Linux 系统运维之 MySQL DBA

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3.《Linux 系统运维之运维监控》 http://www.unixhot.com/pdf/monitor.pdf

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5.《Linux 系统运维之运维规范》 http://www.unixhot.com/pdf/guifan.pdf

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修订历史记录

日 期	版 本	说 明
2009-08-01	V1.0	创建本文原始版本以网页形式发布
2010-07-26	V1.1	PDF 网络发布
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2011-02-03	V1.4	增加“第 7 章 MySQL 性能优化”
2011-05-01	V1.5	详细修改后与《Linux 系统运维》系列同时上线

内容简介

本文通过八个章节，分别阐述了再生产环境中，作为一名运维工程师和 MySQL DBA，应该关注的 MySQL 相关的内容，包括安装时的优化，企业最常用的 MySQL Replication 和 MySQL Cluster 方面的内容。第 7 章和第 8 章阐述了 MySQL 性能相关的内容，如果去监控目前的性能状态，如果去调优以获得最佳的性能指标。在最后一章着重介绍了 MySQL 的备份与恢复，这也是运维工程师和 DBA 工作的重中之重。

前言（Preface）

MySQL 目前已经是各大互联网网站的首选数据库，不仅仅是因为它的开源，更是它良好的性能和插件式的存储引擎，受到越来越多人的青睐。本文也是 Linux 运维系列，所以讲解的 MySQL 数据库技术偏管理一些，在一些大公司应经将 DBA 划分为管理 DBA 和开发 DBA，他们关注的焦点不同。不过没有做过数据库开发的 DBA 并不能称之以为真正的 DBA，所以我并不是 DBA，但作为一名运维工程师或者架构师，数据库又是你不得不掌握并精通的一个技术了。

目录（Contents）

第 1 章 MySQL 概述

1.1 MySQL 简介

1.2 MySQL 相关链接

第 2 章 MySQL 源码安装

2.1 解压并编译安装

2.2 安装参数介绍

2.3 常见用户和组

2.4 安装数据库

2.5 相应权限的修改

2.6 配置文件

2.7 启动数据库并初始化密码

第 3 章 MySQL Replication

3.1 MySQL Replication 概述

3.2 安装 MySQL Slave 数据库

3.3 在 MySQL Master 上的配置

3.4 在 MySQL Slave 上的配置

3.5 测试复制是否成功

第 4 章 MySQL Proxy

4.1 MySQL 读写分离简介

4.2 MySQL 环境部署

4.3 MySQL Proxy 配置

4.4 MySQL Proxy 启动

4.5 MySQL Proxy 测试

第 5 章 MySQL Cluster

5.1 MySQL Cluster 简介

5.2 MySQL Cluster 环境搭建

5.3 MySQL Cluster 测试

第 6 章 Heartbeat 和 DRBD 高可用

6.1 DRBD 介绍

第 1 章 MySQL 概述

1.1 MySQL 简介

MySQL 是最流行的开放源码 SQL 数据库管理系统，它是由 MySQL AB 公司开发、发布并支持的。它的插入式存储引擎可以让使用者根据实际应用使用不同的存储。

1.2 MySQL 相关链接

MySQL 官方网站：http://www.mysql.com/

MySQL 社区版本下载地址：http://www.mysql.com/downloads/mysql/

MySQL 中文文档：http://dev.mysql.com/doc/refman/5.1/zh/index.html

MySQL 实用文档：http://www.unixhot.com/pdf/mysql.pdf

第 2 章 MySQL 源码安装

MySQL 的安装方式有很多，源码安装可定制性比较强，你可以指定你要安装的文件位置，你需要编译的功能等等。

2.1 解压并编译安装

```
[root@MySQL-Master ~]# cd /usr/local/src
[root@MySQL-Master src]# wget
http://ftp.jaist.ac.jp/pub/mysql/Downloads/MySQL-5.1/mysql-5.1.56.tar.gz
[root@MySQL-Master src]# tar zxvf mysql-5.1.56.tar.gz
[root@MySQL-Master src]# cd mysql-5.1.56
[root@MySQL-Master mysql-5.1.56]# ./configure --prefix=/usr/local/mysql \
  --localstatedir=/data/mysql --enable-assembler \
  --with-client-ldflags=-all-static --with-mysqld-ldflags=-all-static \
  --with-pthread --enable-static --with-big-tables --without-ndb-debug \
  --with-charset=utf8 --with-extra-charsets=all \
  --without-debug --enable-thread-safe-client --enable-local-infile --with-plugins=max
[root@MySQL-Master mysql-5.1.56]# make && make install
```

2.2 安装参数介绍

--prefix=/usr/local/mysql //主程序安装目录

--localstatedir=/data/mysql //数据文件存放目录

--with-client-ldflags=-all-static --with-mysqld-ldflags=-all-static//静态编译安装 mysql 客户端和服务端

--with-pthread //采用线程

--with-big-tables //对大表的支持

--with-charset=utf8 //默认字符集为 utf8

--with-extra-charsets=all //安装所有字符集

--without-debug //去掉 debug 模式

--enable-thread-safe-client //以线程方式编译客户端

--with-plugins=max //添加对 innodb 及 partition 的支持

--enable-local-infile //对 load data 的支持

2.3 创建用户和组

[root@MySQL-Master mysql-5.1.56]# groupadd mysql

[root@MySQL-Master mysql-5.1.56]# useradd -s /sbin/nologin -M -g mysql mysql

2.4 安装数据库

[root@MySQL-Master mysql-5.1.56]# cd /usr/local/mysql/

[root@MySQL-Master mysql]# mkdir -p /data/mysql

[root@MySQL-Master mysql]# bin/mysql_install_db --basedir=/usr/local/mysql/ --datadir=/data/mysql/ --user=mysql

