MySQL Essentials

John Russell, MySQL
Lead Writer for InnoDB, Storage Engines, MEM, MEB, HA

MySQL Essentials - Part 1

<u>Part 1: What's MySQL?</u>

Part 2: Building, Installing & Configuring MySQL

Part 3: Application / Architecture Considerations

Part 4: Developing MySQL Applications

What’s MySQL?

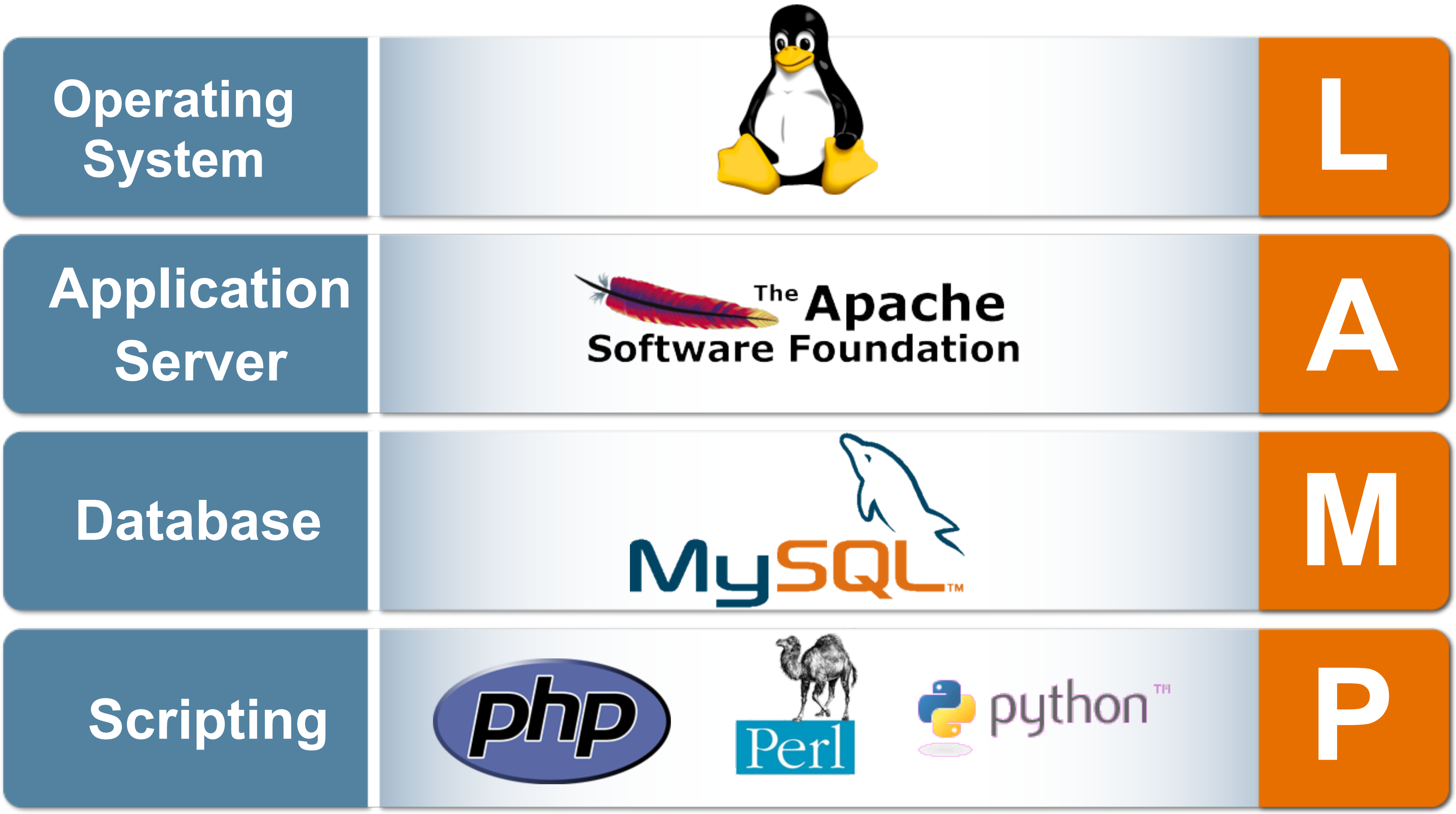
SOFTWARE.
HARDWARE.
COMPLETE.

Overview of MySQL

- 12 million product installations
- 65,000 downloads each day
- Part of the rapidly growing open source LAMP stack
- MySQL GPL & Commercial Editions Available

