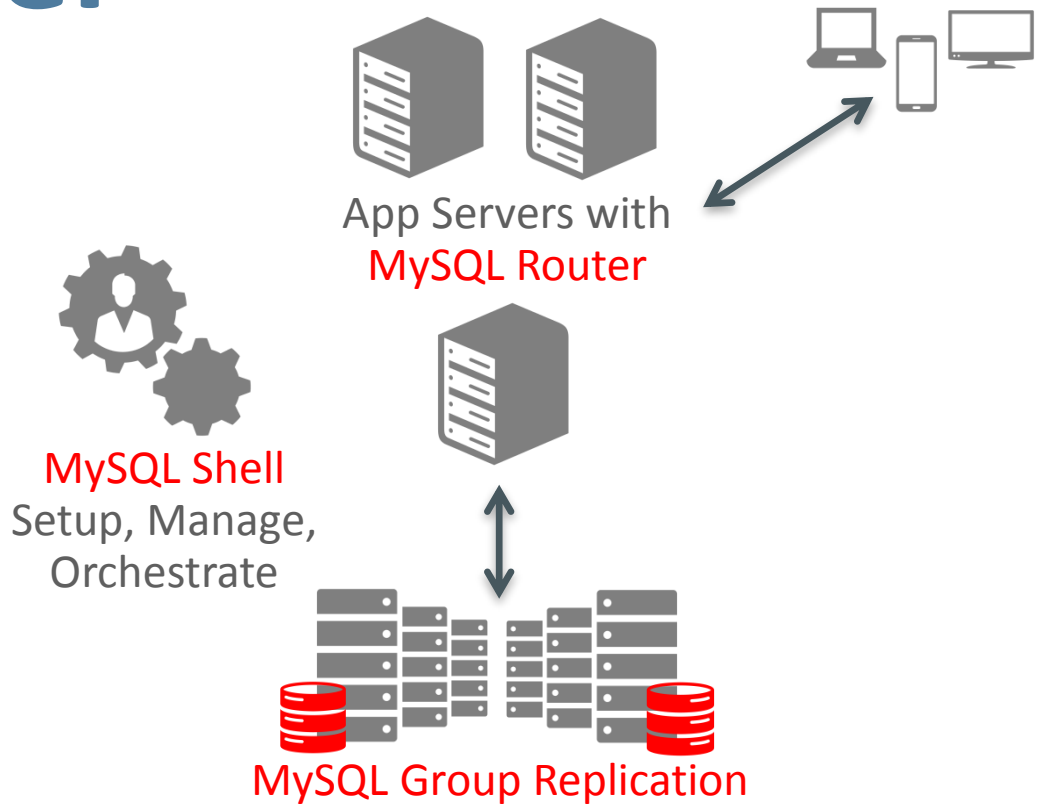
MySQL InnoDB Cluster

“第一级别的MySQL 高可用功能”