2.5 相应权限的修改

[root@MySQL-Master mysql]# chown -R root:mysql /usr/local/mysql/

[root@MySQL-Master mysql]# chown -R mysql:mysql /data/mysql/

2.6 配置文件

[root@MySQL-Master mysql]# cp /usr/local/mysql/share/mysql/my-medium.cnf /etc/my.cnf

[root@MySQL-Master mysql]# cp /usr/local/mysql/share/mysql/mysql.server /etc/init.d/mysqld

[root@MySQL-Master mysql]# chmod 755 /etc/init.d/mysqld

[root@MySQL-Master mysql]# chkconfig --add mysqld

[root@MySQL-Master mysql]# vim /root/.bash_profile

PATH=$PATH:$HOME/bin:/usr/local/mysql/bin

[root@MySQL-Master mysql]# source /root/.bash_profile

2.7 启动数据库并初始化密码。

[root@MySQL-Master mysql]# service mysqld start

Starting MySQL [OK]

[root@MySQL-Master mysql]# mysqladmin -u root password unixhot //设置成自己的密码

第 3 章 MySQL Replication

3.1 MySQL Replication 概述

MySQL Replication 俗称 MySQL AB 复制，主要是通过把主服务器上的二进制日志通过网络传到从服务器上，MYSQL 会自己把二进制日志转换成相关的 DDL，DML，DCL 等语句！但这种复制不同于 MySQL 簇，它是单向异步的。目前 MySQL 复制在企业应用率非常高，已经成为系统工程师必备的技能。

具体的原理请参考 MySQL 官方文档：http://dev.mysql.com/doc/refman/5.1/zh/index.html

3.2 安装 MySQL Slave

实验环境：

实验环境是沿用第二章实验基础上的：

主机名	IP 地址	作用
MySQL-Master	192.168.0.13	MySQL 主库服务器
MySQL-Slave	192.168.0.14	MySQL 从库服务器

3.3 在 MySQL Master 上的配置

3.3.1 创建 Replication 用户

[root@MySQL-Master ~]# mysql -u root -p

Enter password:

Welcome to the MySQL monitor. Commands end with ; or \g.

Your MySQL connection id is 2

Server version: 5.1.55-log Source distribution

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and you are welcome to modify and redistribute it under the GPL v2 license

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> GRANT REPLICATION SLAVE,reload,super ON *.* TO slave@192.168.0.14 IDENTIFIED BY 'unixhot';

Query OK, 0 rows affected (0.00 sec)

Mysql>quit

3.3.2 修改 MySQL 配置文件。

[root@MySQL-Master ~]# vim /etc/my.cnf

server-id=1 #1..设置 server id

log-bin=mysql-binlog #打开二进制日志，最好放在不同的硬盘上，减小磁盘 IO 消耗

expire_logs_day=10 #设置二进制日志保存日期

max_binlog_size=500M #设置每个 binlog 文件的大小

修改完后重新加载数据库：[root@MySQL-Master ~]# /etc/init.d/mysqld restart

注意：mysql-5.1.45.tar.gz 版本默认开启了 log-bin 选项，并且 server-id 默认为 1.

3.3.3 获得 Master DB 的相关信息

```
mysql> show master status;
+------------------+----------+--------------+------------------+
| File             | Position | Binlog_Do_DB | Binlog_Ignore_DB |
+------------------+----------+--------------+------------------+
| mysql-bin.000003 |      106 |              |                  |
+------------------+----------+--------------+------------------+
1 row in set (0.00 sec)
```

注意：供 Slave DB 连接时使用。

3.3.4 备份 Master DB 数据到 Slave DB

备份的方法有很多，可以直接复制数据文件，也可以使用 mysqldump，在这里不再详述。本文全新的搭建，所以不存在数据同步的问题。

3.4 在 MySQL Slave 上的配置。

3.4.1 修改 MySQL 配置文件

[root@MySQL-Slave ~]# vim /etc/my.cnf

server-id=2　#配置多个从服务器时依次设置 id 号

slave-skip-errors=all　#mysql 复制可能出现主服务器上可以运行的语句，从服务器不能够运行，所以我们在 my.cnf 加一句 slave-skip-errors=all 意思是忽略所有的 sql 语句错误！

relay-log=mysql-relay-bin #该文件用于存放 Slave 端的 I/O 线程从 Master 端读取的二进制文件信息

修改完后重启数据库：[root@MySQL-Slave ~]# /etc/init.d/mysqld restart

3.4.2 在 Slave 服务器授权。

mysql> CHANGE MASTER TO

```
    -> MASTER_HOST='192.168.0.13',
    -> MASTER_USER='slave',
    -> MASTER_PASSWORD='unixhot',
    -> MASTER_LOG_FILE='mysql-bin.000003',
    -> MASTER_LOG_POS=106;
Query OK, 0 rows affected (0.04 sec)
```

参数说明：

MASTER_HOST：Master 主机名（或者 IP 地址）

MASTER_USER：Slave 连接 Master 主机的用户名

MASTER_PASSWORD：Slave 连接 Master 的用户密码

MASTER_LOG_FILE：开始复制的日志文件名称

MASTER_LOG_POS：开始复制的日志文件位置，也就是 Log Position。

3.4.3 启动 Slave DB

```
mysql> START SLAVE;
Query OK, 0 rows affected (0.00 sec)
```