facebook YouTube Google™ Alcatel·Lucent ebay WIKIPEDIA

LAMP



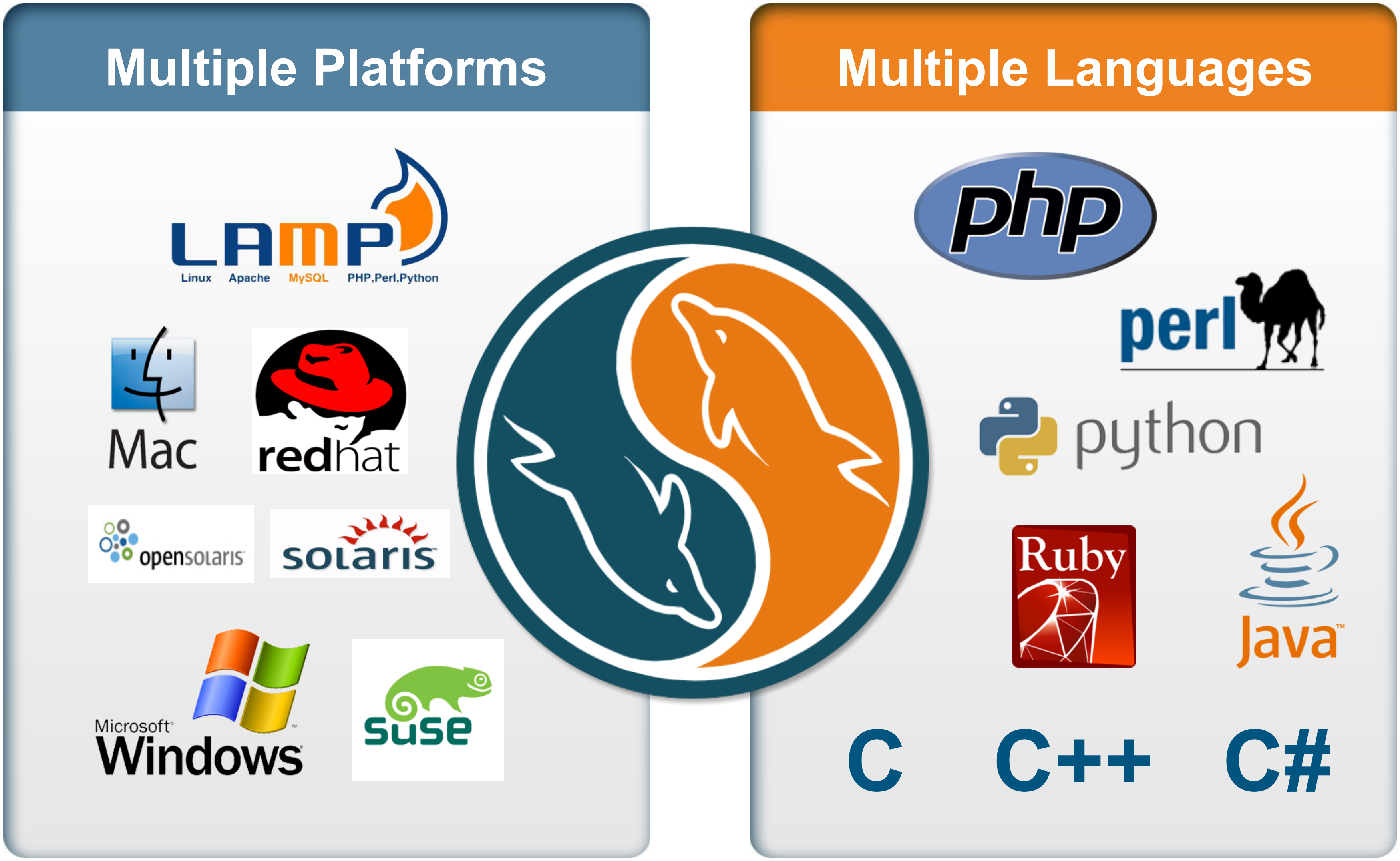
Operating System — L

Application Server — The Apache Software Foundation — A

Database — MySQL — M

Scripting — php, Perl, python — P

MySQL is Everywhere

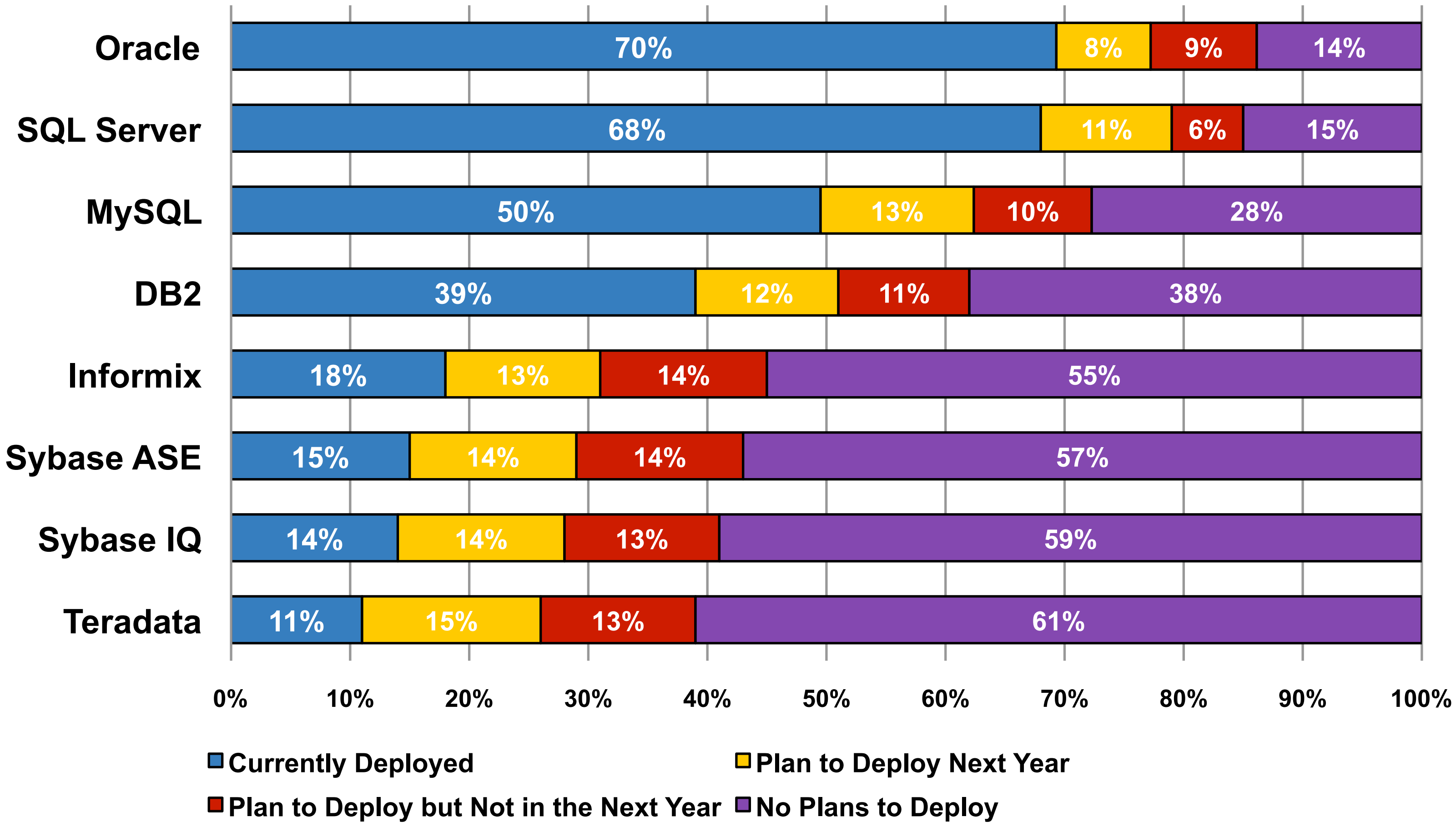


Multiple Platforms

Multiple Languages

C C++ C#

MySQL: #3 Most Deployed Database

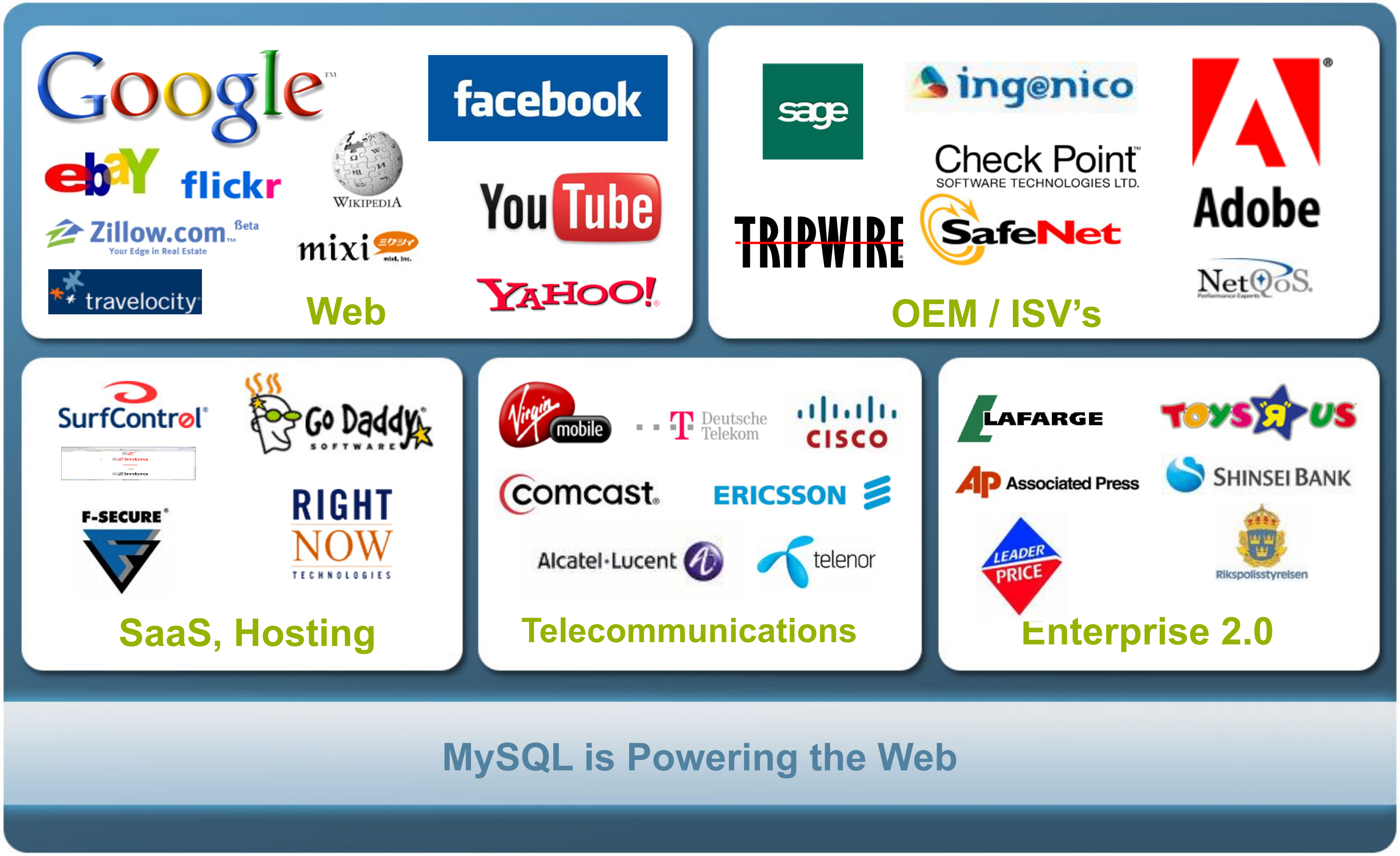


63% Are Deploying MySQL or Are Planning To Deploy

Oracle’s Investment in MySQL

- ***Make MySQL a Better MySQL***
  - *#1 Open Source Database for Web Applications*
- ***MySQL Focus Areas***
  - *Web, Embedded & Telecom*
  - *LAMP*
  - *Windows*
- ***Develop, Promote and Support MySQL***
  - *Improve engineering, consulting and support*
  - *Leverage 24x7, World-Class Oracle Support*
- ***MySQL Community Edition***
  - *Source and binary releases*
  - *GPL license*

MySQL Customers



Web

OEM / ISV's

SaaS, Hosting

Telecommunications

Enterprise 2.0

MySQL is Powering the Web

Web: facebook

Application

Facebook is a social networking site that connects people with friends and others who work, study and live around them.

Key Business Benefit

MySQL has enabled facebook to grow to 500 million users.

Why MySQL?

“We are one of the largest MySQL web sites in production. MySQL has been a revolution for young entrepreneurs.”

Owen Van Natta
Chief Operating Officer
Facebook

Web: eBay

Join eBay Foundation in changing lives. Support one of three great causes

Can't make all 81 home games? Sell Your Tickets.

Bids move faster with Multi-Touch

Application

Real-time personalization platform to display advertising to more relevant buyers and conduct more effective merchandizing.

Key Business Benefits

Highly scalable and cost-effective system that handles all of eBay's personalization and session data needs. Manages 4 billion requests per day of 50/50 read/write operations.

Why MySQL Enterprise Edition?

- Cost-effective
- Performance: 13,000 TPS on Sun Fire x4100
- Scalability: Designed for 10x future growth
- Monitoring: MySQL Enterprise Monitor

Chris Kasten,
Kernel Framework Group, eBay

OEM/ISV: Adobe

Application

Adobe embeds MySQL into several Adobe Creative Suite 3 components, including Adobe Acrobat CS3, Adobe Bridge CS3 and Adobe Version Cue CS3.

Key Business Benefit

MySQL allows Adobe to implement the workgroup productivity features in Adobe Creative Suite CS3 so that our users can be more productive.

Why MySQL?

“We chose MySQL for its reliability, ease of use, low administration and high performance.”

Mike Wallen
Version Cue Product Manager

Telco: Alcatel-Lucent

Application

Alcatel-Lucent’s next generation subscriber database applications

Key Business Benefit

The subscriber database at the heart of the application needed to provide more flexibility and to deliver higher performance, scalability, and reliability at a lower cost.

Why MySQL? Performance & Lower Cost

“MySQL Cluster won the performance tests hands down, and met our needs perfectly.”

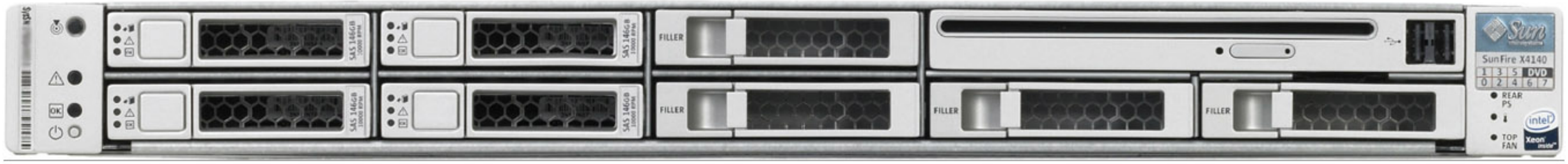
Alain Chastagner,

Alcatel-Lucent

Before We Get Started: Basics

SOFTWARE.
HARDWARE.
COMPLETE.

Hardware: The Perfect MySQL Server



- *The more cores the better (especially for 5.5 and later)*
- *x86_64 - 64 bit for more memory is important*
  - *Data/Memory ratio 1/3 to 1/10 is good rule of thumb*
  - *The more the better*
- *Linux or Solaris best, Windows and Unix also fine.*
- *RAID 10 for most, RAID 5 OK if very read intensive*
- *Hardware RAID battery backed up cache critical!*
  - *More disks are always better!*
    - *4+ recommended, 8-16 can increase IO performance if needed*
- *At least 2 x NICs for redundancy*
- *Slaves should be as powerful as the Master*
- *Oracle Sun X4170 for example*

MySQL Essentials - Part 2

Part 1: Why MySQL?

Part 2: Building, Installing & Configuring MySQL

Part 3: Application / Architecture Considerations

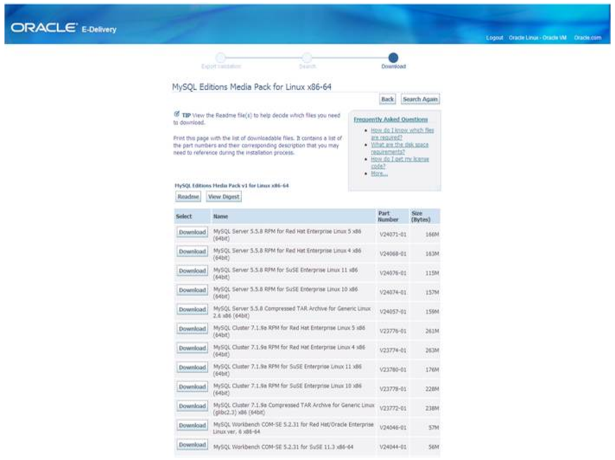
Part 4: Developing MySQL Applications

Building, Installing & Configuring MySQL

SOFTWARE.
HARDWARE.
COMPLETE.

Software: Where to Download?

- **Oracle E-Delivery**
  - **MySQL Commercial Binaries**
  - **Commercial-licensed add-ons**
    - MySQL Enterprise Monitor
    - MySQL Enterprise Backup
- **My Oracle Support**
  - **Latest patch levels**
- **Dev.mysql.com**
  - **GPL Binaries and Source Code**
- **Labs.mysql.com**
  - **Experimental code**
  - **E.g. InnoDB + Memcached**



MySQL Editions Media Pack for Linux x86-64

TIP View the Readme file(s) to help decide which files you need to download.

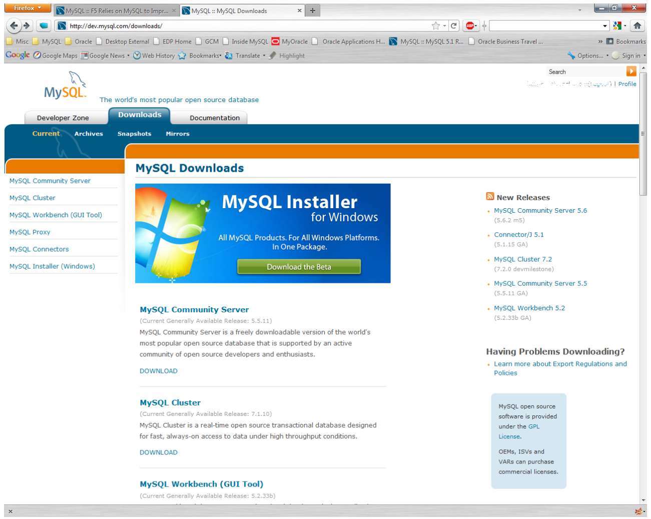
Print this page with the list of downloadable files. It contains a list of the part numbers and their corresponding description that you may need to reference during the installation process.

Frequently Asked Questions

- How do I know which files are required?
- What are the disk space requirements?
- How do I get my license code?
- More...

MySQL Editions Media Pack v1 for Linux x86-64

Select	Name	Part Number	Size (Bytes)
Download	MySQL Server 5.5.8 RPM for Red Hat Enterprise Linux 5 x86 (64bit)	V24071-01	166M
Download	MySQL Server 5.5.8 RPM for Red Hat Enterprise Linux 4 x86 (64bit)	V24068-01	163M
Download	MySQL Server 5.5.8 RPM for SuSE Enterprise Linux 11 x86 (64bit)	V24076-01	115M
Download	MySQL Server 5.5.8 RPM for SuSE Enterprise Linux 10 x86 (64bit)	V24074-01	157M
Download	MySQL Server 5.5.8 Compressed TAR Archive for Generic Linux 2.6 x86 (64bit)	V24057-01	159M
Download	MySQL Cluster 7.1.9a RPM for Red Hat Enterprise Linux 5 x86 (64bit)	V23776-01	261M
Download	MySQL Cluster 7.1.9a RPM for Red Hat Enterprise Linux 4 x86 (64bit)	V23774-01	263M
Download	MySQL Cluster 7.1.9a RPM for SuSE Enterprise Linux 11 x86 (64bit)	V23780-01	176M
Download	MySQL Cluster 7.1.9a RPM for SuSE Enterprise Linux 10 x86 (64bit)	V23778-01	228M
Download	MySQL Cluster 7.1.9a Compressed TAR Archive for Generic Linux (glibc2.3) x86 (64bit)	V23772-01	238M
Download	MySQL Workbench COM-SE 5.2.31 for Red Hat/Oracle Enterprise Linux ver. 6 x86-64	V24046-01	57M
Download	MySQL Workbench COM-SE 5.2.31 for SuSE 11.3 x86-64	V24044-01	56M



http://dev.mysql.com/downloads/

The world's most popular open source database

MySQL Downloads

- MySQL Community Server
- MySQL Cluster
- MySQL Workbench (GUI Tool)
- MySQL Proxy
- MySQL Connectors
- MySQL Installer (Windows)

MySQL Community Server
(Current Generally Available Release: 5.5.11)
MySQL Community Server is a freely downloadable version of the world's most popular open source database that is supported by an active community of open source developers and enthusiasts.
DOWNLOAD

MySQL Cluster
(Current Generally Available Release: 7.1.10)
MySQL Cluster is a real-time open source transactional database designed for fast, always-on access to data under high throughput conditions.
DOWNLOAD

MySQL Workbench (GUI Tool)
(Current Generally Available Release: 5.2.33b)

New Releases

- MySQL Community Server 5.6 (5.6.2 m5)
- Connector/J 5.1 (5.1.15 GA)
- MySQL Cluster 7.2 (7.2.0 devmilestone)
- MySQL Community Server 5.5 (5.5.11 GA)
- MySQL Workbench 5.2 (5.2.33b GA)

Having Problems Downloading?

- Learn more about Export Regulations and Policies

MySQL open source software is provided under the GPL License.

OEMs, ISVs and VARs can purchase commercial licenses.