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



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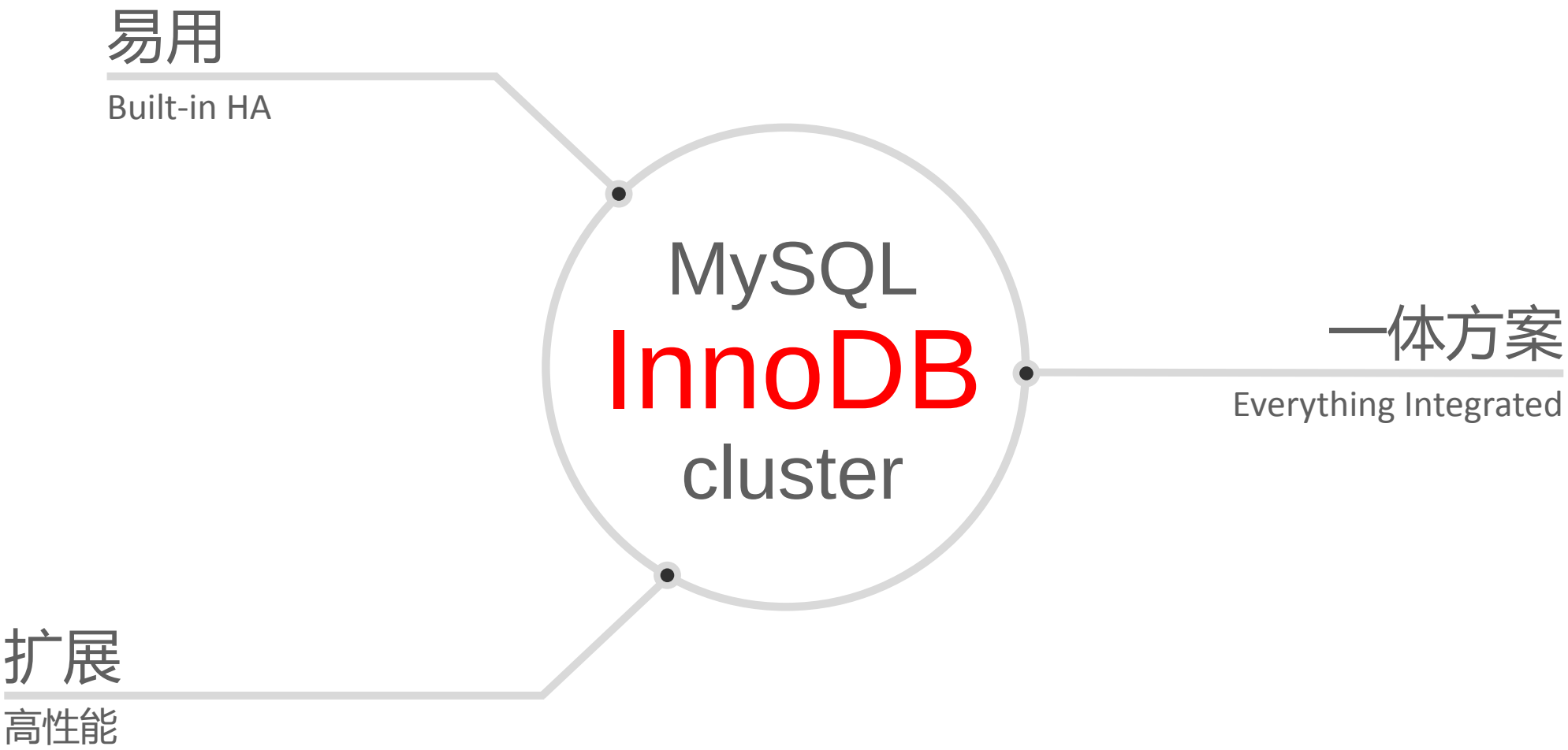

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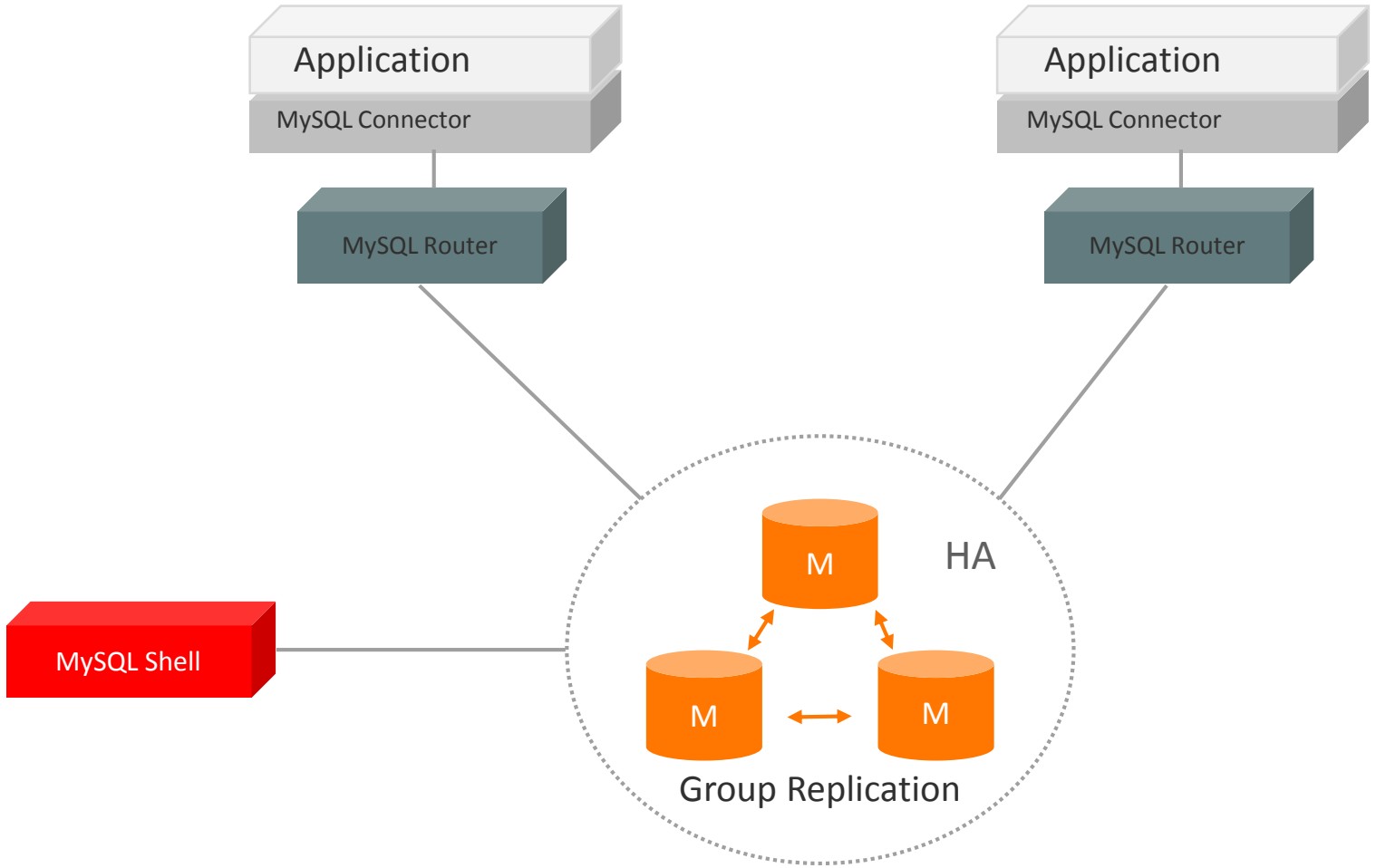
MySQL InnoDB Cluster: 架构



