MySQL Conference & Expo

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MySQL 6.0 Backup

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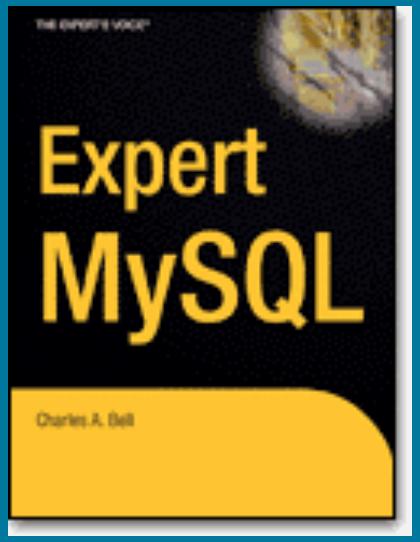
Replication and Backup Team

About the Speaker

- Chuck Bell
- PhD in Engineering from Virginia Commonwealth University
- Working on Backup
- (recovering) Windows Developer
- Author of “Expert MySQL”



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Topics

- Overview
- State of Development
- Comparison with Existing Solutions
- Architecture (brief)
- Capabilities
- Tips and Tricks
- Future Plans
- Live Demo (time permitting)
- Resources

MySQL 6.0 Backup Overview

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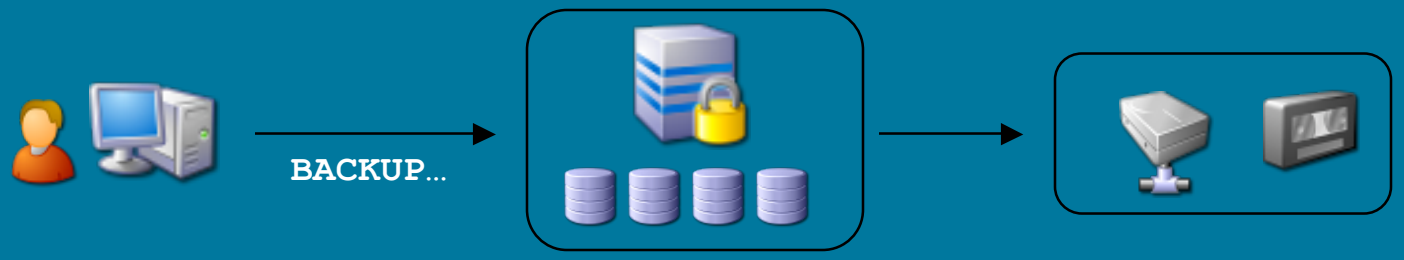
Introduction - MySQL 6.0 Backup

- SQL-driven. Run from any MySQL client
- Back up to local disk on MySQL server host
- New security privileges for backup/restore
- Blocking restore (during recovery operation)
- Non-blocking backup for storage engines supporting consistent read (i.e. InnoDB, Falcon)



Overview

- Data protection and recovery
- BACKUP and RESTORE basic functionality available now
- Database-level backup
  - table
  - views
  - stored procedures
  - stored functions
  - triggers
  - events

Overview

- Cool! Where can I get it?
- Source code can be downloaded from bk-bits:

  http://mysql.bkbits.net/ - see mysql-6.0
- Alpha release available soon in MySQL 6.0.5.
- Latest release builds are available from:
- http://www.mysql.com/download

Design Details

- **Available in 6.0:**
  - ***Enterprise-level consistency*** between and within engines
  - ***Default*** driver for engines that don't support backup
  - ***Consistent Snapshot*** driver for consistent read engines i.e. non-blocking for DML
  - ***Storage-engine specific backup methods*** support for native drivers in API
  - ***Mix logical and physical backup formats*** at the same time (coming soon with MyISAM Native driver)
  - ***Streaming*** backup data (only to server file in first version)
- Future Releases:
  - ***Pluggable, modular architecture***
  - ***Versioning of interfaces and modules for future release and backward compatibility***

State of Development

Already implemented features

- **Enterprise-level consistency**
  with respect to different storage engines, server replication state and XA.
- ***Default*** blocking backup/restore driver
- ***Consistent Snapshot*** non-blocking backup driver
- ***Metadata*** backup (CREATE statement)
- Backup kernel ***synchronization algorithm***
- ***Backup driver API***
  (forge.mysql.com/wiki/OnlineBackup)
- ***Restore driver API***
  (forge.mysql.com/wiki/OnlineBackup)