3.5 测试复制是否成功。

可以在 Master DB 创建一个数据库，或者表，到 Slave DB 上看，如果配置成功就可以成功同步的。

MySQL Replication 的监控请参考《Linux 系统运维之监控》。

第 4 章 MySQL Proxy

4.1 MySQL 读写分离简介

MySQL-Proxy,是处在你的 MySQL 数据库客户和服务端之间的程序，它还支持嵌入性脚本语言 Lua。这个代理可以用来分析、监控和变换（transform） 通信数据。

MySQL Proxy 最强大的一项功能是实现“读 写分离（Read/Write Splitting）”。基本的原理是让主数据库处理事务性查询，而从数据库处理 SELECT 查询。数据库复制被用来把事务性查询导致的变更同步到集群中的从数据库。

4.2 MySQL 环境部署

实验环境：

实验环境是沿用第三章实验基础上的：

主机名	IP 地址	作用
MySQL-Master	192.168.140.128	MySQL 主库服务器
MySQL-Slave	192.168.140.129	MySQL 从库服务器
MySQL-Proxy	192.168.140.130	MySQL 代理服务器

4.2.1 部署安装环境

[root@MySQL-Proxy ~]# rpm -q libevent glib2 pkgconfig libtool mysql-devel

[root@MySQL-Proxy ~]# cd /usr/local/src

[root@MySQL-Proxy src]# wget http://www.lua.org/ftp/lua-5.1.4.tar.gz

[root@MySQL-Proxy src]#

wget http://gd.tuwien.ac.at/db/mysql/Downloads/MySQL-Proxy/mysql-proxy-0.6.0.tar.gz

[root@MySQL-Proxy src]# wget http://www.monkey.org/~provos/libevent-1.4.13-stable.tar.gz

4.2.2 安装 lua

[root@MySQL-Proxy src]# tar zxvf lua-5.1.4.tar.gz

[root@MySQL-Proxy src]# cd lua-5.1.4

[root@MySQL-Proxy lua-5.1.4]# vi Makefile

修改：

INSTALL_TOP= /usr/local/lua

[root@MySQL-Proxy lua-5.1.4]# make && make linux && make install

[root@MySQL-Proxy lua-5.1.4]# export LUA_CFLAGS="-I/usr/local/lua/include" LUA_LIBS="-L/usr/local/lua/lib -llua -ldl" LDFLAGS="-L/usr/local/libevent/lib -lm"

[root@MySQL-Proxy lua-5.1.4]# export CPPFLAGS="-I/usr/local/libevent/include"

[root@MySQL-Proxy lua-5.1.4]# export CFLAGS="-I/usr/local/libevent/include"

4.2.3 安装 libevent

[root@MySQL-Proxy src]# tar zxvf libevent-1.4.13-stable.tar.gz

[root@MySQL-Proxy src]# cd libevent-1.4.13-stable

[root@MySQL-Proxy libevent-1.4.13-stable]# ./configure --prefix=/usr/local/libevent

[root@MySQL-Proxy libevent-1.4.13-stable]# make && make install

4.2.4 安装 MySQL

[root@MySQL-Proxy src]# tar zxvf mysql-5.1.47.tar.gz

[root@MySQL-Proxy src]# cd mysql-5.1.47

[root@MySQL-Proxy mysql-5.1.47]# ./configure --prefix=/usr/local/mysql --without-server

4.2.5 设置环境变量

[root@MySQL-Proxy src]# export LUA_CFLAGS="-I/usr/local/lua/include" LUA_LIBS="-L/usr/local/lua/lib -llua -ldl" LDFLAGS="-L/usr/local/libevent/lib -lm"

[root@MySQL-Proxy src]# export CPPFLAGS="-I/usr/local/libevent/include"

[root@MySQL-Proxy src]# export CFLAGS="-I/usr/local/libevent/include"

4.2.6 安装 MySQL-Proxy

注意：如果你安装更高版本的 mysql-proxy 需要升级你的 glib。

[root@MySQL-Proxy src]# tar zxvf mysql-proxy-0.6.0.tar.gz

[root@MySQL-Proxy src]# cd mysql-proxy-0.6.0

[root@MySQL-Proxy mysql-proxy-0.6.0]# ./configure --prefix=/usr/local/mysql-proxy --with-mysql=/usr/local/mysql --with-lua

[root@MySQL-Proxy mysql-proxy-0.6.0]# make && make install

4.3 MySQL-Proxy 配置

[root@MySQL-Proxy ~]# /usr/local/mysql-proxy/sbin/mysql-proxy --help-all

Usage:

mysql-proxy [OPTION...] - MySQL Proxy

Help Options:

-?, --help

--help-all

--help-admin

--help-proxy

admin module

--admin-address=<host:port> #管理主机监听地址和端口，默认是 4041

proxy-module

-proxy-address=<host:port> #代理主机监听地址和端口，默认是 4040

--proxy-read-only-backend-addresses=<host:port> #只读连接时，代理服务器的监听地址及端口。

默认 4042

--proxy-backend-addresses=<host:port> #连接后端真实服务器时的地址及监听端口，默认是 3306

--proxy-skip-profiling

--proxy-fix-bug-25371

--proxy-lua-script=<file> 连接真实服务器的地址及监听端口，默认是 3306

--no-proxy

Application Options:

