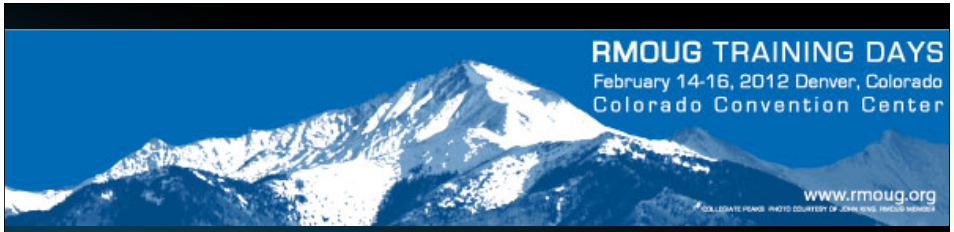

MySQL Security Essentials

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RMOUG
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ORACLE ACE Director

OBJECTIVE

- Identify MySQL security issues
- Improve MySQL installation process
- Identify data issues
- Improve data integrity and security
- Auditing options

ABOUT AUTHOR
RONALD BRADFORD

- 12 years with MySQL / 22 years with RDBMS
  - Senior Consultant at MySQL Inc (06-08)
  - Consultant for Oracle Corporation (96-99)
- 7 years presenting MySQL content
- All time top MySQL blogger
- Published author
- Oracle ACE Director

Available NOW for consulting

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MySQL Security

INSTALL SECURITY

- Default is terrible
- Minimum
  - `$ mysql_secure_installation`
- Recommended
  - Operating System
  - Permissions & Privileges

Hacking MySQL

10 simple ways

HACKING MYSQL

1

```
$ mysql -uroot
```

For a default MySQL installation, there is no password for super user account

HACKING MYSQL

2

```
$ mysql

mysql> USE test
```

For a default MySQL installation, there is anonymous access. More on this soon!

HACKING MYSQL

3

```
$ sudo su -
$ mysql
$ cat ~/.my.cnf
[client]
user=root
password=XXX

# Other users with logins
$ find / -name ".my.cnf"
```

Many host providers have the superuser password in the default user config file

HACKING MYSQL

4

```
$ grep mysql $HOME/.*history
$ grep mysql /home/*/.*history

mysql -uroot -pmysecret dbname
```

Shell commands leave an audit history. If password is specified on command line, it is in history

HACKING MYSQL

4a

```
$ cat wordpress/wp-config.php
$ cat drupal/sites/default/settings.php

# Insert your application here
```

Applications with cleartext passwords and user may have excessive privileges

HACKING MYSQL

5

```
$ mysql -u<some not privileged user>
mysql> SELECT host,user,password FROM mysql.user;
+-------------+------+----------+
| host        | user | password |
+-------------+------+----------+
| localhost   | root |          |
| mactaz.local | root |          |
| 127.0.0.1   | root |          |
| ::1         | root |          |
| localhost   |      |          |
| mactaz.local |      |          |
+-------------+------+----------+
```

Can you view MySQL privileges to find a user with more access?

HACKING MYSQL

6

```
$ cd [mysql-data-dir] # e.g. /var/lib/mysql
$ cat master.info
15
mysql-bin.001536
20160154
10.0.0.1
repl
XXX
3306
60

$ mysql -urepl -pXXX -h10.0.0.1
mysql> SHOW GRANTS;
```

Are datadir permissions secure? Does replication connection have global permissions?