Already implemented features

- ***File storage*** on MySQL server host
- ***Data transfer protocol*** for driver API
- ***Streaming Format*** for backup image file
- ***MyISAM*** backup/restore native driver (coming soon!)
- ***Tablespace*** support for Falcon (coming soon)
- ***No data engine*** backup/restore (coming soon) e.g., blackhole, merge, etc.
- ***Synchronization with binary log*** for point-in-time recovery

Comparison with Existing Solutions

Current MySQL Backup Alternatives

MySQL Tools (non-blocking)

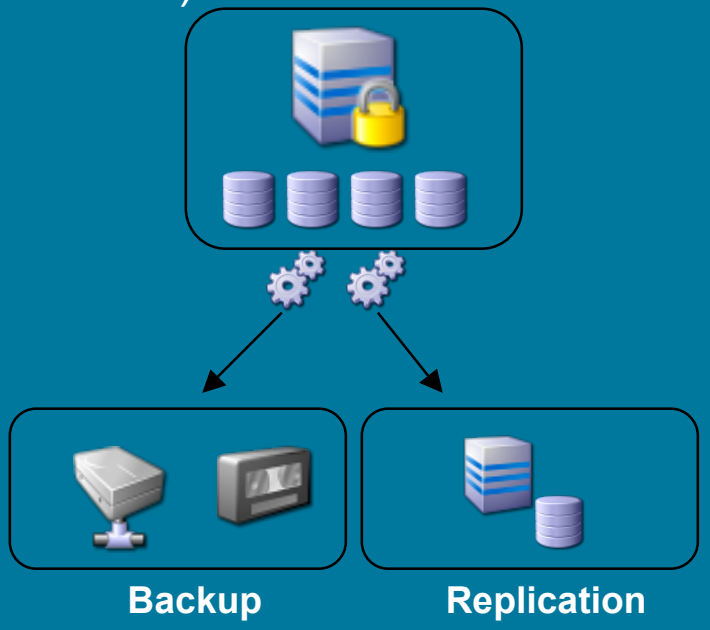
- mysqldump w/ --single-transaction option (InnoDB, Falcon, PBXT)
- MySQL Cluster backup (only NDB)
- Replication
- InnoDB Hot Backup (InnoDB only; commercial tool)

MySQL Tools (blocking)