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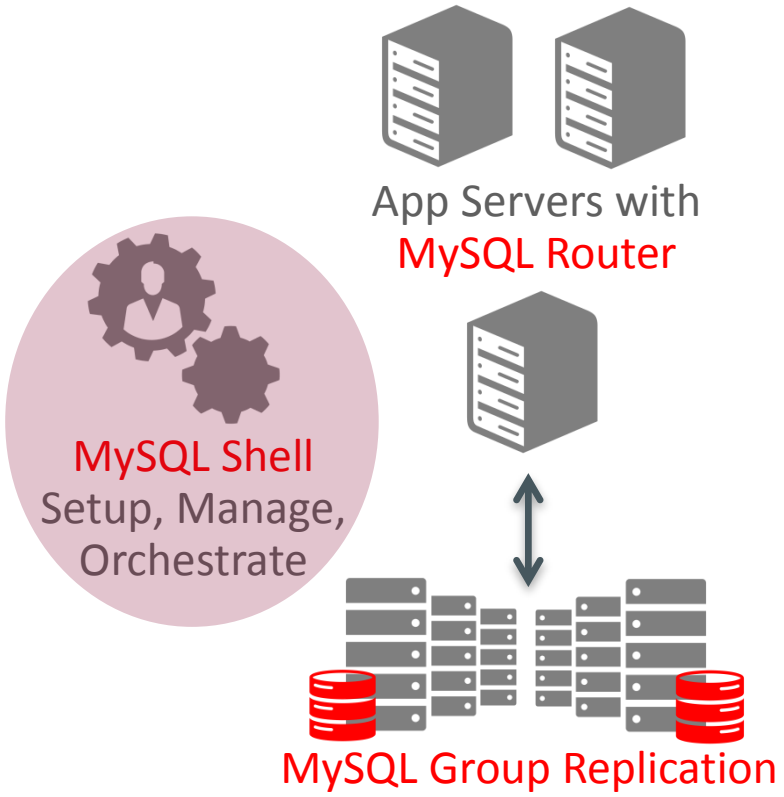
MySQL Shell: 管理 API

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



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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')
```

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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"
            },
…
```