HACKING MYSQL

7

```
$ cd [mysql-data-dir] # e.g. /var/lib/mysql
$ strings mysql/user.MYD
...
dba*2470C0C06DEE42FD1618BB99005ADCA2EC9D1E19

mysql> SELECT 'password',PASSWORD('password');
+----------+-------------------------------------------+
| password | PASSWORD('password')                      |
+----------+-------------------------------------------+
| password | *2470C0C06DEE42FD1618BB99005ADCA2EC9D1E19 |
+----------+-------------------------------------------+
mysql> SELECT 'passwd',PASSWORD('passwd');
+--------+-------------------------------------------+
| passwd | PASSWORD('passwd')                        |
+--------+-------------------------------------------+
| passwd | *59C70DA2F3E3A5BDF46B68F5C8B8F25762BCCEF0 |
+--------+-------------------------------------------+
```

Is datadir permissions secure? Can list all users and password hash

HACKING MYSQL

7a

```
mysql> CREATE SCHEMA IF NOT EXISTS hack;
mysql> use hack;
mysql> CREATE TABLE words(word VARCHAR(100));
mysql> LOAD DATA LOCAL INFILE '/tmp/passwords'
    -> INTO TABLE words(word);

mysql -uroot -e "SELECT word,PASSWORD(word) FROM
hack.words" --skip-column-names > /tmp/mysql-passwords
$ cat /tmp/mysql-passwords
password *2470C0C06DEE42FD1618BB99005ADCA2EC9D1E19
passwd   *59C70DA2F3E3A5BDF46B68F5C8B8F25762BCCEF0
oracle   *2447D497B9A6A15F2776055CB2D1E9F86758182F
changeme *7ACE763ED393514FE0C162B93996ECD195FFC4F5
xxx   *3D56A309CD04FA2EEF181462E59011F075C89548
```

Brute force checking

HACKING MYSQL

8

```
# Replacing/Editing user.MYD

$ cd /tmp
$ echo "[mysqld]
datadir=/tmp" > my.cnf
$ scripts/mysql_install_db --defaults-file=/tmp/my.cnf
$ ls -l /tmp/mysql/user.*
-rw-rw----  1 rbradfor  wheel    320 Feb 13 11:27 /tmp/mysql/user.MYD
-rw-rw----  1 rbradfor  wheel   2048 Feb 13 11:27 /tmp/mysql/user.MYI
-rw-rw----  1 rbradfor  wheel  10630 Feb 13 11:27 /tmp/mysql/user.frm
```

If access data directory, you can replace or hack users data

HACKING MYSQL

9

```
   [mysqld]
init-file=/path/to/init.sql


$ cat init.sql
UPDATE mysql.user SET password=password('fred');
FLUSH PRIVILEGES;
```

Run the SQL file when I start mysqld

HACKING MYSQL

10

```
$ mysqld --skip-grant-tables

$ mysql -uroot

mysql> UPDATE mysql.user
    -> SET password=PASSWORD('hacked');
mysql> FLUSH PRIVILEGES;
```

If access to start and stop mysqld process, you can reset passwords.

Denial of Service (DOS)

BREAKING MYSQL

```
$ mysql
mysql> USE test
mysql> CREATE TABLE filldisk(c VARCHAR(1000));
mysql> INSERT INTO filldisk VALUES(REPEAT('x',1000)),(REPEAT('y',1000)),
(REPEAT('z',1000));
mysql> INSERT INTO filldisk SELECT a.c FROM filldisk a, filldisk b,
filldisk c, filldisk d, filldisk e;
Query OK, 243 rows affected (0.05 sec)
mysql> INSERT INTO filldisk SELECT a.c FROM filldisk a, filldisk b,
filldisk c, filldisk d, filldisk e;
Will it end?
mysql> SELECT POW(3,5);
+----------+
| pow(3,5) |
+----------+
|      243 |
+----------+
mysql> SELECT POW(243,5);
+-----------------+
| pow(243,5)      |
+-----------------+
| 847,288,609,443 |
```

Anonymous access.