- mysqldump
- mysqlhotcopy
- Native file system copy
- SELECT … INTO OUTFILE

Third Party Tools

- Zmanda (non-blocking/blocking)
- BakBone
- Others…

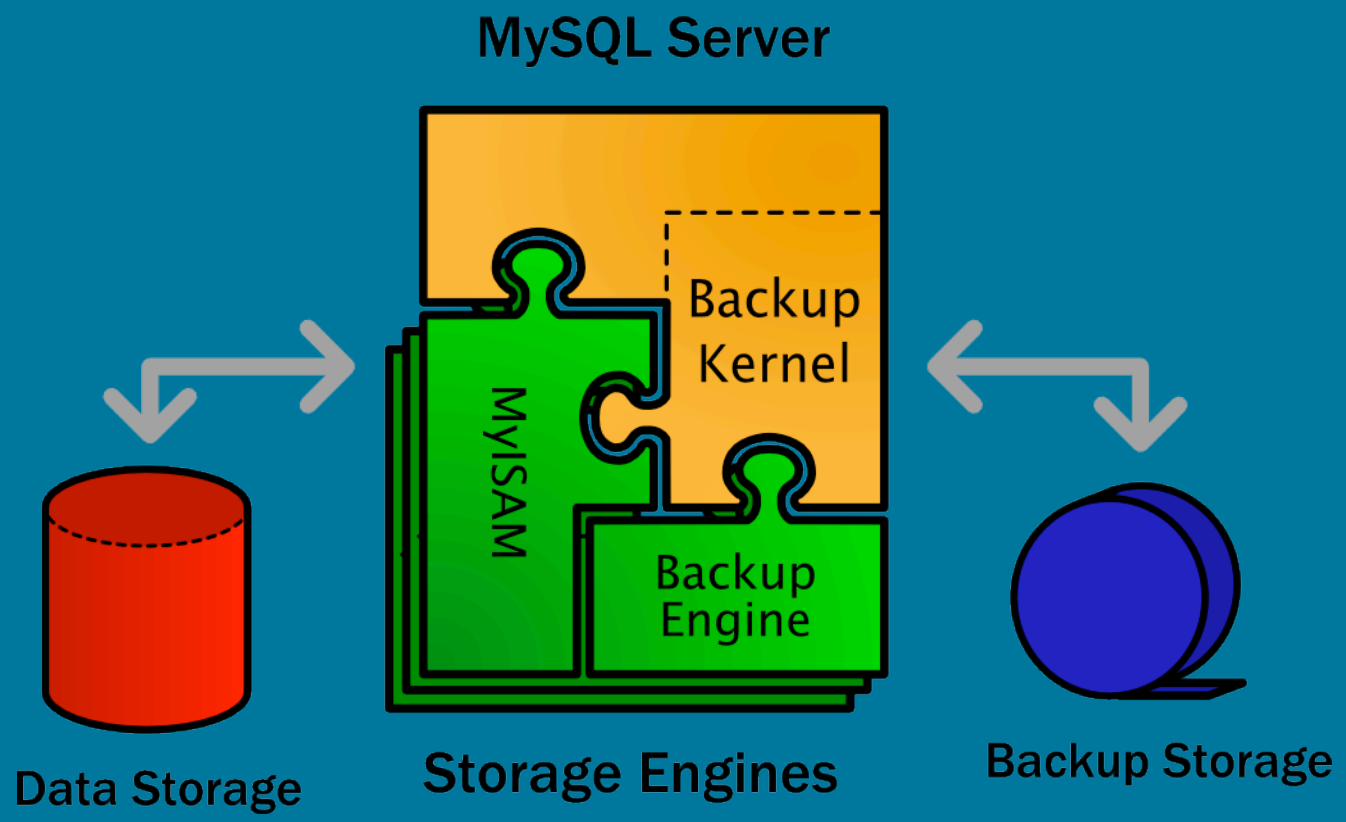


Feature Comparison

Feature	mysqldump	Hot Backup	OB
SQL-Based			☑
Restore command (easier execution)			☑
Non-blocking DML	☑	☑	☑
Logical backup format	☑		
Schema-only backup	☑		
Native drivers (planned)		☑	☑
Non-blocking DML backup for MyISAM			☑
InnoDB only		☑	
Logical backup for InnoDB	☑		☑
Blocking DML backup for MyISAM	☑	☑	
Larger backup files (vs. native backup)	☑		
Slower execution than native backup	☑		

Architecture

Architecture



Terminology

Backup Kernel

- A part of the MySQL server that can execute statements

Backup Engine

- Contains a specific backup driver and restore driver

Backup Driver

- Provides data to backup kernel

Restore Driver

- Restores data into something (normally a storage engine)