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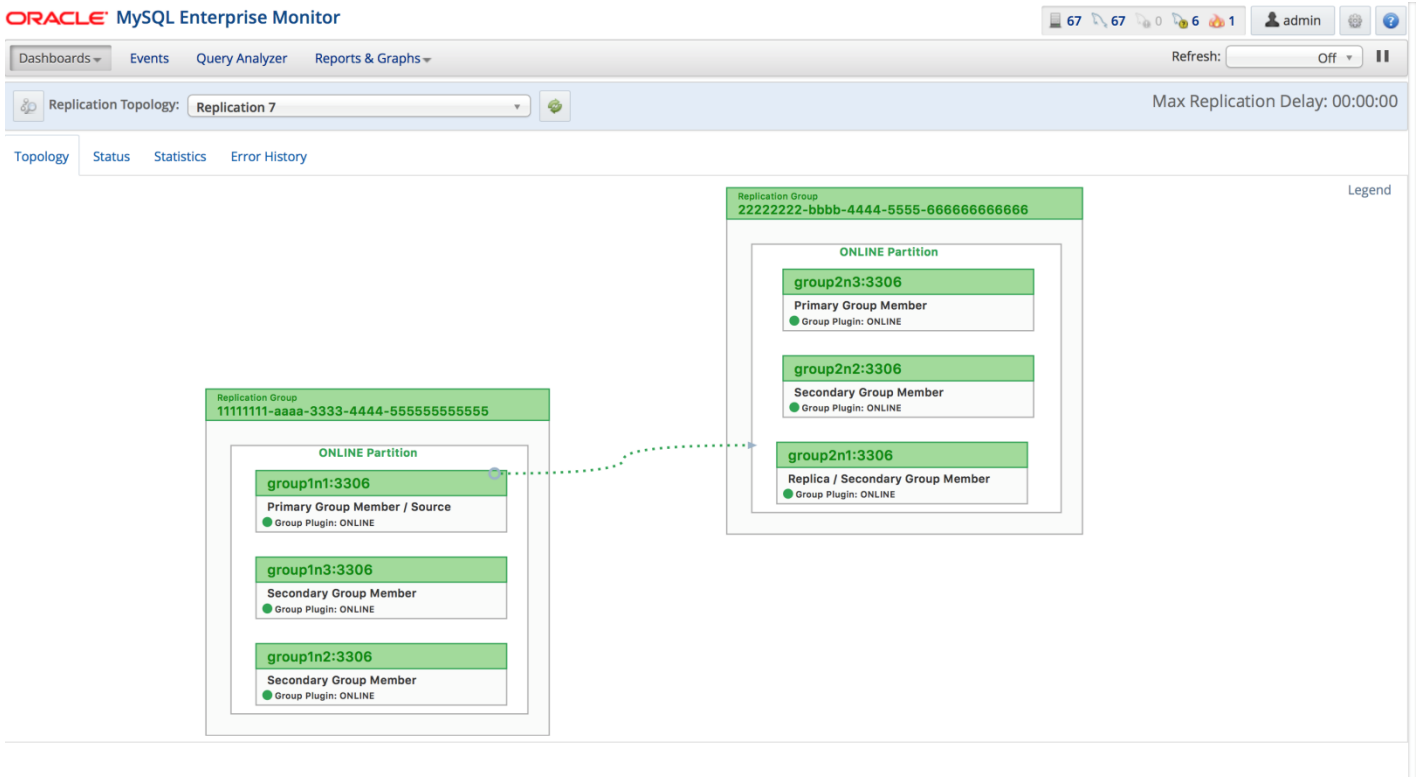
MySQL Enterprise Monitor

- 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
-



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MySQL Router

应用连接透明路由

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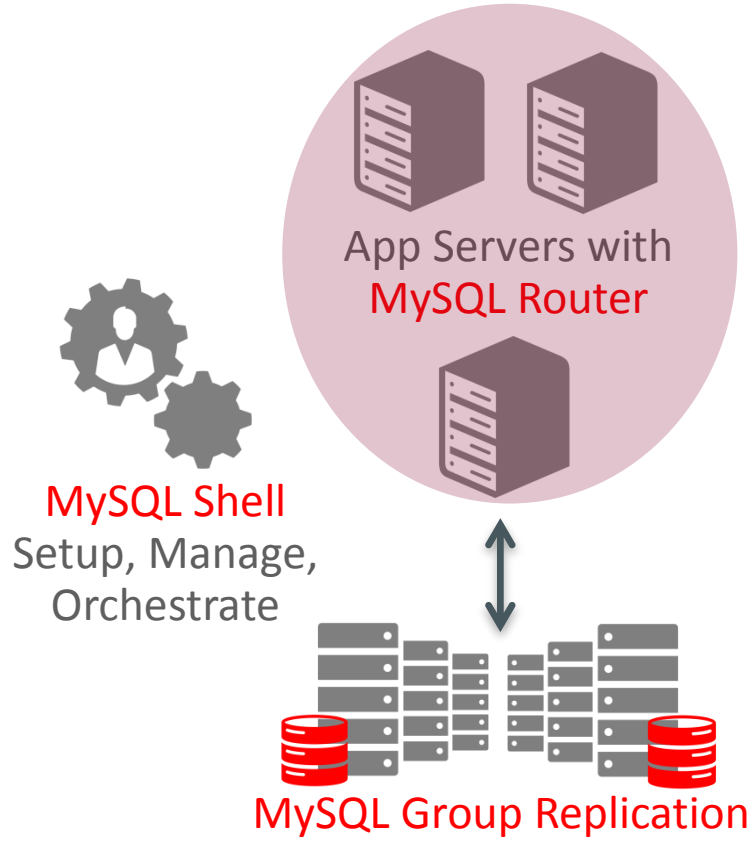
MySQL Router

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!”