BREAKING MYSQL

```
# Steal CPU cycles
mysql> SELECT MD5(a.c), MD5(b.c)
    -> FROM filldisk a, filldisk b ORDER BY RAND();
```

BREAKING MYSQL

```
# Force disk I/O
mysql> SET SESSION tmp_table_size=1024*4; # 4K

mysql> SELECT ...
```

INSTALL SECURITY

- `$ mysql_secure_installation`
  - Remove anonymous users
  - Remove test database
  - Remove non 'localhost' root users
  - Set root password

OS Security

OS SECURITY

- Defaults are not always secure
- Separate Data/Binary Logs/Logs/ Configuration/Backups
  - Individual directory permissions
- Never run mysqld as 'root' user

- Minimize security risk
- Better auditability

DATA SECURITY

```
   $ ls -ld /var/lib/mysql
drwxr-xr-x 6 mysql mysql 4096 Oct 13 16:45 /var/lib/mysql

$ ls -l /var/lib/mysql
total 3749488
drwx------ 2 mysql mysql       4096 Oct  6 18:50 db1
drwx------ 2 mysql mysql       4096 Jun  6 14:11 db2
-rw-rw---- 1 mysql mysql 3298820096 Oct 16 20:42 ibdata1
-rw-rw---- 1 mysql mysql  268435456 Oct 16 20:42 ib_logfile0
-rw-rw---- 1 mysql mysql  268435456 Oct 16 20:42 ib_logfile1
drwx------ 2 mysql mysql       4096 Jun  6 09:37 mysql
srwxrwxrwx 1 mysql mysql          0 Oct 12 20:09 mysql.sock
```

Change default configuration for socket=/var/run/mysql/mysql.sock

INSTALLATION

- Best Practice

Single partition per MySQL Instance

```
/mysql
    /etc
    /data
    /binlog
    /log
    /mysql-version
```

Global files as symlinks from partition

```
/etc/my.cnf
/etc/profile.d/mysql.sh
/etc/init.d/mysqld
```

INSTALLATION

- Software installed by root
  - Separate MySQL permissions for directories

```
$ chown -R root:root /mysql
$ chown -R mysql:mysql /mysql/{data,log,binlog,etc}
$ chmod 700 /mysql/{data,binlog}
$ chmod 750 /mysql/{etc,log}
```

NETWORK

- MySQL listens on one TCP/IP port
  - Default port is 3306
  - --skip-networking disables TCP/IP
- Database does not require physical web access generally
  - Firewall management

User Privileges

USER PRIVILEGES

Best Practice

```
CREATE USER goodguy@localhost IDENTIFIED BY 'sakila';
GRANT CREATE,SELECT,INSERT,UPDATE,DELETE ON db.* TO
goodguy@localhost;
```

Normal Practice

```
CREATE USER superman@'%';
GRANT ALL ON *.* TO superman@'%';
```

http://dev.mysql.com/doc/refman/5.5/en/create-user.html
http://dev.mysql.com/doc/refman/5.5/en/grant.html

GRANT ALL ON *.*

- `GRANT ALL ON *.* TO user@'%'`
  - *.* gives you access to all tables in all schemas
  - @'%' give you access from any external location
  - ALL gives you
  - ALTER, ALTER ROUTINE, CREATE, CREATE ROUTINE, CREATE TEMPORARY TABLES, CREATE USER, CREATE VIEW, DELETE, DROP, EVENT, EXECUTE, FILE, INDEX, INSERT, LOCK TABLES, PROCESS, PROXY, REFERENCES, RELOAD, REPLICATION CLIENT, REPLICATION SLAVE, SELECT, SHOW DATABASES, SHOW VIEW, SHUTDOWN, **SUPER**, TRIGGER, UPDATE, USAGE

SUPER

- SUPER
  - Bypasses read_only
  - Bypasses init_connect
  - Can Disable binary logging
  - Change configuration dynamically
  - No reserved connection

SUPER/READ ONLY

```
$ mysql -ugoodguy -psakila db
mysql> insert into test1(id) values(1);
ERROR 1290 (HY000): The MySQL server is running with th
--read-only option so it cannot execute this statement
```

```
$ mysql -usuperman db
mysql> insert into test1(id) values(1);
Query OK, 1 row affected (0.01 sec)
```