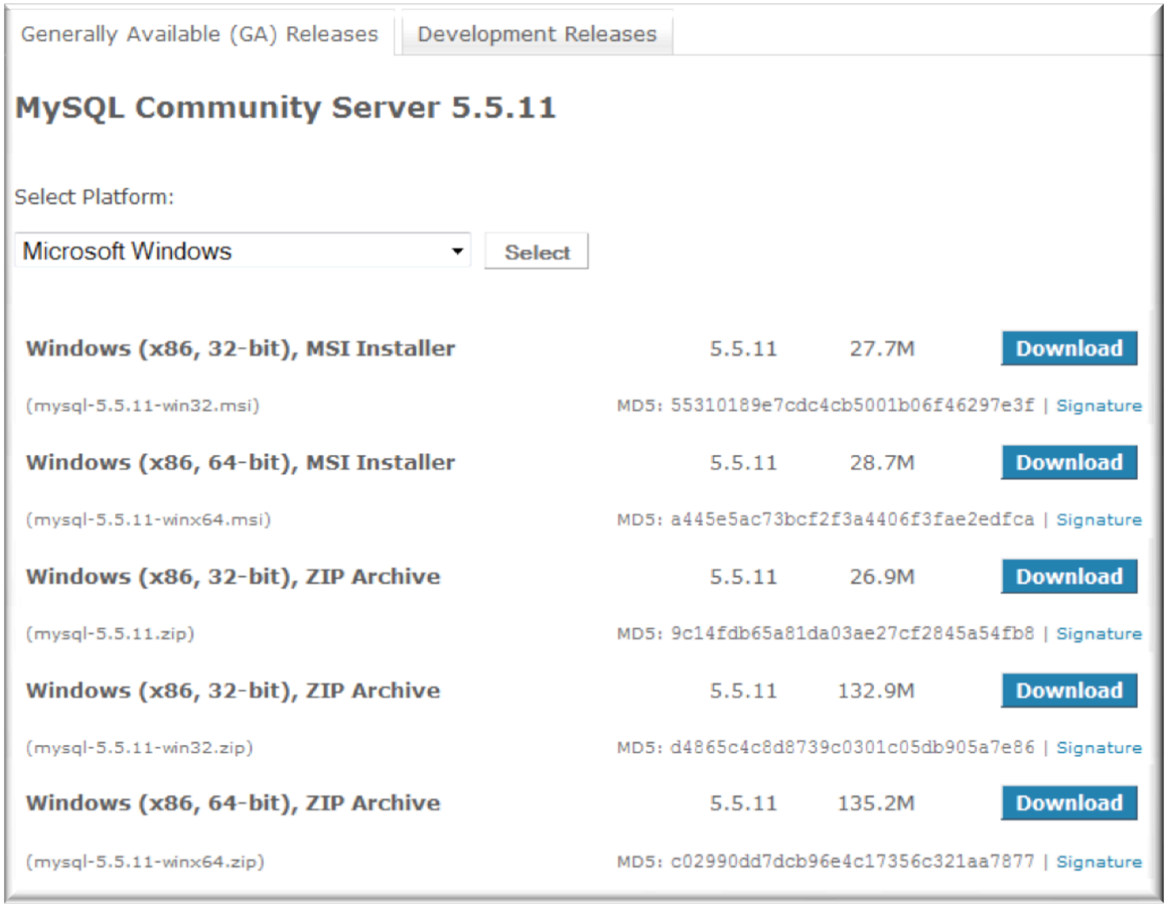
MySQL Windows Installer

MySQL Server Support for Windows

- *All current Windows versions…*
  - *Windows XP*
  - *Windows Vista*
  - *Windows 7*
  - *Windows Server 2003*
  - *Windows Server 2008*
- *Minimal additional requirements*
- *32 and 64 bit x86 architectures supported*

Installation Packages

- *Complete (MSI Installer or unzip)*
- *Essentials*
  - *Excludes Instance Manager*
  - *Documentation*
  - *Developer Components.*



MySQL Community Server 5.5.11

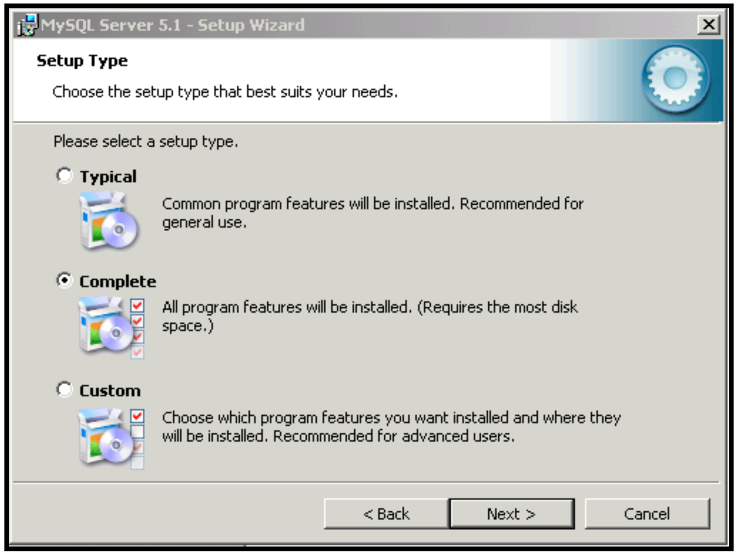
Select Platform:

Microsoft Windows

Windows (x86, 32-bit), MSI Installer	5.5.11	27.7M	Download
(mysql-5.5.11-win32.msi)	MD5: 55310189e7cdc4cb5001b06f46297e3f | Signature		
Windows (x86, 64-bit), MSI Installer	5.5.11	28.7M	Download
(mysql-5.5.11-winx64.msi)	MD5: a445e5ac73bcf2f3a4406f3fae2edfca | Signature		
Windows (x86, 32-bit), ZIP Archive	5.5.11	26.9M	Download
(mysql-5.5.11.zip)	MD5: 9c14fdb65a81da03ae27cf2845a54fb8 | Signature		
Windows (x86, 32-bit), ZIP Archive	5.5.11	132.9M	Download
(mysql-5.5.11-win32.zip)	MD5: d4865c4c8d8739c0301c05db905a7e86 | Signature		
Windows (x86, 64-bit), ZIP Archive	5.5.11	135.2M	Download
(mysql-5.5.11-winx64.zip)	MD5: c02990dd7dcb96e4c17356c321aa7877 | Signature		

Begin Installation

- ***Run mysql-5.x.xx-winxx.msi***
- ***Select type of install…***
  - Developers select **Complete**
  - DBAs select **Typical**



Setup Type

Choose the setup type that best suits your needs.

Please select a setup type.

○ **Typical**

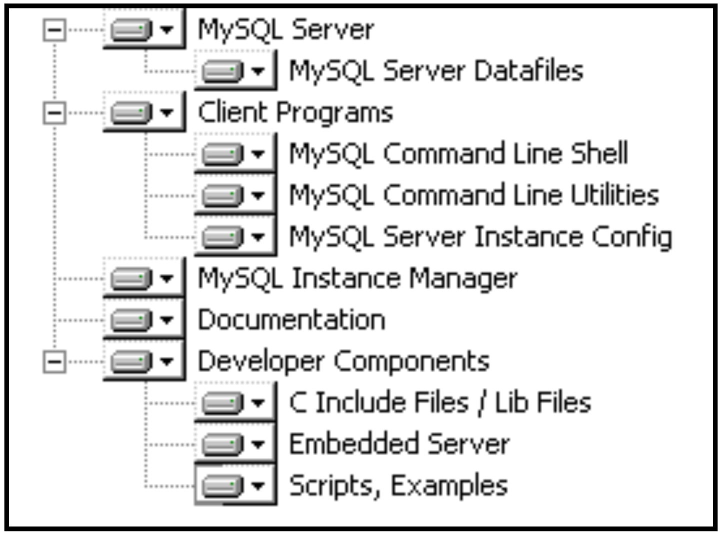
Common program features will be installed. Recommended for general use.

● **Complete**

All program features will be installed. (Requires the most disk space.)

○ **Custom**

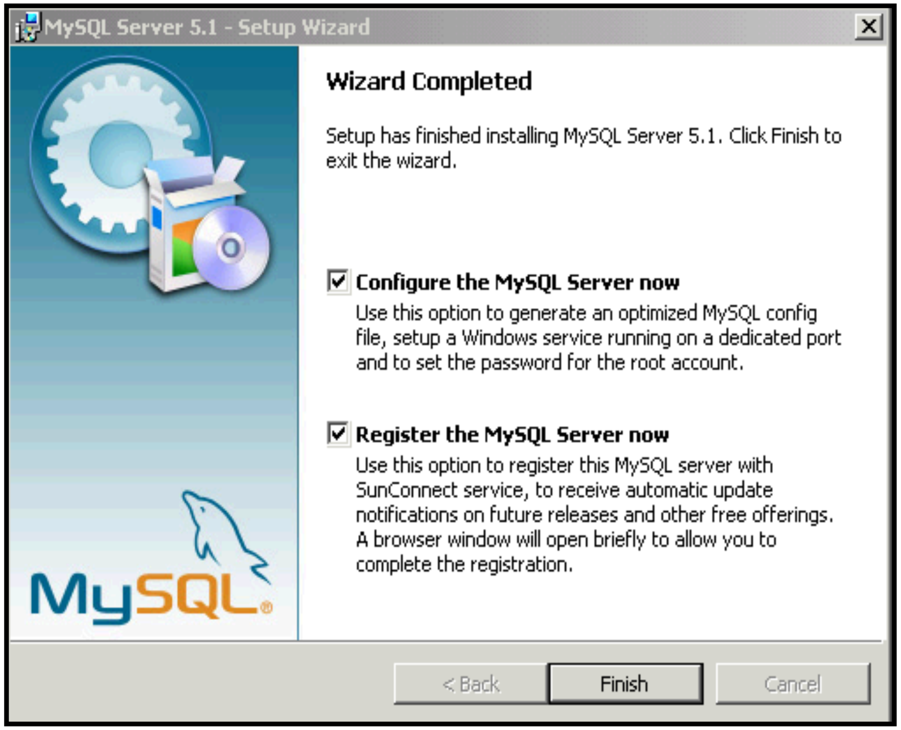
Choose which program features you want installed and where they will be installed. Recommended for advanced users.



- MySQL Server
  - MySQL Server Datafiles
- Client Programs
  - MySQL Command Line Shell
  - MySQL Command Line Utilities
  - MySQL Server Instance Config
- MySQL Instance Manager
- Documentation
- Developer Components
  - C Include Files / Lib Files
  - Embedded Server
  - Scripts, Examples

Complete Installation

- Several **Next** clicks
- Then **Finish**
- Leave **Configure** checked



Wizard Completed

Setup has finished installing MySQL Server 5.1. Click Finish to exit the wizard.

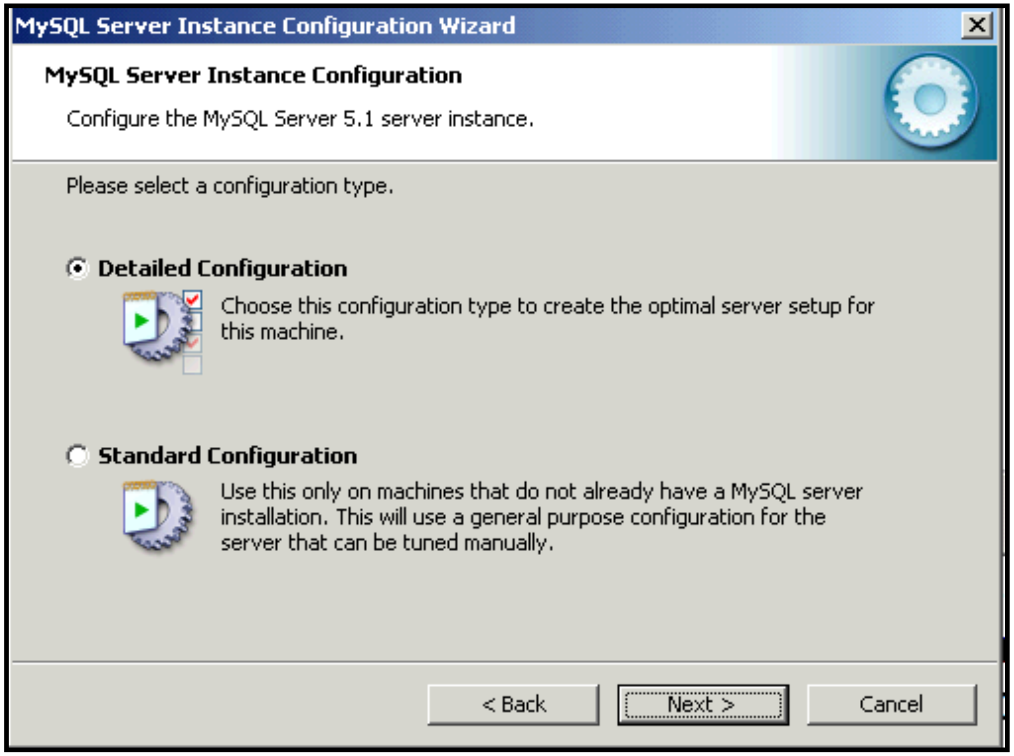
☑ **Configure the MySQL Server now**

Use this option to generate an optimized MySQL config file, setup a Windows service running on a dedicated port and to set the password for the root account.

☑ **Register the MySQL Server now**

Use this option to register this MySQL server with SunConnect service, to receive automatic update notifications on future releases and other free offerings. A browser window will open briefly to allow you to complete the registration.

Select **Detailed Configuration**



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please select a configuration type.

● Detailed Configuration

Choose this configuration type to create the optimal server setup for this machine.

○ Standard Configuration

Use this only on machines that do not already have a MySQL server installation. This will use a general purpose configuration for the server that can be tuned manually.