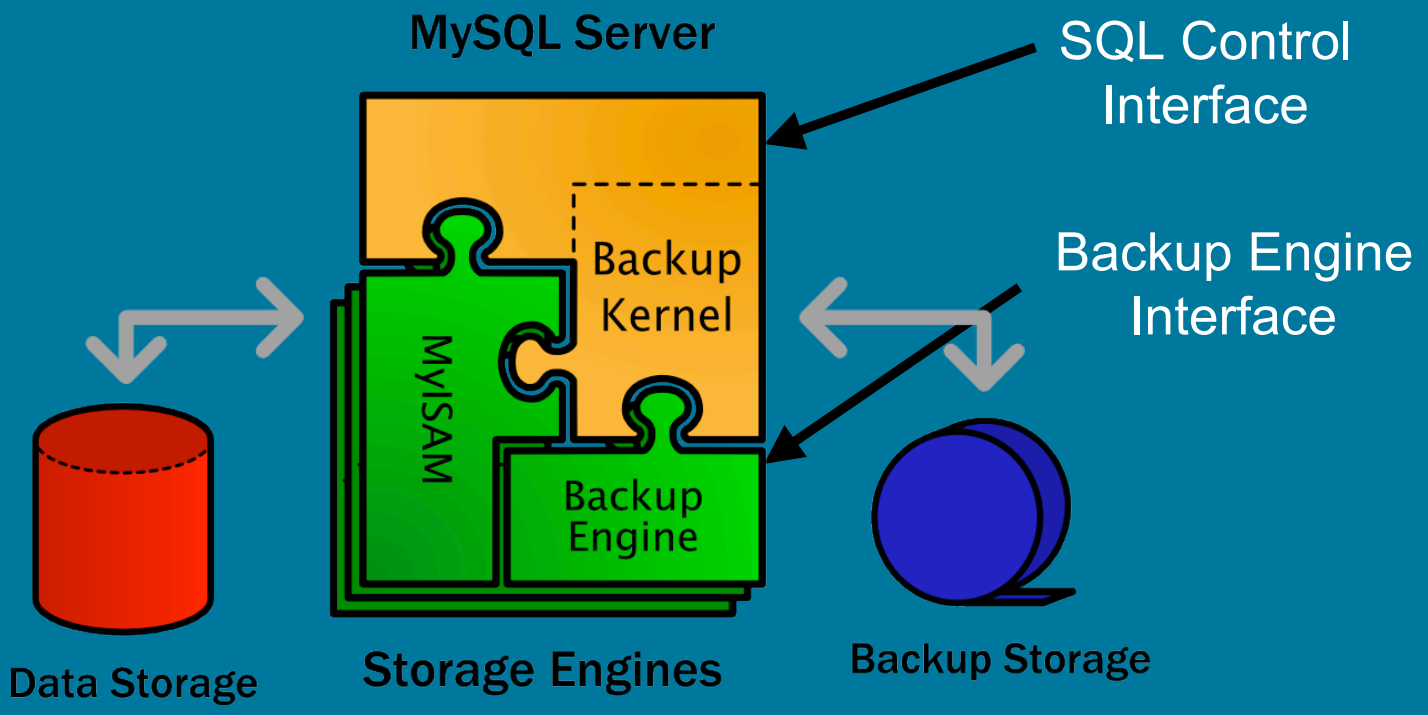
Default backup or restore driver

- A driver provided by server kernel (can be pluggable)

Native backup or restore driver

- A driver provided by a storage engine (can be pluggable)

Interfaces



1. **SQL Control Interface** – Between the MySQL client and the MySQL server. Statements that control when a backup should be taken, show status information, etc.
2. **Backup Engine Interface** – Between the backup kernel and backup engine. Implemented in each storage engine that has data storage that should be backed up natively.