-V, --version

--daemon

--pid-file=<file>

4.4 MySQL Proxy 启动

4.4.1 命令行启动

```
[root@MySQL-Proxy ~]# /usr/local/mysql-proxy/sbin/mysql-proxy \
> --proxy-read-only-backend-addresses=192.168.140.129:3306 \
> --proxy-backend-addresses=192.168.140.128:3306 \
> --proxy-lua-script=/usr/local/mysql-proxy/share/mysql-proxy/rw-splitting.lua &
```

检测是否开始监听：

```
[root@MySQL-Proxy ~]# netstat -ntlp | grep mysql
tcp        0      0 0.0.0.0:4040          0.0.0.0:*          LISTEN      28739/mysql-proxy
tcp        0      0 0.0.0.0:4041          0.0.0.0:*          LISTEN      28739/mysql-proxy
```

4.4.2 脚本启动

```
[root@MySQL-Proxy ~]# vi /etc/init.d/mysql-proxy
#!/bin/bash
PRODIR=/usr/local/mysql-proxy
```

```
LUA_PATH=$PRODIR/share/mysql-proxy

start(){
$PRODIR/sbin/mysql-proxy --proxy-read-only-backend-addresses=192.168.140.129:3306
--proxy-backend-addresses=192.168.140.128:3306 --proxy-lua-script=$LUA_PATH/rw-splitting.lua
>>$PRODIR/mysql-proxy.log &
}

stop(){
kill $(pidof mysql-proxy)
if [ $? -ne 0 ];then
    kill -9 $(pidof mysql-proxy)
fi
}

case "$1" in
    start)
        start
        ;;
    stop)
        stop
        ;;
    restart)
        stop
        start
        ;;
    *)
        echo $"Usage: $0 {start|stop|restart}"
Esac
[root@MySQL-Proxy ~]# chmod +x /etc/init.d/mysql-proxy
```

[root@MySQL-Proxy ~]# /etc/init.d/mysql-proxy start

4.5 MySQL Proxy 测试

4.5.1 测试环境部署

在 MySQL-Master 上创建测试数据库和用户。

mysql> create database unixhot;

mysql> GRANT ALL PRIVILEGES ON unixhot.* to proxytest@'%' identified by 'unixhot';

4.5.2 连接测试

[root@MySQL-Proxy ~]# mysql -h 192.168.140.130 -P 4040 -u proxytest -p

输入密码即可登录。

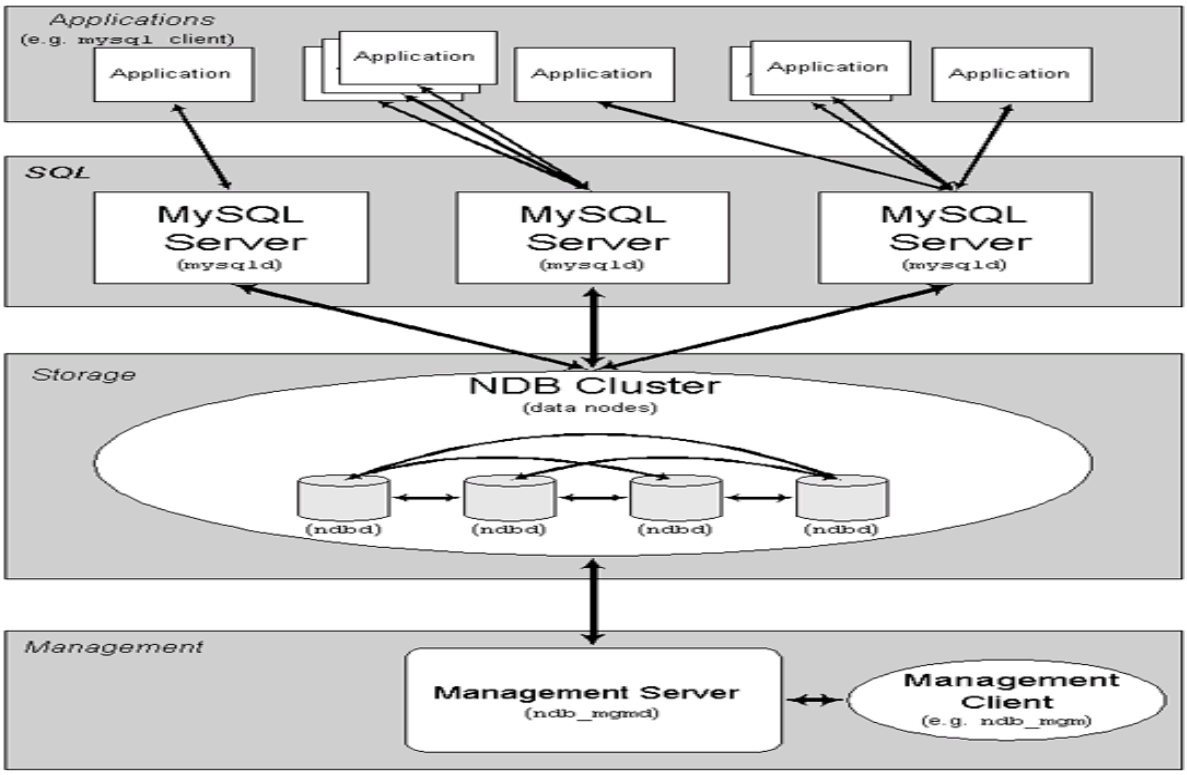
注意：在这里只做简单测试，具体请根据具体应用进行测试。由于目前 MySQL Proxy 技术还不够成熟，如果想在生产环境部署，请慎用。