To re-launch configuration wizard:

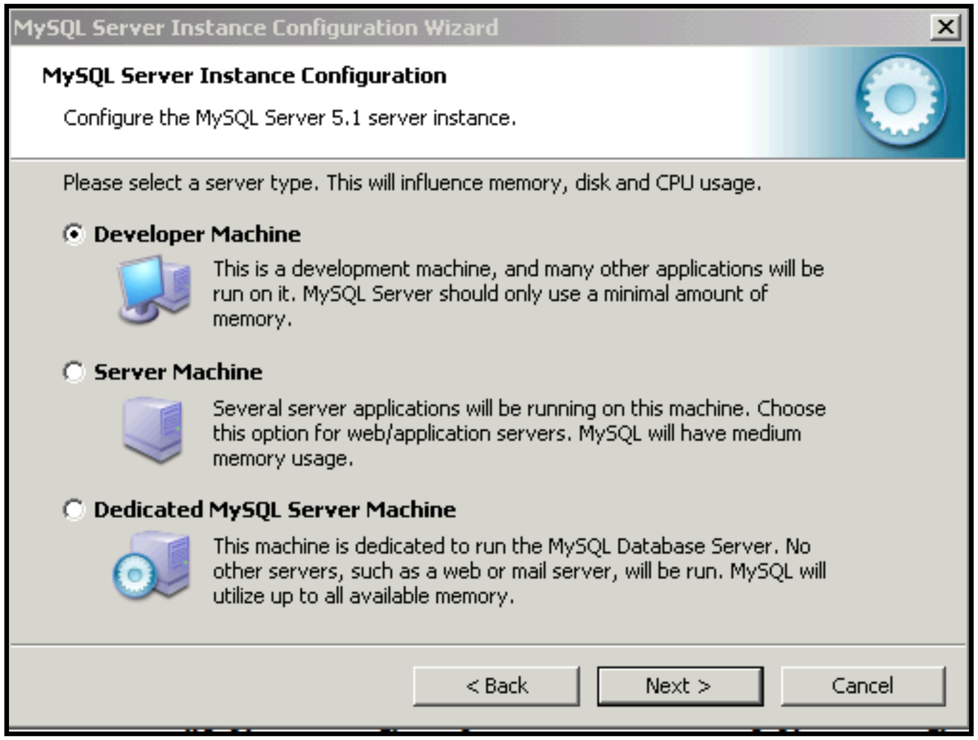
Start->MySQL->MySQL Server 5.5-> MySQL Server Instance Config Wizard

Selecting Configuration Options

- ***Instance***
  - *a running MySQL Server process*
  - *or a MySQL Windows Service*
- **Instance features and properties are determined by**
  - Parameters
  - Startup options
  - Active (enabled) components
- Configuration file is **my.ini**
- Located in the MySQL installation directory

Selecting Configuration Options (cont.)

- Select appropriate server type
- For a trial use **Developer Machine**



MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please select a server type. This will influence memory, disk and CPU usage.

● **Developer Machine**

This is a development machine, and many other applications will be run on it. MySQL Server should only use a minimal amount of memory.

○ **Server Machine**

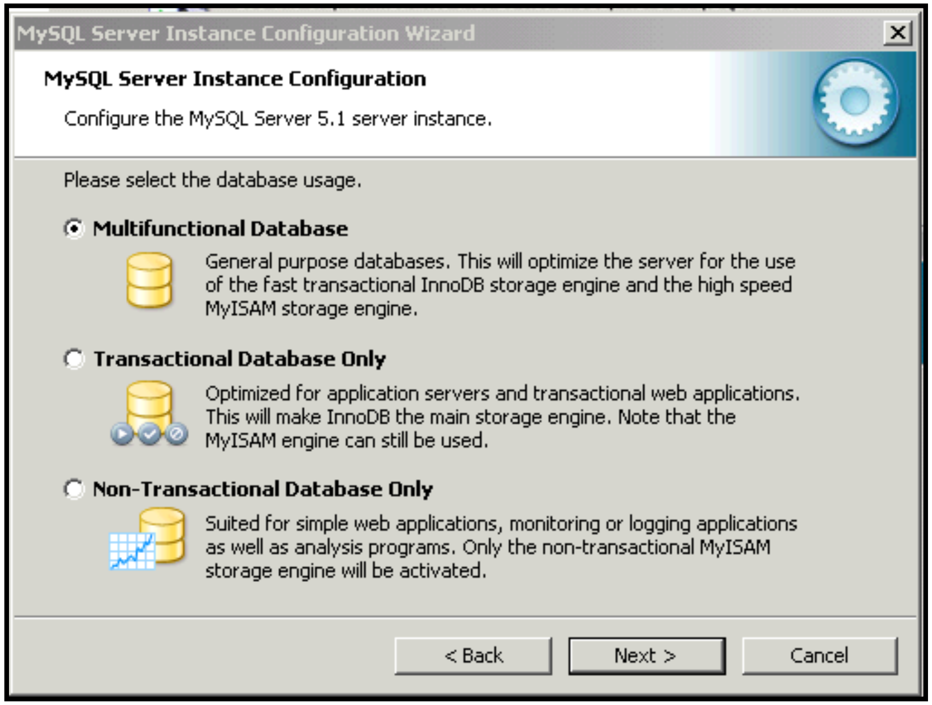
Several server applications will be running on this machine. Choose this option for web/application servers. MySQL will have medium memory usage.

○ **Dedicated MySQL Server Machine**

This machine is dedicated to run the MySQL Database Server. No other servers, such as a web or mail server, will be run. MySQL will utilize up to all available memory.

Selecting Configuration Options (cont.)

- MySQL supports many database **storage engines**
- Perhaps a new concept for some DBAs
- Can all run at the same time on the same MySQL Instance
- **InnoDB** (transactional) is the one to care about most
- Select **Multifunction**



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please select the database usage.

● **Multifunctional Database**

General purpose databases. This will optimize the server for the use of the fast transactional InnoDB storage engine and the high speed MyISAM storage engine.

○ **Transactional Database Only**

Optimized for application servers and transactional web applications. This will make InnoDB the main storage engine. Note that the MyISAM engine can still be used.

○ **Non-Transactional Database Only**

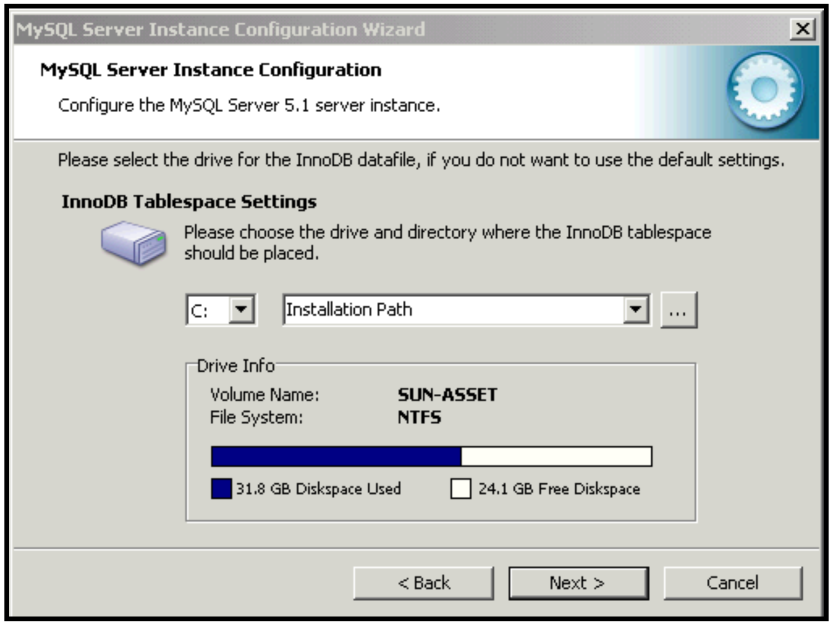
Suited for simple web applications, monitoring or logging applications as well as analysis programs. Only the non-transactional MyISAM storage engine will be activated.

Selecting Configuration Options (cont.)

- Select location for InnoDB files

✓ Performance Tips

- High performance storage?
  - **Specify drive letter**
- Select a disk that has:
  - Space available
  - Where OS is not installed



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please select the drive for the InnoDB datafile, if you do not want to use the default settings.

InnoDB Tablespace Settings

Please choose the drive and directory where the InnoDB tablespace should be placed.

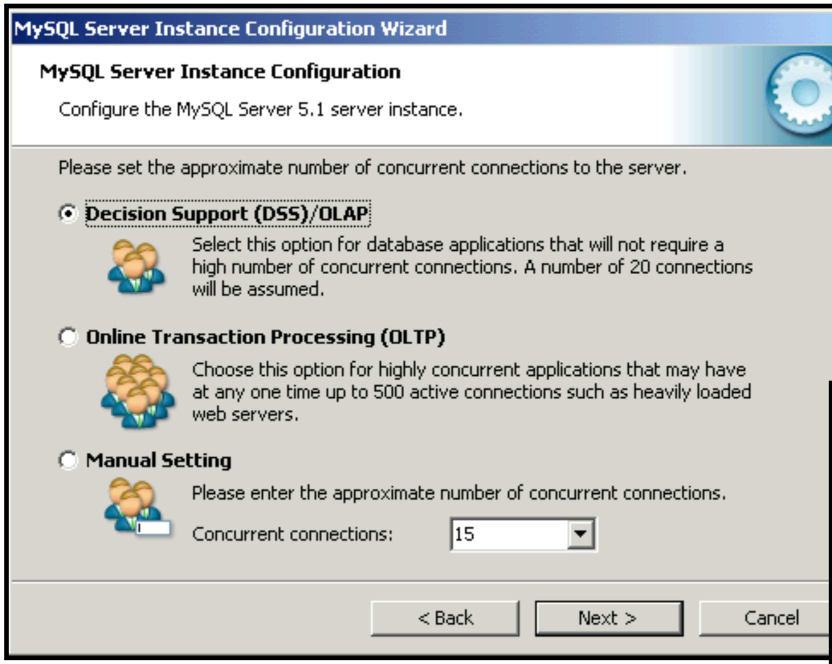
C: | Installation Path

Drive Info

Volume Name: **SUN-ASSET**
File System: **NTFS**

■ 31.8 GB Diskspace Used □ 24.1 GB Free Diskspace

Selecting Configuration Options (cont.)



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please set the approximate number of concurrent connections to the server.

● **Decision Support (DSS)/OLAP**

Select this option for database applications that will not require a high number of concurrent connections. A number of 20 connections will be assumed.

○ **Online Transaction Processing (OLTP)**

Choose this option for highly concurrent applications that may have at any one time up to 500 active connections such as heavily loaded web servers.

○ **Manual Setting**

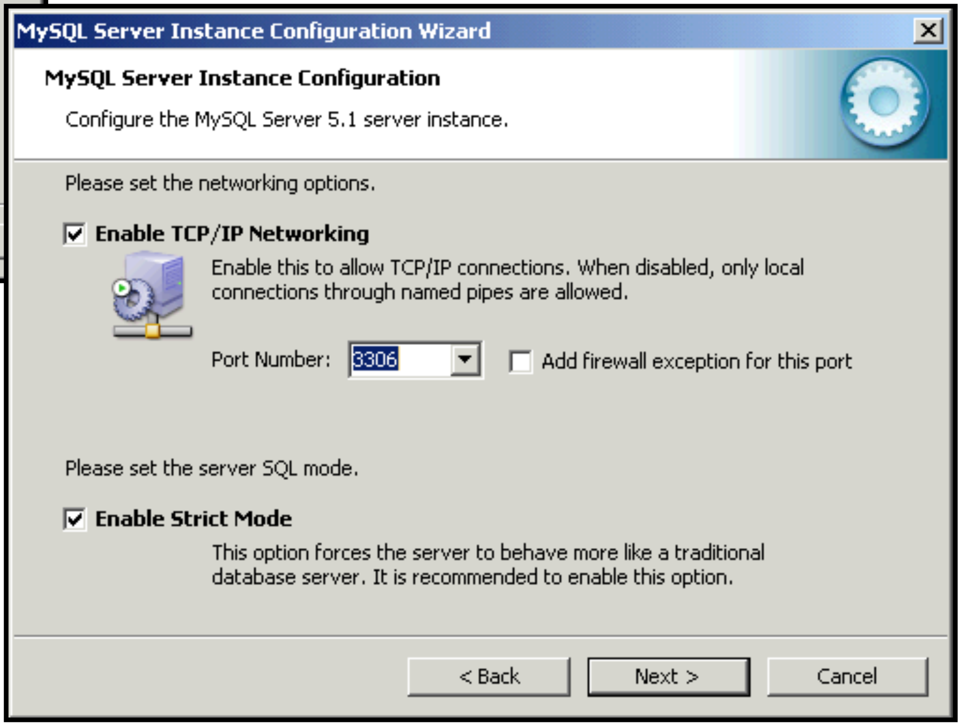
Please enter the approximate number of concurrent connections.

Concurrent connections: 15

- ***Set expected connections***

- ***Default Port – 3306***
- ***Use Strict Mode***

Strict mode controls how MySQL handles invalid or missing input values



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please set the networking options.

☑ **Enable TCP/IP Networking**

Enable this to allow TCP/IP connections. When disabled, only local connections through named pipes are allowed.

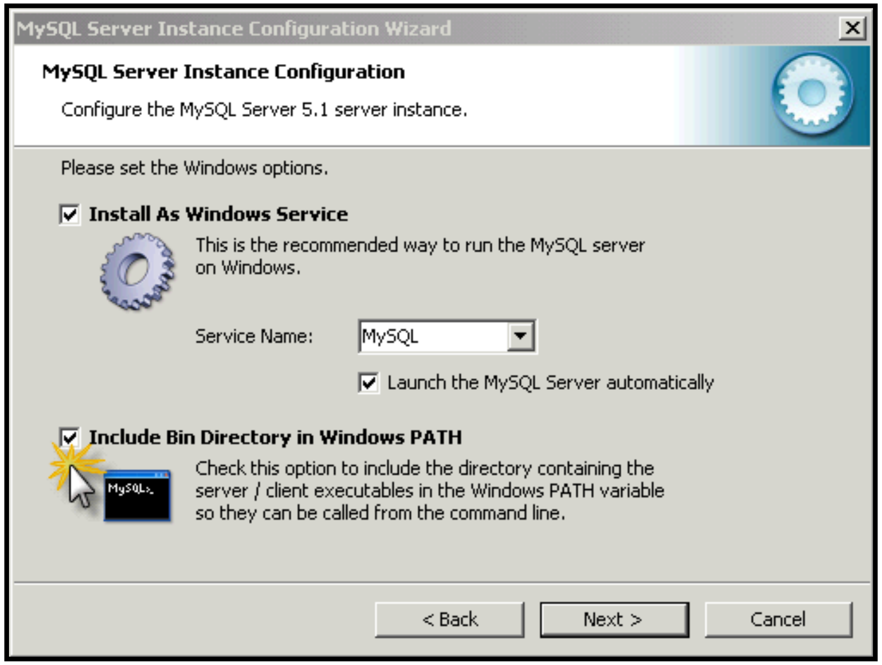
Port Number: 3306 □ Add firewall exception for this port

Please set the server SQL mode.