Backup Kernel & Backup Engine

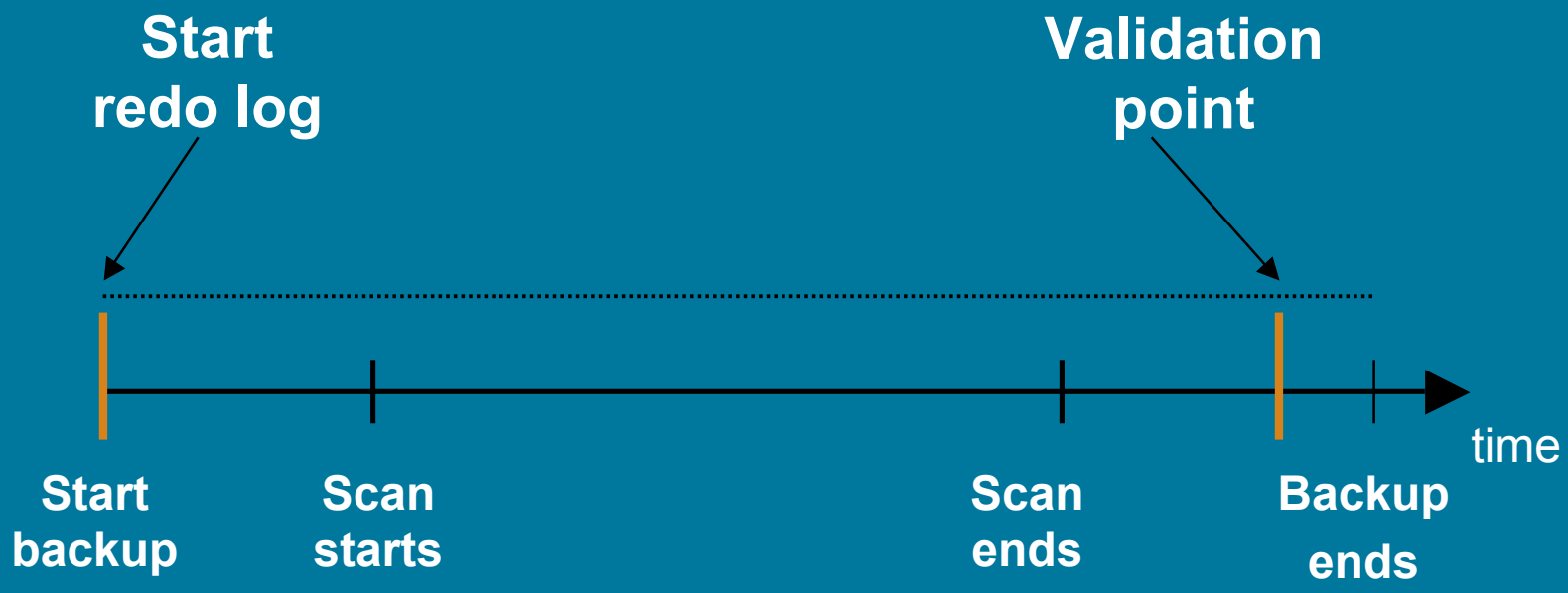
Backup Kernel Responsibilities

- execute BACKUP and RESTORE SQL statements
- backup/restore metadata
- initialize and coordinate work of backup/restore drivers
- write/read backup archive to/from backup storage media

Backup Engine Responsibilities

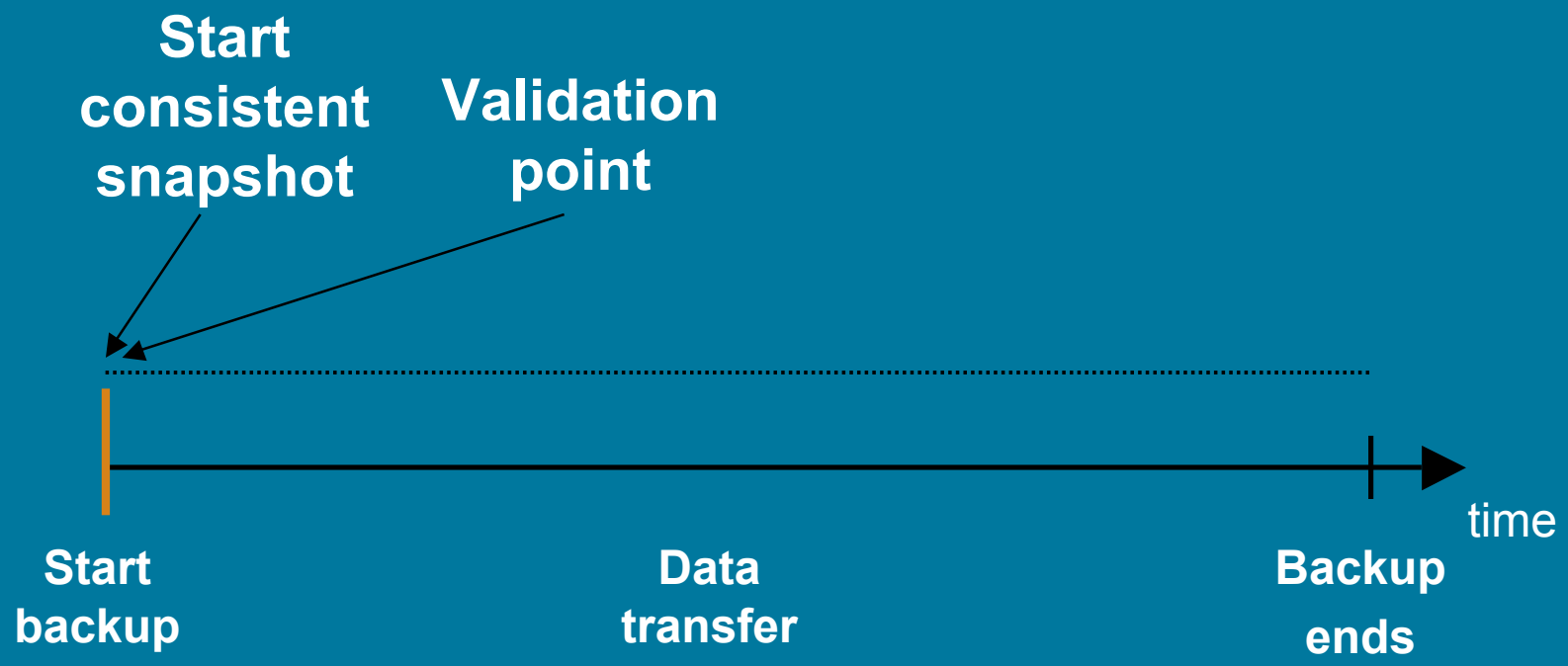
- create consistent image of data stored in tables
- restore table contents from previously created image
- estimate size of the backup image

Example at-end Native Backup Driver



The *validation point* is at the end of the backup

Example at-start Native Backup Driver



The *validation point* is at the start of backup

Capabilities

SQL Statements

- **`BACKUP DATABASE {db_list} TO {image_file_name};`**

  Executes the backup operation for the list of databases.