第 5 章 MySQL Cluster

5.1 MySQL Cluster 简介

请参考官方文档：http://dev.mysql.com/doc/refman/5.1/zh/ndbcluster.html

下面是官方的 MySQL Cluster 的基本架构图：



5.2 MySQL Cluster 环境搭建

搭建 MySQL Cluster 至少需要三个节点，一个管理节点来实现管理功能，一个 SQL 节点主机来实现 MySQL server 功能，一个 ndb 节点主机实现 NDB Cluster 的功能。

5.2.1 实验环境

主机名	IP 地址	作用
MySQL-SQL-Node1	192.168.140.128	SQL 节点服务器
MySQL-Data-Node1	192.168.140.129	Data 节点服务器
MySQL-MGM-Node	192.168.140.130	管理节点服务器

注意：如果你的实验环境是根据本文的设置，为了对 MySQL Cluster 的配置不冲突，请整理前面的实验环境，如下：

[root@MySQL-Proxy ~]# /etc/init.d/mysql-proxy stop

[root@MySQL-Slave ~]# /etc/init.d/mysqld stop

[root@MySQL-Master ~]# /etc/init.d/mysqld stop

5.2.2 部署安装环境

[root@MySQL-SQL-Node1 src]# wget

http://ftp.jaist.ac.jp/pub/mysql/Downloads/MySQL-Cluster-7.1/mysql-cluster-gpl-7.1.3.tar.gz

[root@MySQL-SQL-Node1 src]# chmod +x mysql-cluster-gpl-7.1.3.tar.gz

[root@MySQL-SQL-Node1 src]# scp mysql-cluster-gpl-7.1.3.tar.gz 192.168.140.129:/usr/local/src

[root@MySQL-SQL-Node1 src]# scp mysql-cluster-gpl-7.1.3.tar.gz 192.168.140.130:/usr/local/src

5.2.3 部署管理(MGM)节点

1> 安装 MGM 节点

```
[root@MySQL-MGM-Node ~]# cd /usr/local/src
[root@MySQL-MGM-Node src]# tar zxvf mysql-cluster-gpl-7.1.3.tar.gz
[root@MySQL-MGM-Node src]# cd mysql-cluster-gpl-7.1.3
[root@MySQL-MGM-Node mysql-cluster-gpl-7.1.3]# ./configure --prefix=/usr/local/mysqlcluster \
  --with-charset=utf8 --with-collation=utf8_general_ci \
  --with-client-ldflags=-all-static -with-mysqld-ldflags=-all-static \
  --enable-assembler --with-extra-charsets=complex \
  --enable-thread-safe-client --with-big-tables --with-readline \
  --with-ssl --with-embedded-server --enable-local-infile \
  --with-unix-socket-path=/usr/local/mysqlcluster/tmp/mysql.sock \
  --sysconfdir=/usr/local/mysqlcluster/etc --without-debug \
  --with-mysqld-user=mysql --with-plugins=max
```

[root@MySQL-MGM-Node mysql-cluster-gpl-7.1.3]# make && make install

2> 配置 MGM 节点

[root@MySQL-MGM-Node ~]# cd /usr/local/mysqlcluster/

[root@MySQL-MGM-Node mysqlcluster]# mkdir mysql-cluster

[root@MySQL-MGM-Node mysqlcluster]# vi mysql-cluster/config.ini

[NDBD DEFAULT]

NoOfReplicas= 1

DataMemory=50M

IndexMemory=10M

[NDB_MGMD]

id=1

HostName=192.168.140.130

DataDir=/usr/local/mysqlcluster/mysql-cluster

[NDBD]

id=2

HostName=192.168.140.129

DataDir=/usr/local/mysqlcluster/ndbdata

[MYSQLD]

id=3

HostName=192.168.140.128

3> 启动 MGM 节点

[root@MySQL-MGM-Node mysqlcluster]# libexec/ndb_mgmd -f

/usr/local/mysqlcluster/mysql-cluster/config.ini

5.2.4 部署 NDBD 节点

1> 安装 NDBD 节点

```
[root@MySQL-Data-Node1 ~]# cd /usr/local/src
[root@MySQL-Data-Node1 src]# tar zxvf mysql-cluster-gpl-7.1.3.tar.gz
[root@MySQL-Data-Node1 src]# cd mysql-cluster-gpl-7.1.3
[root@MySQL-Data-Node1 mysql-cluster-gpl-7.1.3]# ./configure --prefix=/usr/local/mysqlcluster \
  --with-charset=utf8 --with-collation=utf8_general_ci \
  --with-client-ldflags=-all-static -with-mysqld-ldflags=-all-static \
  --enable-assembler --with-extra-charsets=complex \
  --enable-thread-safe-client --with-big-tables --with-readline \
  --with-ssl --with-embedded-server --enable-local-infile \
  --with-unix-socket-path=/usr/local/mysqlcluster/tmp/mysql.sock \
  --sysconfdir=/usr/local/mysqlcluster/etc --without-debug \
  --with-mysqld-user=mysql --with-plugins=max
[root@MySQL-Data-Node1 mysql-cluster-gpl-7.1.3]# make && make install
```