☑ **Enable Strict Mode**

This option forces the server to behave more like a traditional database server. It is recommended to enable this option.

Selecting Configuration Options (cont.)



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please set the Windows options.

☑ **Install As Windows Service**

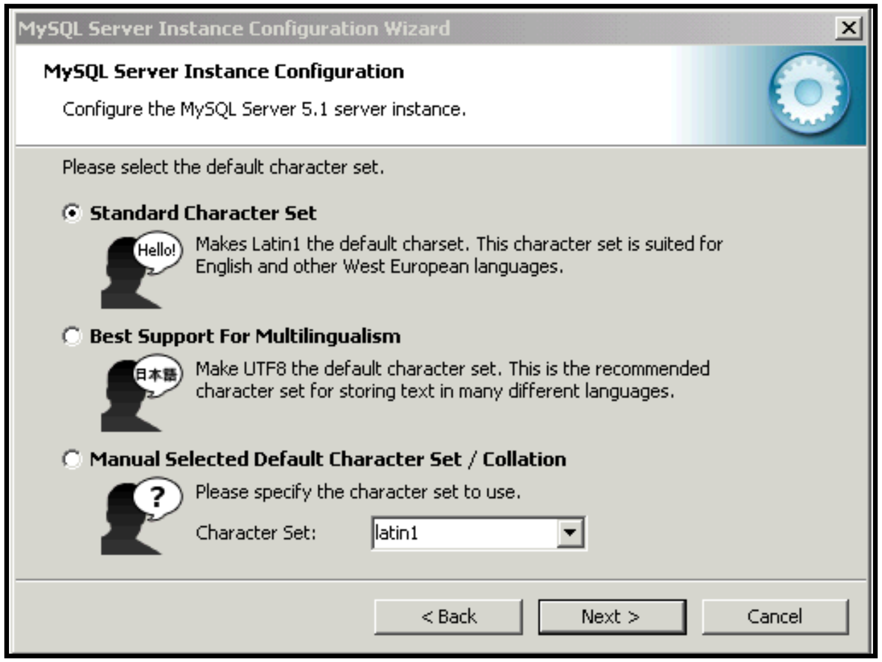
This is the recommended way to run the MySQL server on Windows.

Service Name: MySQL

☑ Launch the MySQL Server automatically

☑ **Include Bin Directory in Windows PATH**

Check this option to include the directory containing the server / client executables in the Windows PATH variable so they can be called from the command line.



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please select the default character set.

● **Standard Character Set**

Makes Latin1 the default charset. This character set is suited for English and other West European languages.

○ **Best Support For Multilingualism**

Make UTF8 the default character set. This is the recommended character set for storing text in many different languages.

○ **Manual Selected Default Character Set / Collation**

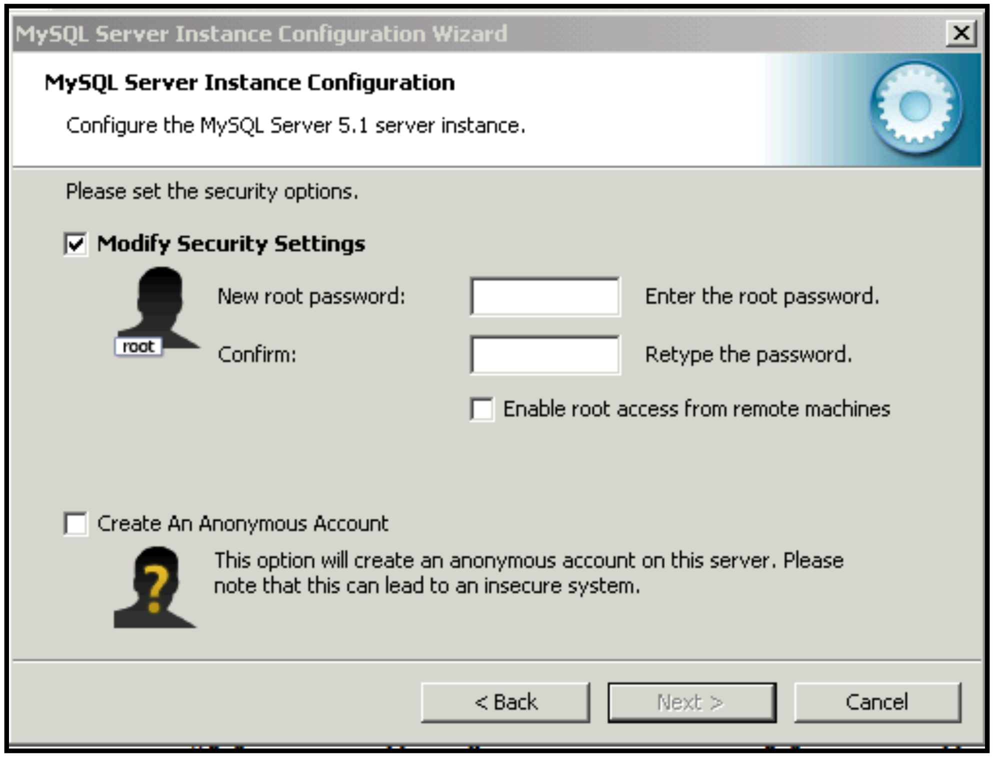
Please specify the character set to use.

Character Set: latin1

Selecting Configuration Options (cont.)

- ***Password for MySQL "root" account.***
  - ***Equiv to "sa" in MSSQL***
  - ***NOT an OS account***
  - ***Don't forget***

- ***Enable access from remote if you plan on non-local access.***



MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration

Configure the MySQL Server 5.1 server instance.

Please set the security options.

☑ **Modify Security Settings**

New root password: Enter the root password.

Confirm: Retype the password.

□ Enable root access from remote machines

□ Create An Anonymous Account

This option will create an anonymous account on this server. Please note that this can lead to an insecure system.

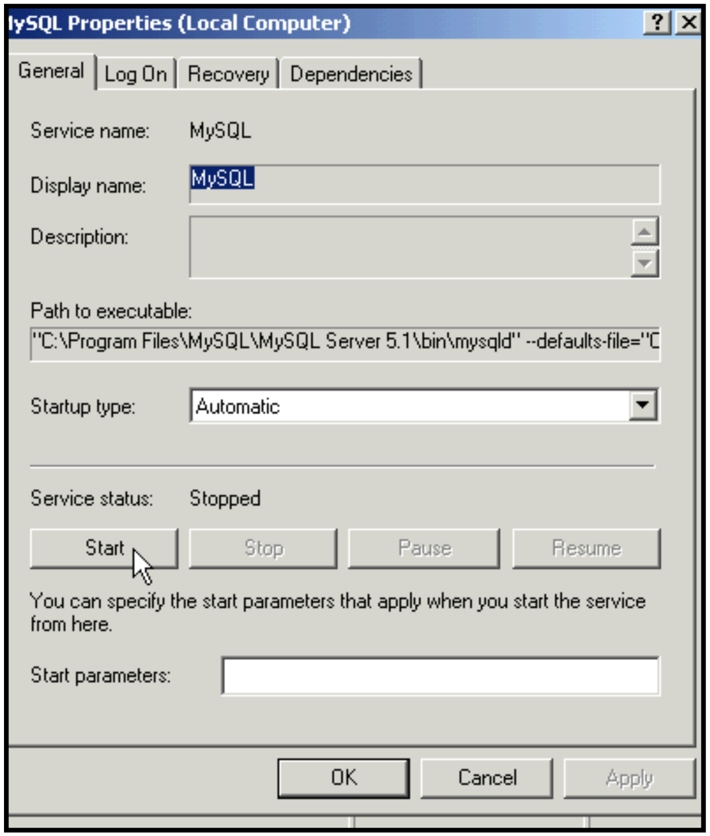
Selecting Configuration Options (cont.)

- ***From the command line***

```
>"C:\Program Files\MySQL\MySQL Server 5.5\bin\mysqld"
--defaults-file="C:\Program Files\MySQL\MySQL Server 5.5\my.ini“
```

- ***Or installed and Started as a service*** ✓

- **Hint:** *if you are having any issues append*
- `--console`



lySQL Properties (Local Computer)

Service name: MySQL

Display name: MySQL

Description:

Path to executable:
"C:\Program Files\MySQL\MySQL Server 5.1\bin\mysqld" --defaults-file="C

Startup type: Automatic

Service status: Stopped

You can specify the start parameters that apply when you start the service from here.

Start parameters:

Building from Source

Why/When to Build from Source

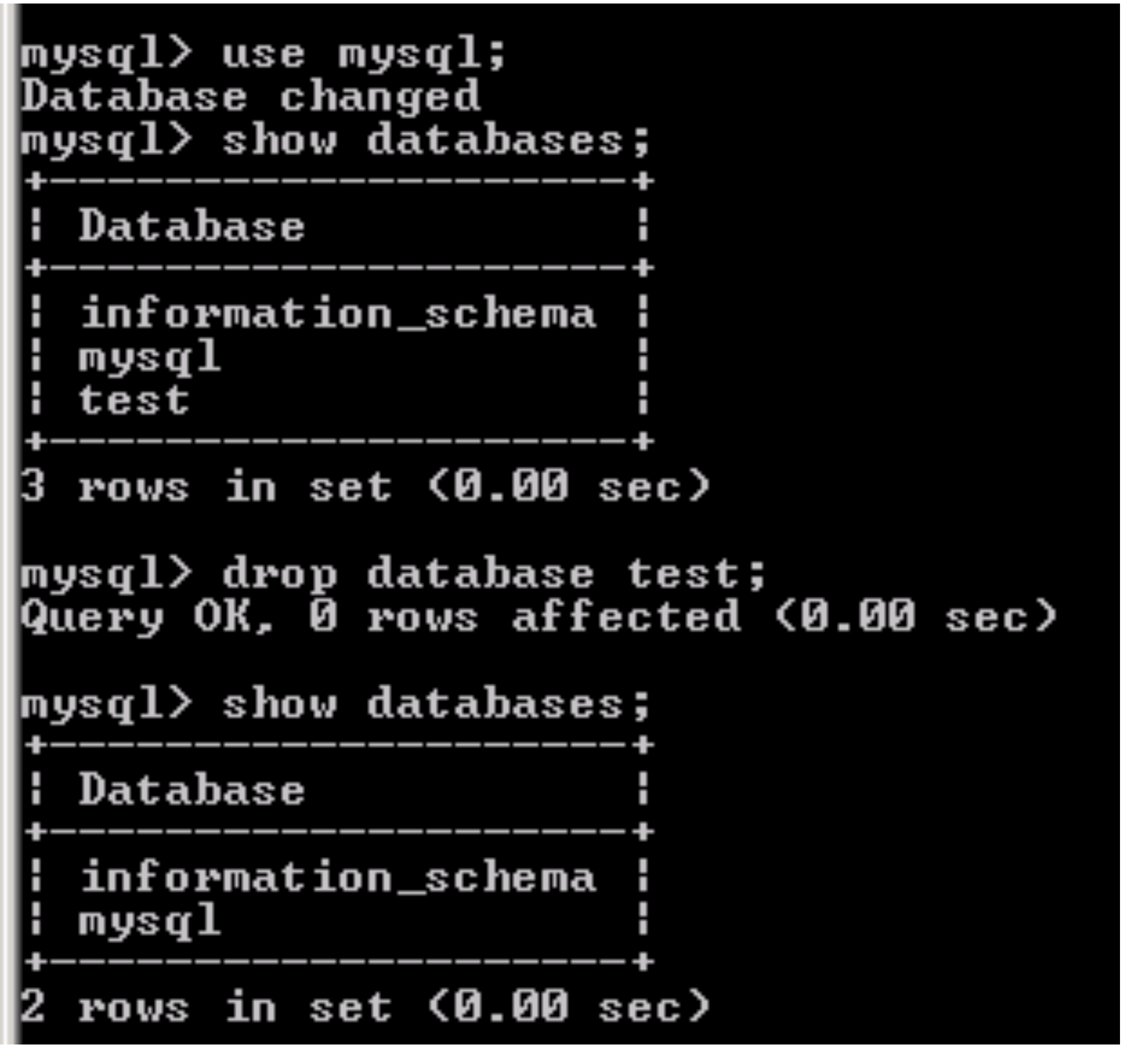
- Binary packages available for all supported platforms
- Install and start coding in SQL, Java, C, C++, C#, PHP, Perl, Python, VB…
- Build-from-source appropriate for:
- Deploying on unsupported platforms
- Compiling with more aggressive optimization options, or more extensive debugging options
- Developing add-ons such as storage engines
- Packaging MySQL as part of custom hardware or software solutions
- Developing performance patches

Post Installation Tasks & Security

Post Installation Tasks To Secure Installation

- ✓ ***Delete the test database***
- ✓ ***Secure the root account***
- ✓ ***Ensure root can’t login from an anonymous host***
- ✓ ***Delete anonymous accounts***
- ✓ ***MSI installer or mysql_secure_installation script (in scripts directory) can be used to automate some of these steps***