SUPER / CONNECT

```
#my.cnf
[client]
init_connect=SET NAMES utf8


This specifies to use UTF8 for communication with client
and data
```

SUPER / CONNECT

```
$ mysql -usuperman db
$ mysql -ugoodguy -psakila db
                                    l VARIABLES LIKE
mysql> SHOW SESSION VARIABLES LIKE 'ch%';
+--------------------------+----------+   +---------+----------+
| Variable_name            | Value    |   |         | Value    |
+--------------------------+----------+   +---------+----------+
| character_set_client     | utf8     |   | ent     | latin1   |
| character_set_connection | utf8     |   | nection | latin1   |
| character_set_database   | latin1   |   | abase   | latin1   |
| character_set_filesystem | binary   |   | esystem | binary   |
| character_set_results    | utf8     |   | ults    | latin1   |
| character_set_server     | latin1   |   | ver     | latin1   |
| character_set_system     | utf8     |   | tem     | utf8     |
+--------------------------+----------+   +---------+----------+
```

SUPER/BINARY LOG

```
mysql> SHOW MASTER STATUS;
+------------------+----------+--------------+------------------+
| File             | Position | Binlog_Do_DB | Binlog_Ignore_DB |
+------------------+----------+--------------+------------------+
| binary-log.000001 |      354 |              |                  |
+------------------+----------+--------------+------------------+

mysql> INSERT INTO account VALUES (9,'New',100);
mysql> SET SQL_LOG_BIN=0;
mysql> UPDATE account SET balance=1,000 WHERE id=9;
mysql> SET SQL_LOG_BIN=1;
mysql> UPDATE account SET balance = balance - 50 WHERE id=9;
mysql> SHOW MASTER STATUS;
+------------------+----------+--------------+------------------+
| File             | Position | Binlog_Do_DB | Binlog_Ignore_DB |
+------------------+----------+--------------+------------------+
| binary-log.000001 |      674 |              |                  |
+------------------+----------+--------------+------------------+
```

1 2 3

SUPER / BINARY LOG

```
$ mysqlbinlog binary-log.000001 --start-position=354 --stop-position=674

# at 354
#100604 18:00:08 server id 1  end_log_pos 450 Query thread_id=1 exec_time=0
error_code=0
use mysql/*!*/;
SET TIMESTAMP=1275688808/*!*/;
INSERT INTO account VALUES (9,'New',100);
/*!*/;
# at 579
#100604 18:04:31 server id 1  end_log_pos 674 Query thread_id=2 exec_time=0
error_code=0
use mysql/*!*/;
SET TIMESTAMP=1275689071/*!*/;
mysql> UPDATE balance SET balance = balance - 50 WHERE id=9;
/*!*/;
DELIMITER ;
# End of log file
ROLLBACK /* added by mysqlbinlog */;
```

1 3

SUPER/CONNECTION

```
$ mysql -uroot

mysql> show global variables like 'max_connections';
+-----------------+-------+
| Variable_name   | Value |
+-----------------+-------+
| max_connections | 3     |
+-----------------+-------+
1 row in set (0.07 sec)

mysql> show global status like 'threads_connected';
+-------------------+-------+
| Variable_name     | Value |
+-------------------+-------+
| Threads_connected | 4     |
+-------------------+-------+
```


SUPER/CONNECTION

```
$ mysql -uroot
mysql> SHOW PROCESSLIST;
+----+------+-----------+------+---------+------+-----------+---------------
| Id | User | Host      | db   | Command | Time | State     | Info
+----+------+-----------+------+---------+------+-----------+---------------
| 13 | root | localhost | db1  | Query   |  144 | User sleep | UPDATE test1 ...
| 14 | root | localhost | db1  | Query   |  116 | Locked     | select * from test1
| 15 | root | localhost | db1  | Query   |   89 | Locked     | select * from test1

mysql>  KILL THREAD 13;
```

```
$ mysql -uroot
ERROR 1040 (HY000): Too many connections
```

APPLICATION USERS

- Track Data Security
- Separation of responsibilities

- Application Viewer (Read Only Access)
  - SELECT
- Application User (Read/Write Access)
  - INSERT, UPDATE, DELETE, SELECT
- Application DBA (Schema Access Only)
  - CREATE, DROP, CREATE ROUTINE, SELECT, INSERT, UPDATE, DELETE, ...