2> 配置 NDBD 节点

```
[root@MySQL-Data-Node1 ~]# cd /usr/local/mysqlcluster/
[root@MySQL-Data-Node1 mysqlcluster]# mkdir etc ndbdata
[root@MySQL-Data-Node1 mysqlcluster]# vi etc/my.cnf
[mysqld]
basedir=/usr/local/mysqlcluster/
datadir=/usr/local/mysqlcluster/var
user=mysql
```

port=3306

socket=/usr/local/mysql/tmp/mysql.sock

ndbcluster

ndb-connectstring=192.168.140.130

[mysql_cluster]

ndb-connectstring=192.168.140.130

3> 启动 NDBD 节点

[root@MySQL-Data-Node1 mysqlcluster]# libexec/ndbd --initial

注意：

第一次启动需要加--initial 参数进行初始化工作，在以后的启动中，千万不要加该参数，因为 ndbd 程序会清除之前建立的所有用于恢复的数据文件和日志文件。

5.2.5 部署 SQL 节点

1> 安装 SQL 节点

[root@MySQL-SQL-Node1 ~]# cd /usr/local/src/

[root@MySQL-SQL-Node1 src]# tar zxvf mysql-cluster-gpl-7.1.3.tar.gz

[root@MySQL-SQL-Node1 src]# cd mysql-cluster-gpl-7.1.3

[root@MySQL-SQL-Node1 mysql-cluster-gpl-7.1.3]# ./configure --prefix=/usr/local/mysqlcluster \

--with-charset=utf8 --with-collation=utf8_general_ci \

--with-client-ldflags=-all-static -with-mysqld-ldflags=-all-static \

--enable-assembler --with-extra-charsets=complex \

--enable-thread-safe-client --with-big-tables --with-readline \

--with-ssl --with-embedded-server --enable-local-infile \

--with-unix-socket-path=/usr/local/mysqlcluster/tmp/mysql.sock \

```
  --sysconfdir=/usr/local/mysqlcluster/etc --without-debug \
  --with-mysqld-user=mysql --with-plugins=max
[root@MySQL-Data-Node1 mysql-cluster-gpl-7.1.3]# make && make install
```

2> 配置 SQL 节点

```
[root@MySQL-SQL-Node1 ~]# cd /usr/local/mysqlcluster/
[root@MySQL-SQL-Node1 mysqlcluster]# mkdir etc
[root@MySQL-SQL-Node1 mysqlcluster]# chown -R root:mysql .
[root@MySQL-SQL-Node1 mysqlcluster]# bin/mysql_install_db --user=mysql
[root@MySQL-SQL-Node1 mysqlcluster]# vi etc/my.cnf
[mysqld]
basedir=/usr/local/mysqlcluster/
datadir=/usr/local/mysqlcluster/var
user=mysql
port=3306
socket=/usr/local/mysql/tmpcluster/mysql.sock
ndbcluster
ndb-connectstring=192.168.140.130
[mysql_cluster]
ndb-connectstring=192.168.140.130
```

3> 启动 SQL 节点

```
[root@MySQL-SQL-Node1 mysqlcluster]# bin/mysqld_safe --user=mysql &
```

5.3 MySQL Cluster 测试

在管理节点上测试：

```
[root@MySQL-MGM-Node ~]# cd /usr/local/mysqlcluster/
[root@MySQL-MGM-Node mysqlcluster]# bin/ndb_mgm
-- NDB Cluster -- Management Client --
ndb_mgm> show
Connected to Management Server at: localhost:1186
Cluster Configuration
---------------------
[ndbd(NDB)]  1 node(s)
id=2 @192.168.140.129   (mysql-5.1.44 ndb-7.1.3, Nodegroup: 0, Master)

[ndb_mgmd(MGM)]     1 node(s)
id=1 @192.168.140.130   (mysql-5.1.44 ndb-7.1.3)

[mysqld(API)] 1 node(s)
id=3 @192.168.140.128   (mysql-5.1.44 ndb-7.1.3)
```

第 6 章 Heartbeat 和 DRBD 高可用

6.1 DRBD 介绍

DRBD(Distributed Replicated Block Device)，DRBD 号称是 "网络 RAID"，开源软件，由 LINBIT 公司开发。DRBD 分为两个部分，内核中的驱动程序代码和用户空间的工具。Linux 2.6.33 之后的内核版本集成了 DRBD。

DRBD 实际上是一种块设备的实现,主要被用于 Linux 平台下的高可用(HA)方案之中。他是有内

核模块和相关程序而组成，通过网络通信来同步镜像整个设备，有点类似于一个网络 RAID 的功能。也就是说当你将数据写入本地的 DRBD 设备上的文件系统时,数据会同时被发送到网络中的另外一台主机之上， 并以完全相同的形式记录在一个文件系统中（实际上文件系统的创建也是由 DRBD 的同步来实现的）。本地节点（主机）与远程节点（主机）的数据可以保证实时 的同步，并保证 IO 的一致性。所以当本地节点的主机出现故障时,远程节点的主机上还会保留有一份完全相同的数据,可以继续使用，以达到高可用的目的。

6.2 Heartbeat 介绍

6.3 部署前的准备工作

第一步：准备两台服务器，分别安装上 MySQL。

第二步：检查你的内核版本，如果是或高于 2.6.33 的话，就不需要安装了。

```
[root@MySQL-M ~]# uname -r
2.6.18-164.el5
```

第三步：准备 DRBD 使用的硬盘，我为两台服务器各加了一块硬盘。并分区，没有创建文件系统。

```
 Device Boot      Start         End      Blocks   Id  System
/dev/sdb1               1         261     2096451   83  Linux
```