Delete the test Database

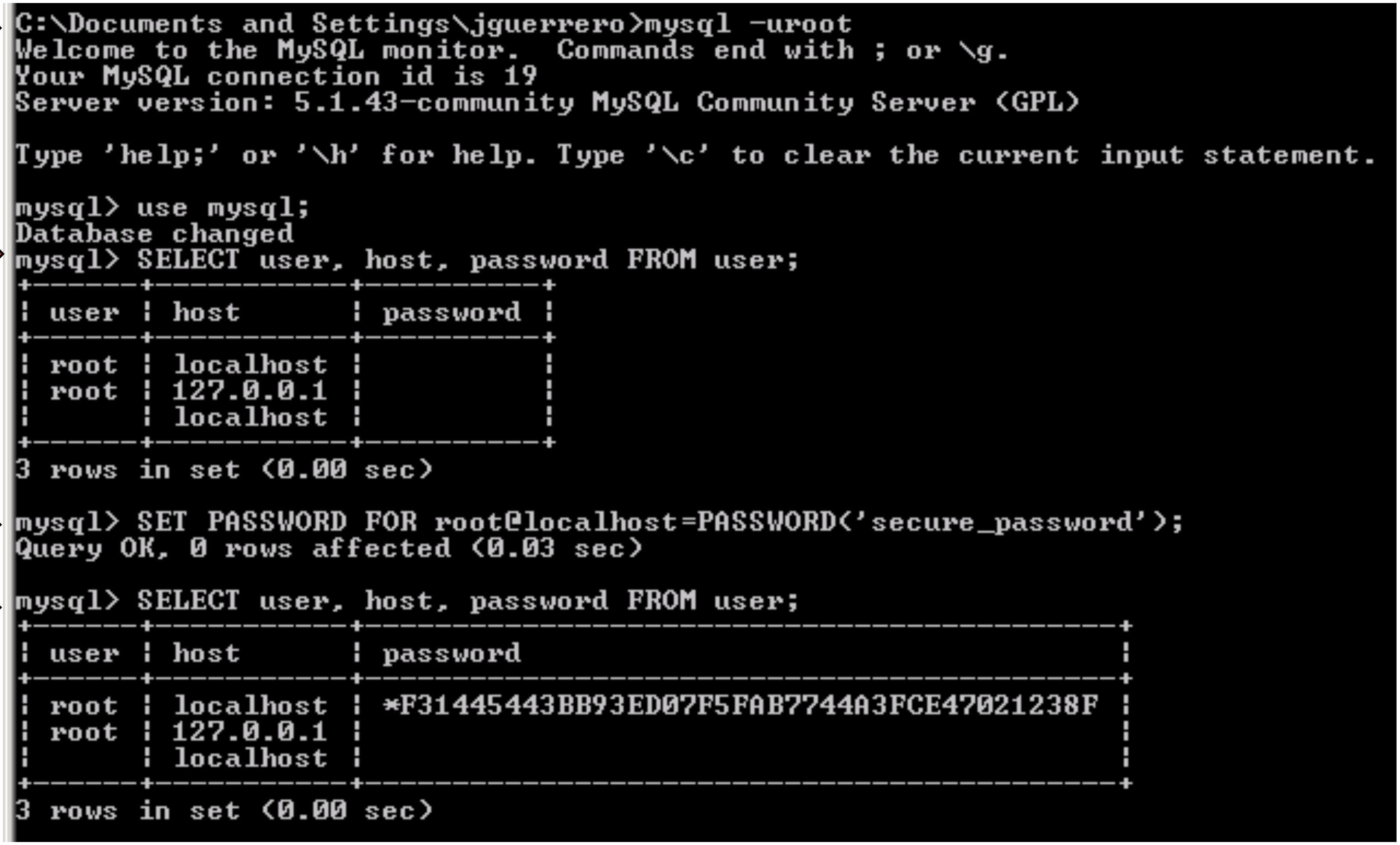


```
mysql> use mysql;
Database changed
mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| test               |
+--------------------+
3 rows in set (0.00 sec)

mysql> drop database test;
Query OK, 0 rows affected (0.00 sec)

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
+--------------------+
2 rows in set (0.00 sec)
```

root Accounts

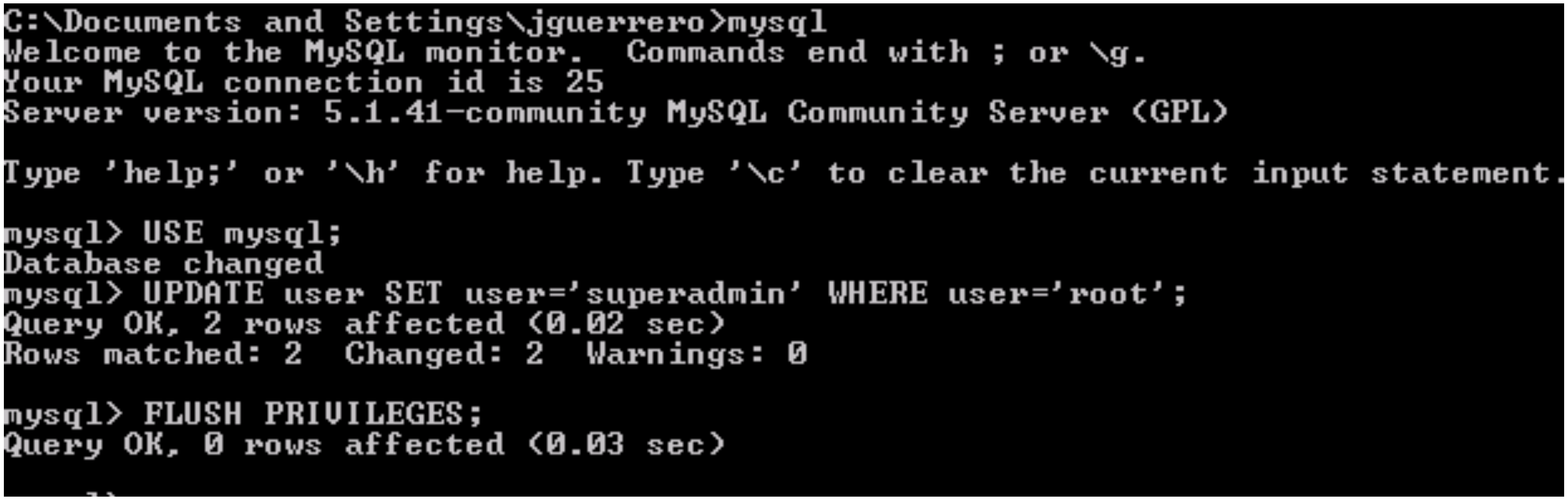
- One (or two) accounts are created named root
- Super user accounts that can do anything
- The initial root account passwords are blank
- One root account for connecting from local host
- ⚠ Other allows connections from any host
- Rename the root account with a different (more difficult name) to prevent brute-force attacks

Secure root Account



```
C:\Documents and Settings\jguerrero>mysql -uroot
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 19
Server version: 5.1.43-community MySQL Community Server (GPL)

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

mysql> use mysql;
Database changed
mysql> SELECT user, host, password FROM user;
+------+-----------+----------+
| user | host      | password |
+------+-----------+----------+
| root | localhost |          |
| root | 127.0.0.1 |          |
|      | localhost |          |
+------+-----------+----------+
3 rows in set (0.00 sec)

mysql> SET PASSWORD FOR root@localhost=PASSWORD('secure_password');
Query OK, 0 rows affected (0.03 sec)

mysql> SELECT user, host, password FROM user;
+------+-----------+-------------------------------------------+
| user | host      | password                                  |
+------+-----------+-------------------------------------------+
| root | localhost | *F31445443BB93ED07F5FAB7744A3FCE47021238F |
| root | 127.0.0.1 |                                           |
|      | localhost |                                           |
+------+-----------+-------------------------------------------+
3 rows in set (0.00 sec)
```

Change the Name of root User

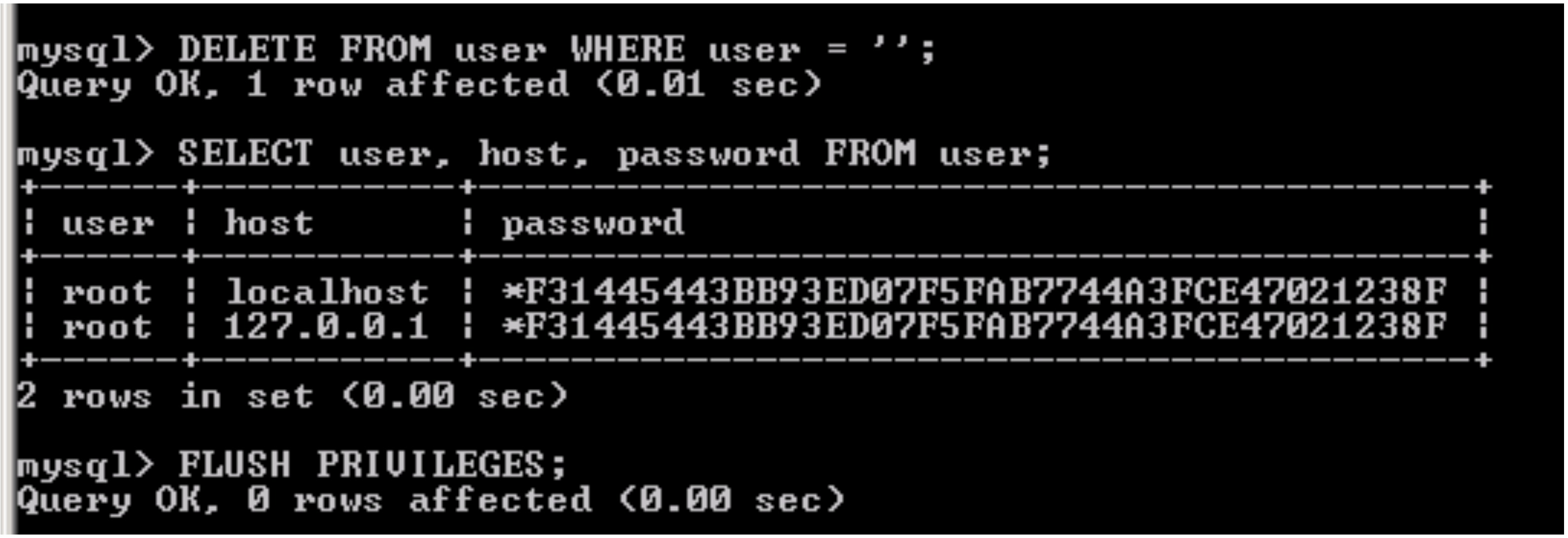


```
C:\Documents and Settings\jguerrero>mysql
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 25
Server version: 5.1.41-community MySQL Community Server (GPL)

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

mysql> USE mysql;
Database changed
mysql> UPDATE user SET user='superadmin' WHERE user='root';
Query OK, 2 rows affected (0.02 sec)
Rows matched: 2  Changed: 2  Warnings: 0

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.03 sec)
```

Anonymous Accounts

- *Two anonymous user accounts are created by default*
  - *Empty user names and no passwords*
  - *One anonymous account for connections from the local host*
  - *Prior to 5.1.16 had global privileges, just like the root accounts*
  - *Other is for connections from any host*
  - *Has all privileges for the test database or other databases with names that start with test*
- *Delete these accounts!*

Delete Anonymous Accounts



```
mysql> DELETE FROM user WHERE user = '';
Query OK, 1 row affected (0.01 sec)

mysql> SELECT user, host, password FROM user;
+------+-----------+-------------------------------------------+
¦ user ¦ host      ¦ password                                  ¦
+------+-----------+-------------------------------------------+
¦ root ¦ localhost ¦ *F31445443BB93ED07F5FAB7744A3FCE47021238F ¦
¦ root ¦ 127.0.0.1 ¦ *F31445443BB93ED07F5FAB7744A3FCE47021238F ¦
+------+-----------+-------------------------------------------+
2 rows in set (0.00 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.00 sec)
```

MySQL Essentials - Part 3

Part 1: Why MySQL?

Part 2: Building, Installing & Configuring MySQL

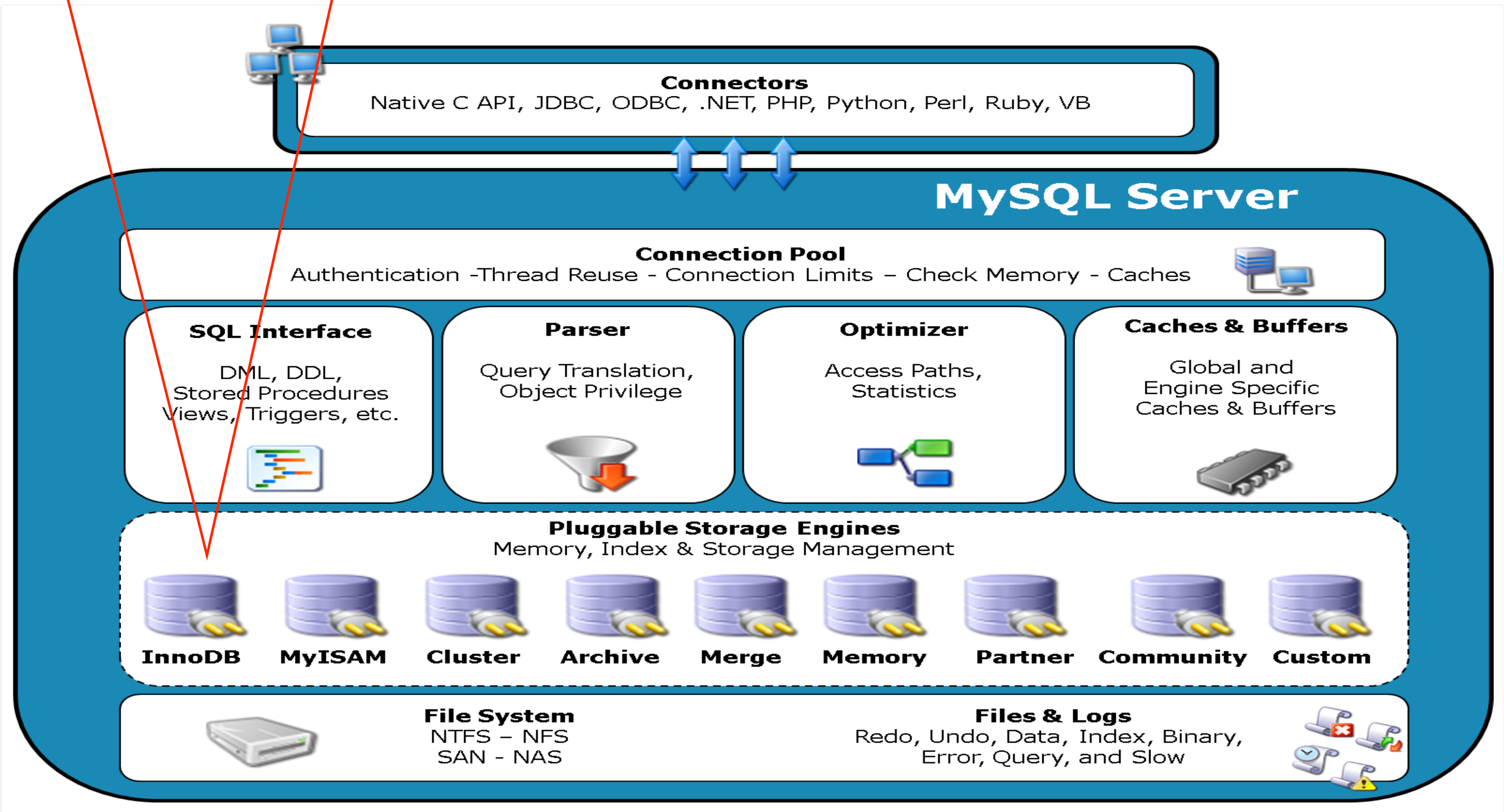
Part 3: Application / Architecture Considerations

Part 4: Developing MySQL Applications

Pluggable Storage Engine Architecture

InnoDB as default storage engine

- ACID Transactions, FKs, Crash Recovery



Connectors
Native C API, JDBC, ODBC, .NET, PHP, Python, Perl, Ruby, VB

MySQL Server

Connection Pool
Authentication -Thread Reuse - Connection Limits – Check Memory - Caches

SQL Interface
DML, DDL,
Stored Procedures
Views, Triggers, etc.