SECURICH ACL

- User privilege via roles
- http://securich.com

Open source third party package

NEW FEATURES

- User authentication interface (5.5)

http://dev.mysql.com/doc/refman/5.5/en/authentication-plugins.html

- PAM/LDAP Authentication (5.6 Enterprise)

http://blogs.oracle.com/MySQL/entry/new_commercial_extensions_for_mysql
http://blogs.oracle.com/mysql_joro/entry/mysql_55_brings_in_new_ways_to_authenticate_users

Data Integrity

DATA INTEGRITY

```
CREATE TABLE sample_data (
  i TINYINT UNSIGNED NOT NULL,
  c CHAR(2) NULL,
  t TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP
) ENGINE=InnoDB DEFAULT CHARSET latin1;
INSERT INTO sample_data(i) VALUES (0), (100), (255);
Query OK, 3 rows affected (0.00 sec)
SELECT * FROM sample_data;
+-----+------+---------------------+
| i   | c    | t                   |
+-----+------+---------------------+
|   0 | NULL | 2010-06-06 13:28:44 |
| 100 | NULL | 2010-06-06 13:28:44 |
| 255 | NULL | 2010-06-06 13:28:44 |
+-----+------+---------------------+
3 rows in set (0.00 sec)
```

DATA INTEGRITY

```
mysql> INSERT INTO sample_data (i) VALUES (-1), (9000);

mysql> SELECT * FROM sample_data;
+-----+------+---------------------+
| i   | c    | t                   |
+-----+------+---------------------+
|   0 | NULL | 2010-06-06 13:28:44 |
| 100 | NULL | 2010-06-06 13:28:44 |
| 255 | NULL | 2010-06-06 13:28:44 |
|   0 | NULL | 2010-06-06 13:32:52 |
| 255 | NULL | 2010-06-06 13:32:52 |
+-----+------+---------------------+
5 rows in set (0.01 sec)
```

Data In != Data out

SQL_MODE

```
SQL_MODE =
  STRICT_ALL_TABLES,
  NO_ZERO_DATE,
  NO_ZERO_IN_DATE,
  NO_ENGINE_SUBSTITUTION;
```

Minimum Recommended Configuration

http://dev.mysql.com/doc/refman/5.5/en/server-sql-mode.html

Installation

INSTALLATION

- Current version is 5.5
  - http://dev.mysql.com/downloads/
- RedHat distro current version is
  - 5.0.77 - 28 JAN 2009
- Ubuntu distro version is
  - 5.1.44 - 04 FEB 2010

UPDATES

- MySQL is open source
  - More frequent updates
  - MySQL enterprise monthly updates
  - MySQL community ~ 6 months updates
- Release notes

http://dev.mysql.com/doc/refman/5.5/en/news-5-5-x.html

INSTALLATION

- MySQL 5.5 via distro
  - rpm available
  - Oracle has no yum repository
    - No immediate plans for community
  - Canonical (Ubuntu) has no ETA
    - .deb available **NEW **

INSTALLATION

- Recommendations
  - Use MySQL created rpms
  - Use MySQL Tar Binary
- Issues
  - Dependencies
    - PHP/Perl etc

Auditing

AUDITING OPTIONS

- Status variables
- Binary log
- Schema compare
- Audit plugin (5.5)
- Oracle Audit Vault