第四步：IP 地址和主机名

主机名	IP 地址	作用
MySQL-node1	192.168.140.137	MySQL 主库服务器
MySQL-node2	192.168.140.139	MySQL 备库服务器

6.4 安装 DRBD

该小节所有内容需要在两个节点 MySQL-node1 和 MySQL-node2 分别执行。

6.4.1 下载软件包

```
[root@MySQL-node1 ~]# cd /usr/local/src
[root@MySQL-node1 src]# wget http://oss.linbit.com/drbd/8.3/drbd-8.3.7.tar.gz
[root@MySQL-node1 src]# tar zxvf drbd-8.3.7.tar.gz
[root@MySQL-node1 src]# cd drbd-8.3.7
```

6.4.2 编译为内核模块方式

```
[root@MySQL-node1 drbd-8.3.7]# ./configure --prefix=/usr/local/drbd \
> --sysconfdir=/etc --with-km
[root@MySQL-node1 drbd-8.3.7]# make
Module build was successful.(显示模块创建成功为正确)
[root@MySQL-node1 drbd-8.3.7]# make install
[root@MySQL-node1 ~]# whereis drbd
drbd: /etc/drbd.d /etc/drbd.conf /usr/local/drbd
```

6.4.3 载入 DBRD 模块到内核中

```
[root@MySQL-node1 ~]# modprobe drbd
[root@MySQL-node1 ~]# lsmod | grep drbd
drbd                   272504  0
[root@MySQL-node1 ~]# echo "modprobe drbd" >> /etc/rc.local
```

6.4.4 DRBD 命令

安装成功后，会发现，系统增加了以下三个命令：

```
[root@MySQL-node1 ~]# ls /sbin/drbd*
/sbin/drbdadm  /sbin/drbdmeta  /sbin/drbdsetup
```

6.5 DRBD 配置

6.5.1 /etc/drbd.conf

```
[root@MySQL-M ~]# cat /etc/drbd.conf
# You can find an example in  /usr/share/doc/drbd.../drbd.conf.example

include "drbd.d/global_common.conf";
include "drbd.d/*.res";
```

默认情况下，该文件包含了/etc/drbd.d 目录下的配置文件,下面是我修改好的 drbd.conf

```
[root@MySQL-M ~]# cat /etc/drbd.conf
include "drbd.d/global_common.conf";
resource r0 {  #定义一个资源名字 r0
    on MySQL-node1 {
        device /dev/drbd1;  #设置一个 DRBD device，编号是从 0 开始，主设备号 147。
        disk /dev/sdb1; #本地使用的 device
        address 192.168.140.137:7789;  #网络设置，IP 地址加端口
        meta-disk internal;
    }

    on MySQL-node2 {
        device /dev/drbd1;
        disk /dev/sdb1;
        address 192.168.140.139:7789;
        meta-disk internal;
    }
}
```

6.5 初始化设置

6.5.1 创建 DRBD 元数据

```
[root@MySQL-node1 ~]# drbdadm create-md r0
Writing meta data...
initializing activity log
NOT initialized bitmap
New drbd meta data block successfully created.
success
[root@MySQL-node1 ~]# drbdadm attach r0
[root@MySQL-node1 ~]# drbdadm syncer r0
[root@MySQL-node1 ~]# drbdadm connect r0
```

设置为主节点：

```
[root@MySQL-node1 ~]# drbdadm -- --overwrite-data-of-peer primary r0
[root@MySQL-node1 ~]# mkfs.ext3 /dev/drbd1
[root@MySQL-node1 ~]# cat /proc/drbd
version: 8.3.7 (api:88/proto:86-91)
GIT-hash: ea9e28dbff98e331a62bcbcc63a6135808fe2917 build by root@MySQL-M, 2010-11-26
02:36:34

 1: cs:SyncSource ro:Primary/Secondary ds:UpToDate/Inconsistent C r---n
    ns:75304 nr:0 dw:66388 dr:8952 al:25 bm:2 lo:0 pe:0 ua:0 ap:0 ep:1 wo:b oos:2024192
    [>....................] sync'ed:  3.6% (2024192/2096348)K
    finish: 1:52:27 speed: 256 (2,120) K/sec


[root@MySQL-node2 ~]# cat /proc/drbd
version: 8.3.7 (api:88/proto:86-91)
GIT-hash: ea9e28dbff98e331a62bcbcc63a6135808fe2917 build by root@MySQL-node2, 2010-11-27
01:50:08

 1: cs:SyncTarget ro:Secondary/Primary ds:Inconsistent/UpToDate C r----
    ns:0 nr:79880 dw:79880 dr:0 al:0 bm:2 lo:0 pe:0 ua:0 ap:0 ep:1 wo:b oos:2019616
```

```
[>....................] sync'ed:  3.8% (2019616/2096348)K
finish: 0:42:04 speed: 512 (1,868) K/sec
```

第 7 章 MySQL 性能监控

MySQL 运行状态的监控是每个运维工程师，和 MySQL DBA 的主要工作之一。我们把 MySQL 的监控分为两个部分，一部分为基本状态的监控（请参考《Linux 系统运维之运维监控》），一部分为性能方面的监控，是为 MySQL 性能优化提供的参考信息，在这一章节，详细讲解，MySQL 性能监控方面的内容。

7.1 性能监控的工具

在 MySQL 的命令行中，DBA 们通常使用一下命令来获取 MySQL 的状态报告：

Mysql> show status;

Mysql> show master status;

Mysql> show slave status;

Mysql> show inodb status;