  The wild card '*' indicates all databases are included in the image file.

- **`RESTORE FROM {archive};`**

  Restores all databases in the image file.

  Performs a destructive restore.

Example Execution

- Backup and Restore commands generate a key to the backup progress logs.

```
mysql> backup database expert_mysql to 'expert_mysql.bak';
+------------+
| backup_id  |
+------------+
| 58         |
+------------+
1 row in set (0.36 sec)
```

Backup Progress Logs

- Currently tables in mysql database
- Work underway to change to logging mechanism
- Two logs (tables)
  - online_backup
  - online_backup_progress
- To find statistics and metadata about a backup or restore, use online_backup
- To find progress information, use online_backup_progress

online_backup log

```
mysql> SELECT * FROM mysql.online_backup WHERE backup_id = 58 \G
*************************** 1. row ***************************
          backup_id: 58
         process_id: 0
         binlog_pos: 107
        binlog_file: .\mysql-bin.000001
       backup_state: complete
          operation: backup
          error_num: 0
        num_objects: 4
        total_bytes: 903
validity_point_time: 2008-04-09 16:38:15
         start_time: 2008-04-09 16:38:15
          stop_time: 2008-04-09 16:38:15
host_or_server_name: localhost
           username: root
        backup_file: expert_mysql.bak
       user_comment:
            command: backup database expert_mysql to
'expert_mysql.bak'
            engines: Default
1 row in set (0.00 sec)
```

online_backup_progress log

```
mysql> SELECT * FROM mysql.online_backup_progress WHERE backup_id = 58 \G
*************************** 1. row ***************************
  backup_id: 58
     object: backup kernel
 start_time: NULL
  stop_time: NULL
total_bytes: 0
   progress: 0
  error_num: 0
      notes: starting
*************************** 2. row ***************************
  backup_id: 58
     object: backup kernel
 start_time: NULL
  stop_time: NULL
total_bytes: 0
   progress: 0
  error_num: 0
      notes: running
*************************** 3. row ***************************
  backup_id: 58
     object: backup kernel
 start_time: NULL
  stop_time: NULL
total_bytes: 0
   progress: 0
  error_num: 0
      notes: validity point
```

online_backup_progress log

```
*************************** 4. row ***************************
  backup_id: 58
     object: backup kernel
 start_time: NULL
  stop_time: NULL
total_bytes: 0
   progress: 0
  error_num: 0
      notes: running
*************************** 5. row ***************************
  backup_id: 58
     object: backup kernel
 start_time: NULL
  stop_time: NULL
total_bytes: 0
   progress: 0
  error_num: 0
      notes: complete
5 rows in set (0.00 sec)

mysql>
```

Tips and Tricks

Tips and Tricks

- MySQL 6.0 is a maturing product.

  …and we need your help to make it better.

  BOF session: Tonight 7:30 pm Ballroom C

  Topics:

  - Replication @ 7:30 pm
  - Backup @ 9:00 pm
- Using MySQL 6.0 Backup in your data protection and recovery processes.
  - Data protection
  - Recovery
- Controlling backup driver selection.

Future Plans

Planned Features

- **Coverage for all MySQL storage engines** providing a bullet-proof backup and recovery paradigm.
- **Plug-in architecture** so that engines can upgrade at runtime their technology to do backup (today native backup drivers are loaded together with the storage engines)

Planned Features

- Backup to other media
- Standalone mysqlbackup tool
- Full server, database, and enhanced point-in-time recovery

Limitations of 6.0.5 Alpha Release

- Code does not enforce referential integrity. Backing up and restoring partial integrity sets can lead to inconsistency.
- Error handling needs more work.
- Minimal blocking of DDL operations
- No "atomic restore", i.e. if the restore fails in the middle, then the server might be inconsistent

- No XBSA support
- No selective restores
- No pipe from backup to restore
- Not integrated with NDB
- The restore cannot restore the mysql database or the information_schema views.

Live Demo

Resources

References and Contacts

- MySQL Forge

  http://forge.mysql.com/wiki/OnlineBackup
- Online Documentation

  http://dev.mysql.com/doc/refman/6.0/en/backup-database-restore.html
- Contacts
  - Lars Thalmann (Technical Lead) lars@mysql.com
  - Rafal Somla rsomla@mysql.com
  - Chuck Bell cbell@mysql.com

Questions?