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MySQL InnoDB Cluster

演示

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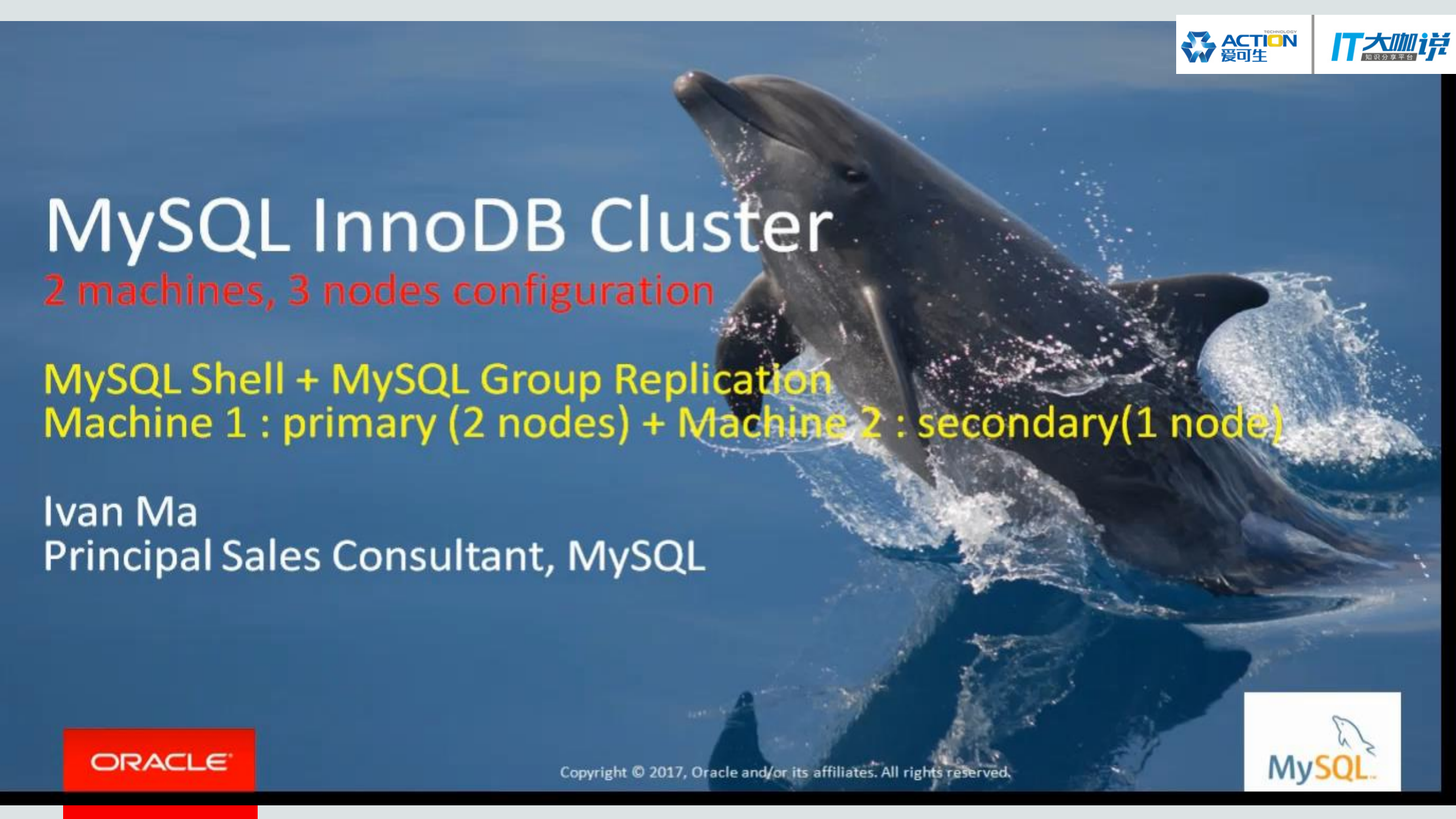

MySQL InnoDB Cluster

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

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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

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