STATUS VARIABLES

```
mysql> SELECT variable_name, variable_value
    -> FROM INFORMATION_SCHEMA.GLOBAL_STATUS
    -> WHERE variable_name LIKE 'COM_ALTER%'
    -> OR variable_name LIKE 'COM_DROP%'
    -> OR variable_name LIKE 'COM_CREATE%';
+----------------------+----------------+
| variable_name        | variable_value |
+----------------------+----------------+
| COM_ALTER_DB         | 0              |
| COM_ALTER_DB_UPGRADE | 0              |
| COM_ALTER_EVENT      | 0              |
| COM_ALTER_FUNCTION   | 0              |
| COM_ALTER_PROCEDURE  | 0              |
| COM_ALTER_SERVER     | 0              |
| COM_ALTER_TABLE      | 4              |
| COM_ALTER_TABLESPACE | 0              |
```

BINARY LOG

```
$ mysqlbinlog /path/to/file > binlog.txt
$ grep -ie ALTER -e CREATE -e DROP binlog.txt

ALTER TABLE example ADD COLUMN i INT;
ALTER TABLE example ADD INDEX (i);
ALTER TABLE example DROP INDEX y;
ALTER TABLE example DROP COLUMN y;
```

SCHEMA

```
$ mysqldump -uroot -p \
  --no-data --all-databases --skip-dump-date \
  | sed -e "s/AUTO_INCREMENT=[^\ ] //"
  > schema.`date +%Y%m%d.%H%M`sql

# Compare with a previous version
$ diff schema.20111018.sql schema.20111017.sql
```

AUDIT PLUGIN

- Auditing interface (5.5)

  http://dev.mysql.com/doc/refman/5.5/en/audit-plugins.html

TBD

- Oracle Audit Vault

Better Security

RESTRICTING MYSQLD

- Gazzang ezncrypt mask
  - Also provides Transparent Encryption

http://mikefrank.wordpress.com/2011/12/20/on-protecting-mysql-from-unwanted-use-of-skip_grant_tables/

RESTRICTING MYSQLD

- Compile from source
  - --disable-grant-options
    - Removes --skip-grant-tables, --init-file and --bootstrap

http://dev.mysql.com/doc/refman/5.1/en/source-configuration-options.html

Conclusion

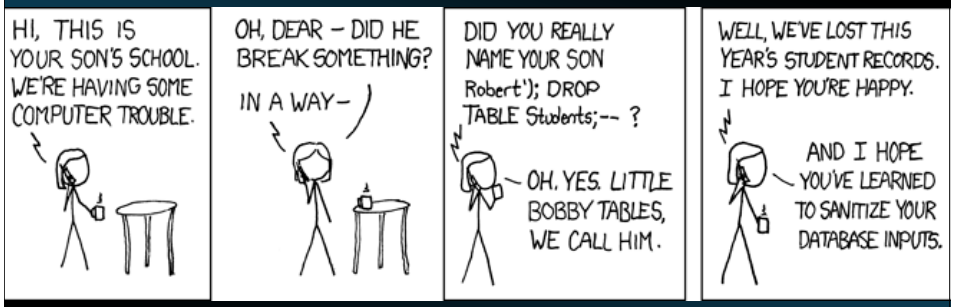
CONCLUSION

- MySQL is not secure by default
  - Responsibility on you (DBA/SA)
- Starts with OS security
- Use appropriate privileges

NOT COVERED

- Replication
- SSL
- Backups
- SQL Injection
  - Sanitize your database inputs

http://xkcd.com/327/



http://xkcd.com/327/

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REFERENCES

- Securing MySQL by Sheeri Cabral

http://sheeri.com/content/securing-mysql-and-how-be-rock-star-dba-pr

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REFERENCES

- OurSQL podcast
  - Episode 59: Security Blankets 1
  - Episode 61: Security Blankets 2
  - Episode 55: MySQL Data encryption

http://technocation.org/

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