Parser
Query Translation,
Object Privilege

Optimizer
Access Paths,
Statistics

Caches & Buffers
Global and
Engine Specific
Caches & Buffers

Pluggable Storage Engines
Memory, Index & Storage Management

File System
NTFS – NFS
SAN - NAS

Files & Logs
Redo, Undo, Data, Index, Binary,
Error, Query, and Slow

Storage Engines

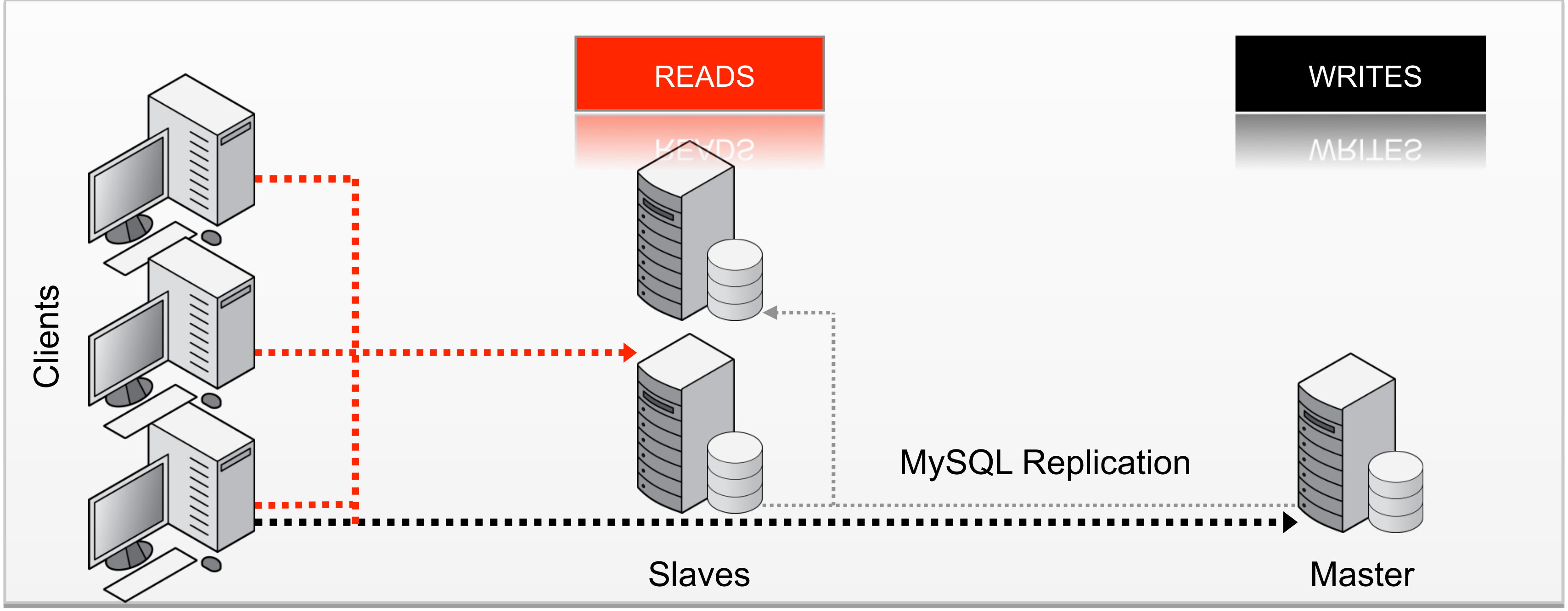
- MySQL cliches are all about MyISAM:
  - Fast for simple operations, but not scalable due to table locks
  - Vulnerable to crashes; repair tables on restart
  - No transactions; can't roll back after mistakes or errors
- InnoDB is the most Oracle-like part of MySQL:
  - Concurrent readers and writers; high scalability
  - Transactional - commit changes, roll back mistakes, queries see snapshot data; a.k.a. ACID model
  - Fast and reliable crash recovery
- InnoDB = default storage engine in 5.5 and up
- Still on 5.1? Install InnoDB Plugin

Storage Engines **(cont.)**

- What does it mean for InnoDB to be default?
- Define a primary key for all tables, based on most important queries.
- Secondary indexes also important to avoid full-table scans.
- Turn auto-commit off.
- Set innodb_buffer_pool_size as high as practical.
- Investigate file-per-table mode, Barracuda file format, compression.
- Lots more documentation in 5.5: SE chapter, Optimization, Glossary.
- MEMORY storage engine:
- InnoDB with big buffer pool can give similar benefits.
- For queries with >, <, BETWEEN operators, explore USING BTREE.

MySQL Replication

Read Scalability

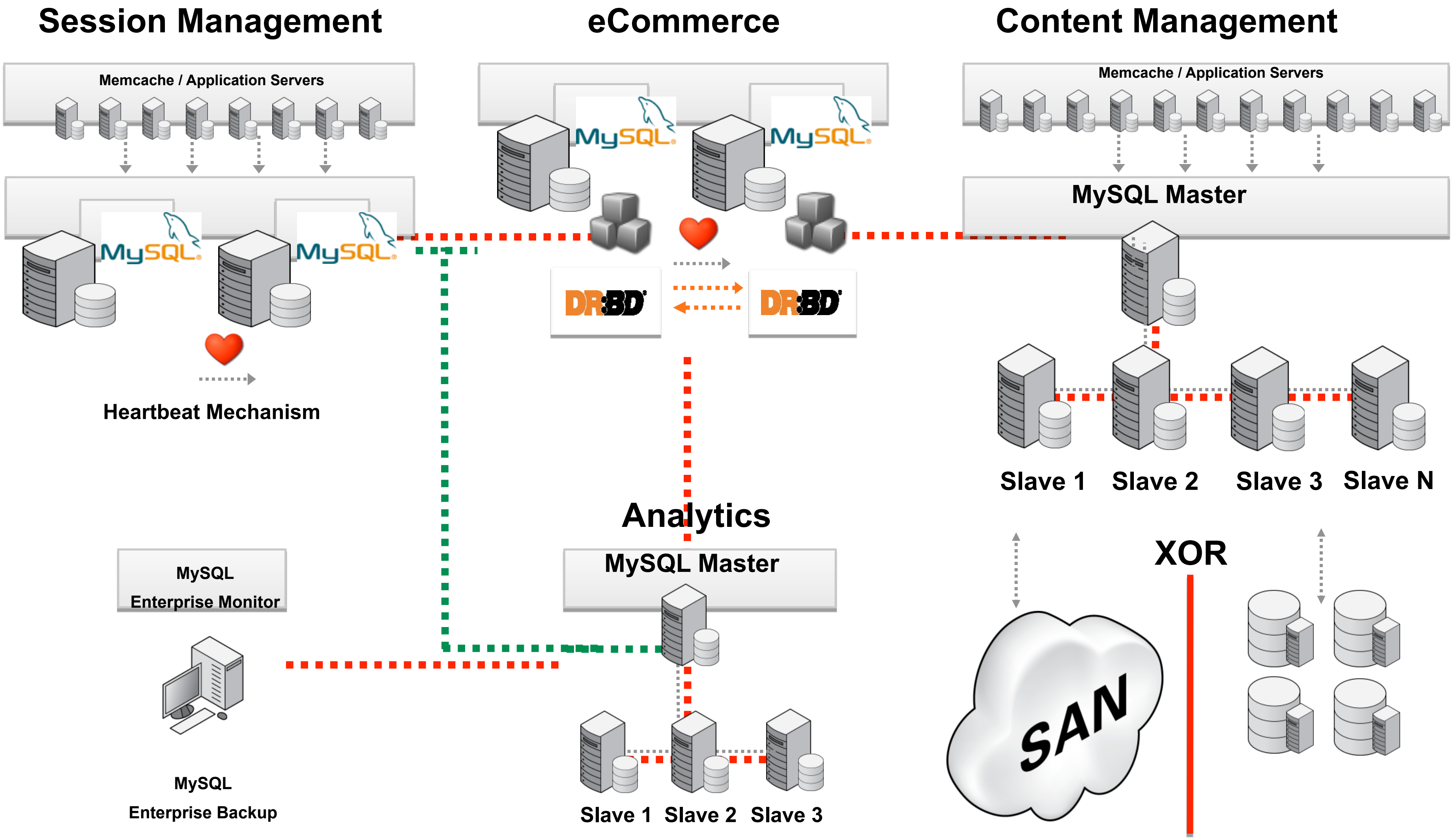


- *Used by leading web properties for scale-out*
- *Reads are directed to slaves, writes to master*
- *Delivers higher performance & scale with efficient resource utilization*

Medium: Web Reference Architecture

				Social Network
	Small	**Medium**	Large	Extra Large
Queries/Second	<500	**<5,000**	10,000+	25,000+
Transactions/Second	<100	**<1,000**	10,000+	25,000+
Concurrent Read Users	<100	**<5,000**	10,000+	25,000+
Concurrent Write Users	<10	**<100**	1,000+	2,500+
Database Size				
Sessions	<2 GB	**<10 GB**	20+ GB	40+ GB
eCommerce	<2 GB	**<10 GB**	20+ GB	40+ GB
Analytics	<10 GB	**<500 GB**	1+ TB	2+ TB
Content Management	<10 GB	**<500 GB**	1+ TB	2+ TB

Medium: Web Reference Architecture



Best Practices (1)

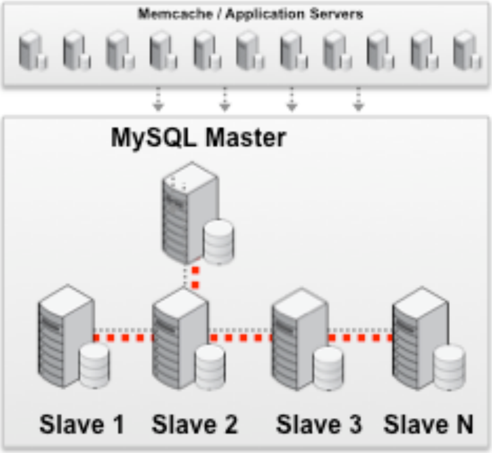
Medium Web Reference Architecture

- *Each component deployed onto dedicated server & storage infrastructure*
  - *Deployed, managed and scaled independently*
- *Server ratio: 8 application servers to each MySQL Server*
  - *More for PHP applications, less for Java*
- *Memcached deployed in session & content management components*
  - *Distributed memory caching layer*
  - *Reads fulfilled from cache, relieving load on the source database servers*

Best Practices (2)

Medium Web Reference Architecture

- ***Content Management***
  - *Each slave can handle around 3,000 concurrent users*
  - *Each master can handle up to 30 slaves*
  - *MySQL Replication for high availability*
    - *Can include Heartbeat, depending on application failover requirements*
  - *Meta data of content assets managed by MySQL*
  - *Distributed File System (i.e. MogileFS for indexing content assets*
  - *Physical storage*
    - *High quality SAN (redundancy for HA)*
    - *Distributed across local storage with DRBD for HA of indexing and meta data*



Best Practices (3)

Medium Web Reference Architecture

- ***Session Management & eCommerce***
  - ***Deployed onto InnoDB storage engine***
  - ***Session data maintained for up to 1 hour in a dedicated partition, rolling partitions used to delete aged data***
  - ***Data is captured in Analytics Datababase***
  - ***MySQL Replication with Heartbeat for HA***
    - ***Optionally add DRBD for eCommerce***
  - ***If web traffic grows, move Session Management to MySQL Cluster***
    - ***Persist session data for real-time personalization of user experience***
    - ***99.999% availability and in-memory data management can reduce need for DRBD & memcached***

MySQL Essentials - Part 4

Part 1: Why MySQL?