下面是 show status 输出的最后一行，可以看到总共有 268 行。面对如此庞大的性能指标，让很多 DBA 望而生畏。

268 rows in set (0.00 sec)

7.2 mysqlreport

Mysqlreport 是用 perl 编写的一个命令行工具，解决了 show status 产生的大量我们难以阅读的状况。

7.2.1 mysqlreport 的相关资源

http://hackmysql.com/mysqlreport （官方首页）

http://hackmysql.com/mysqlreportguide （用户手册）

7.2.2 mysqlreport 安装

Mysqlreport 需要 Perl-DBI 和 Perl-DBD-Mysql 的支持。

[root@MySQL-Master ~]# cd /usr/local/src

[root@MySQL-Master src]# wget http://hackmysql.com/scripts/mysqlreport-3.5.tgz

[root@MySQL-Master src]# tar zxvf mysqlreport-3.5.tgz

mysqlreport-3.5/

mysqlreport-3.5/COPYING

mysqlreport-3.5/mysqlreportdoc.html

mysqlreport-3.5/mysqlreportguide.html

mysqlreport-3.5/mysqlreport

7.2.3 mysqlreport 参数详解

[root@MySQL-Master mysqlreport-3.5]# perl mysqlreport --help

mysqlreport v3.5 Apr 16 2008

mysqlreport makes an easy-to-read report of important MySQL status values.

Command line options (abbreviations work):

--user USER Connect to MySQL as USER #用户名

--password PASS Use PASS or prompt for MySQL user's password #密码

--host ADDRESS Connect to MySQL at ADDRESS #主机 IP 或可以解析的域名

--port PORT Connect to MySQL at PORT #mysql 端口。

--socket SOCKET Connect to MySQL at SOCKET #设置通过 mysql socket 连接。

```
--no-mycnf          Don't read ~/.my.cnf                    #不读取 my.cnf 配置文件
--infile FILE       Read status values from FILE instead of MySQL
--outfile FILE      Write report to FILE                    #输出写入到文件中
--email ADDRESS     Email report to ADDRESS (doesn't work on Windows) #发送输出日志到邮件
--flush-status      Issue FLUSH STATUS; after getting current values
--relative X        Generate relative reports. If X is an integer,
                        reports are live from the MySQL server X seconds apart.
                        If X is a list of infiles (file1 file2 etc.),
                        reports are generated from the infiles in the order
                        that they are given.
--report-count N    Collect N number of live relative reports (default 1)
--detach            Fork and detach from terminal (run in background)
--help              Prints this     #打印此帮助日志
--debug             Print debugging information
```

Visit http://hackmysql.com/mysqlreport for more information.

第 8 章 MySQL 性能优化

MySQL 性能优化，是我么进行应用系统优化时最后要考虑的问题，也是必需要考虑的问题，虽然每个应用的数据库都不尽相同，但还是有一些通用的优化方法，在这一章节主要讲解，我们常用的通用的一些优化的方法。

8.1 索引缓存（MYISAM）

索引是 MySQL 性能优化中一个重量级的角色，至于如何有效使用索引，大家可以询问开发人员或者参考其它的书籍，在这里主要讲讲索引缓存。

那么是不是所有的数据库都需要开启索引缓存呢，答案是否定的，我们需要参考的是您的应用，通常情况下，你的应用 Select 查询占数据库操作的 80%都需要使用缓存索引，而如果你的 Update 和 insert 比较多的话，使用索引缓存反而影响了 MySQL 的性能，可以说索引缓存是把双刃剑。

MySQL 使用 key_buffer 选项来配置给索引缓存分配的内存空间大小。这个值需要你根据 mysqlreport 中的 Key 的使用和命中信息来决定大小。一般需要大于，你数据库中所有 MYI 文件的总大小。以下命令可以统计出所有 MYI 文件的总大小，结果的单位是字节。

```
ls -l | grep 'MYI$' | awk -F' ' '{print$5}'|awk -v sum=0 '{sum += $NF} END{print sum}'
```

8.2 查询缓存(MYISAM、INNODB)

MySQL 支持查询缓存，它会在内存中开辟一块内存区用来缓存 select 查询的结果。对于 select 比较多的应用，应该开启查询缓存。同上，如果对于 slect 和 update 几乎一样的应用，不推荐使用查询缓存，因为只要是缓存都存在缓存的过期重建，而每次 update 都会导致 update 的操作表的缓存被重建。

默认 MySQL 是没有使用查询缓存。在 my.cnf 添加以下内容开启：

Query_cahce_size = 200000000

Query_cache_type =1

Query_cache_limit = 1000000

8.3 线程缓存

MySQL 使用多线程来处理并发的链接，最大的线程数量通过 max_connections 来制定，为了减少创建线程的重复开销，可以开启线程的缓存，其实就是开启线程的复用技术。

MySQL 默认是没有使用，在 my.cnf 添加以下内容开启：

Thread_cahce_size = 200

8.4 表高速缓存

表高速缓存是指 MySQL 访问一个表时，会判断表高速缓存是否有空间，如果有的话，就把表放入高速缓存中，再打开表，这样可以更快的访问表的内容。

通过 table_cache 选项来设置大小。

MySQL 优化的路还很长，需要不断增加对 MySQL 的了解，对应用系统的了解，才能根据应用将 MySQL 的性能发挥到极致。笔者经验有限，本文档会持续更新，分享工作中的问题和经验，欢迎大家加入“运维社区”，请用 Google 搜索“运维社区”，我们始终站在第一位。

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