Part 2: Building, Installing & Configuring MySQL

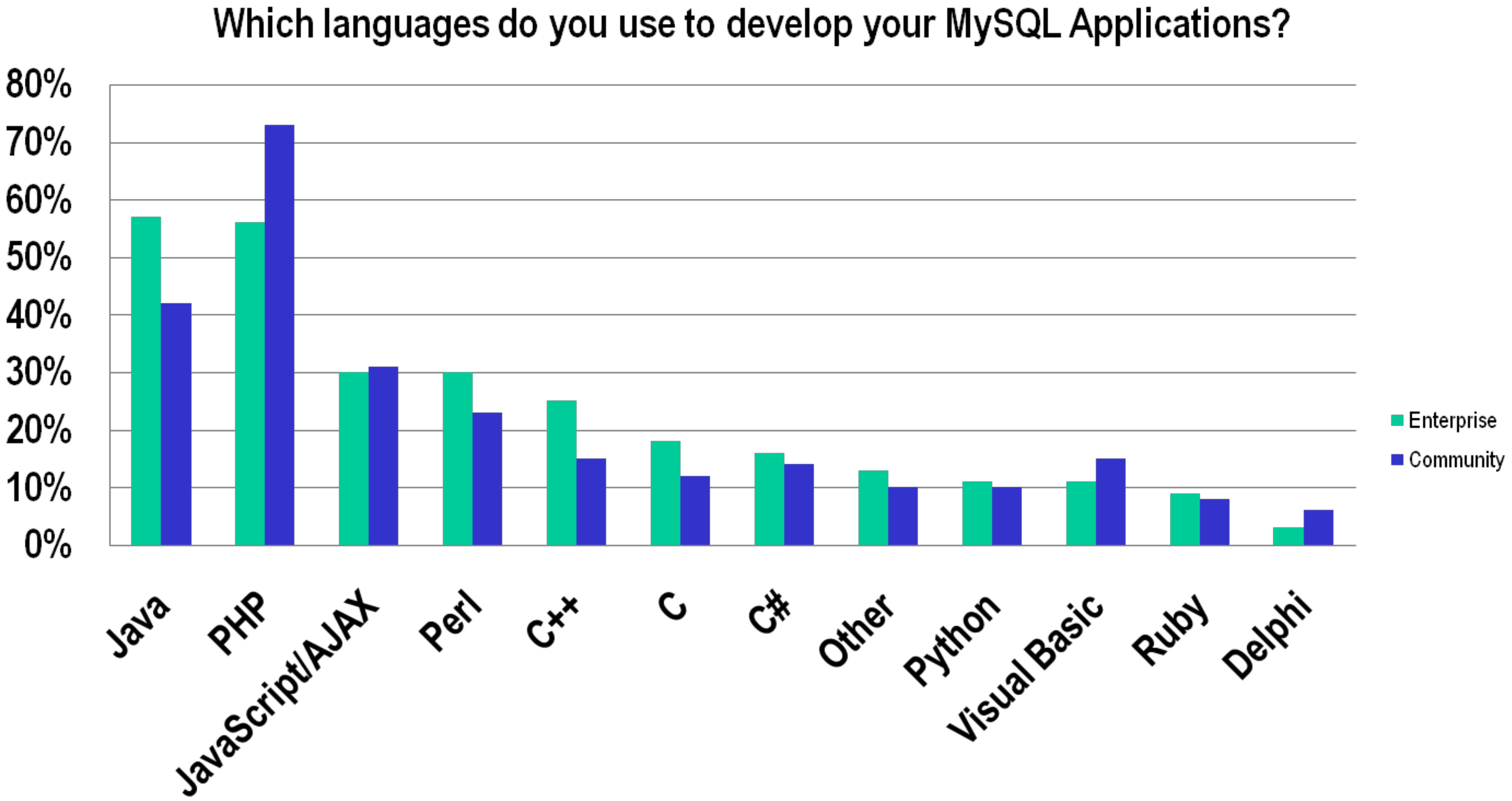
Part 3: Application / Architecture Considerations

Part 4: Developing MySQL Applications

Developing MySQL Applications

SOFTWARE.
HARDWARE.
COMPLETE.

MySQL User Survey: Top Languages



ORACLE

Developing Java Applications with MySQL

Connecting Java to MySQL

- *The JDBC driver is called MySQL Connector/J*
- *Type IV (all-java)*
- *Available from the following sources*
  - *Software*
    - *http://dev.mysql.com/downloads/connector/j/5.5.html*
    - *Maven, Ivy*
    - *Many Linux and BSD distributions*
  - *Documentation*
    - *http://dev.mysql.com/doc/refman/5.5/en/connector-j.html*

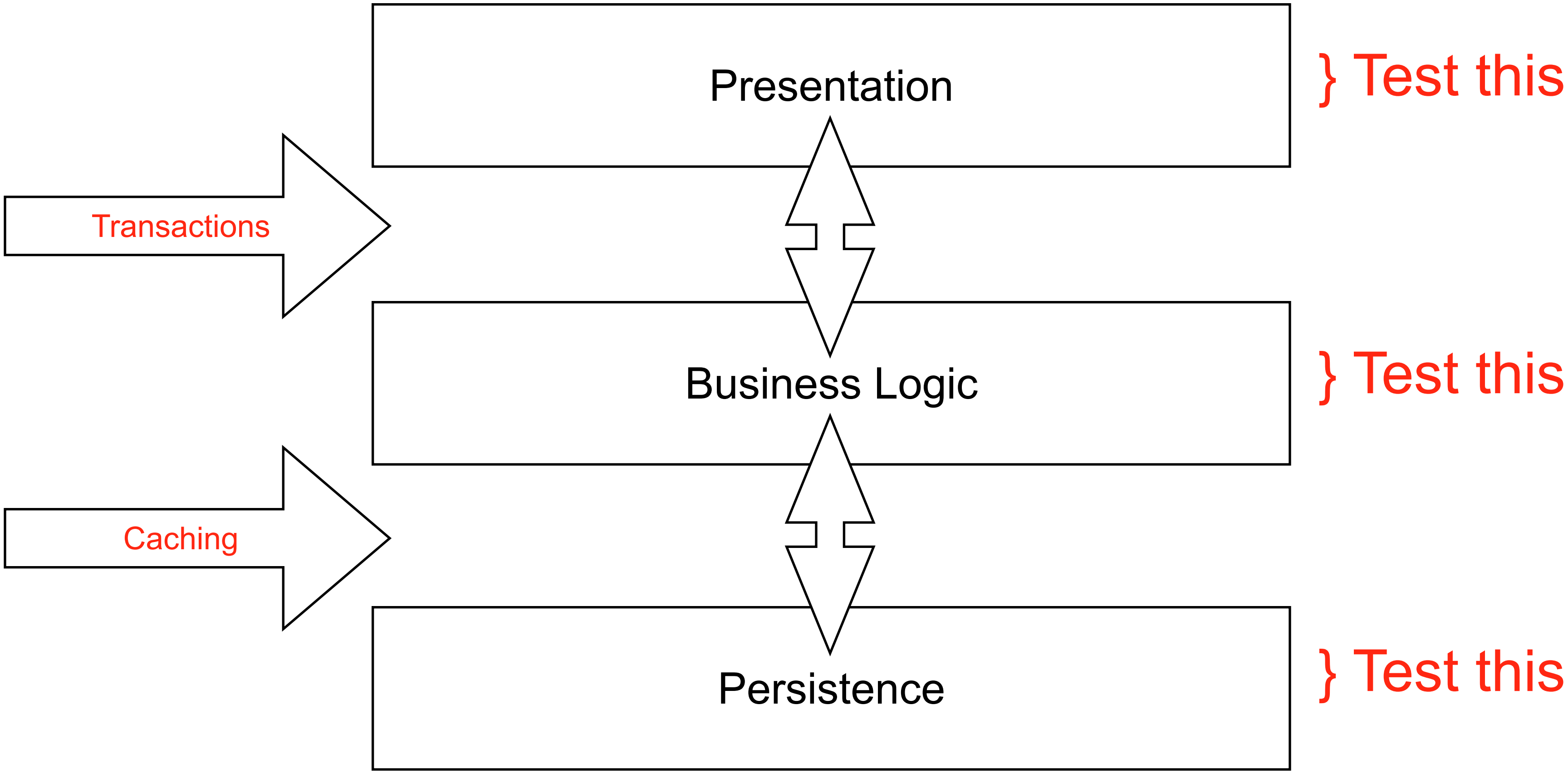
Connector/J Wisdom

- rewriteBatchedStatements=true
- useServerPrepStmts=true
- cachePrepStmts=true; also set prepStmtCacheSize and prepStmtCacheSqlLimit
- maintainTimeStats=false
- useUnbufferedIO=false, useReadAheadInput=false
  - Always benchmark I/O settings like these
- useConfigs=... for bundled sets of config options:
  - maxPerformance, solarisMaxPerformance, fullDebug, 3-0-Compat, 5-0-Compat

Understanding the Classpath

- ***The classpath is where Java looks for compiled code***
- ***There are some standard classpath locations:***
    - ***WEB-INF/lib, WEB-INF/classes in webapps***
    - ***$JRE_HOME/lib/ext***
- ***When developing or deploying avoid these:***
    - ***$JRE_HOME/lib/ext***
    - ***Application-server-wide***
        - ***e.g. $CATALINA_HOME/lib***
- ***If possible let your IDE or tools manage it***

Architecting for Success - Start Clean



Points to take away

- Start with clean architecture
  - Easier to start with than refactor to
  - Enable reusability
  - Enable quality through testability
  - Easier to add caching, partitioning later
- Consider frameworks instead of “raw” JDBC:
  - Avoid repetitive boilerplate code
  - Avoid resource-wasting mistakes
  - Enable re-use of persistence components
  - Business logic-level transactions become simpler

Developing PHP Applications with MySQL

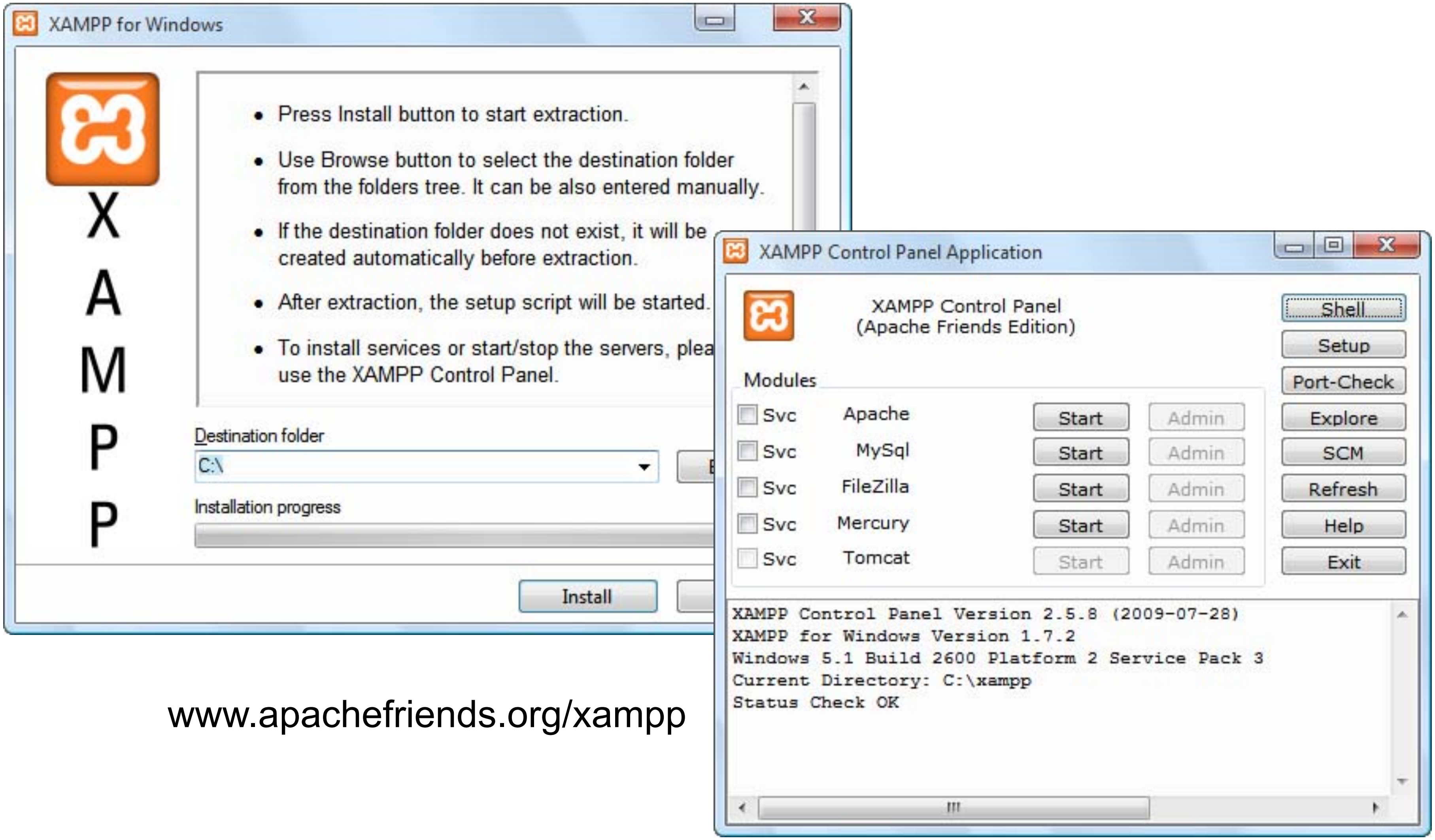
Introduction to PHP

- PHP Hypertext Preprocessor
- Web-Centric Scripting Language
  - *Processed by a Web-Server module*
  - *Can be embedded in HTML*
  - *Built-in functionality for dealing with Web-Things*
- PHP consists out of a relatively small core and a large collection of function libraries (“extensions”)
- http://php.net

PHP Installation

- *You need:*
  - *A Web Server (Apache HTTPd, Oracle Web Server, Microsoft IIS, nginx, …)*
  - *MySQL Server*
  - *PHP runtime*
- *For getting started there are bundles installing all of them*
  - *XAMPP*
- *It is also useful to install an IDE like NetBeans for editing PHP files*

XAMPP



XAMPP for Windows

- Press Install button to start extraction.
- Use Browse button to select the destination folder from the folders tree. It can be also entered manually.
- If the destination folder does not exist, it will be created automatically before extraction.
- After extraction, the setup script will be started.
- To install services or start/stop the servers, plea use the XAMPP Control Panel.

Destination folder: C:\

Installation progress

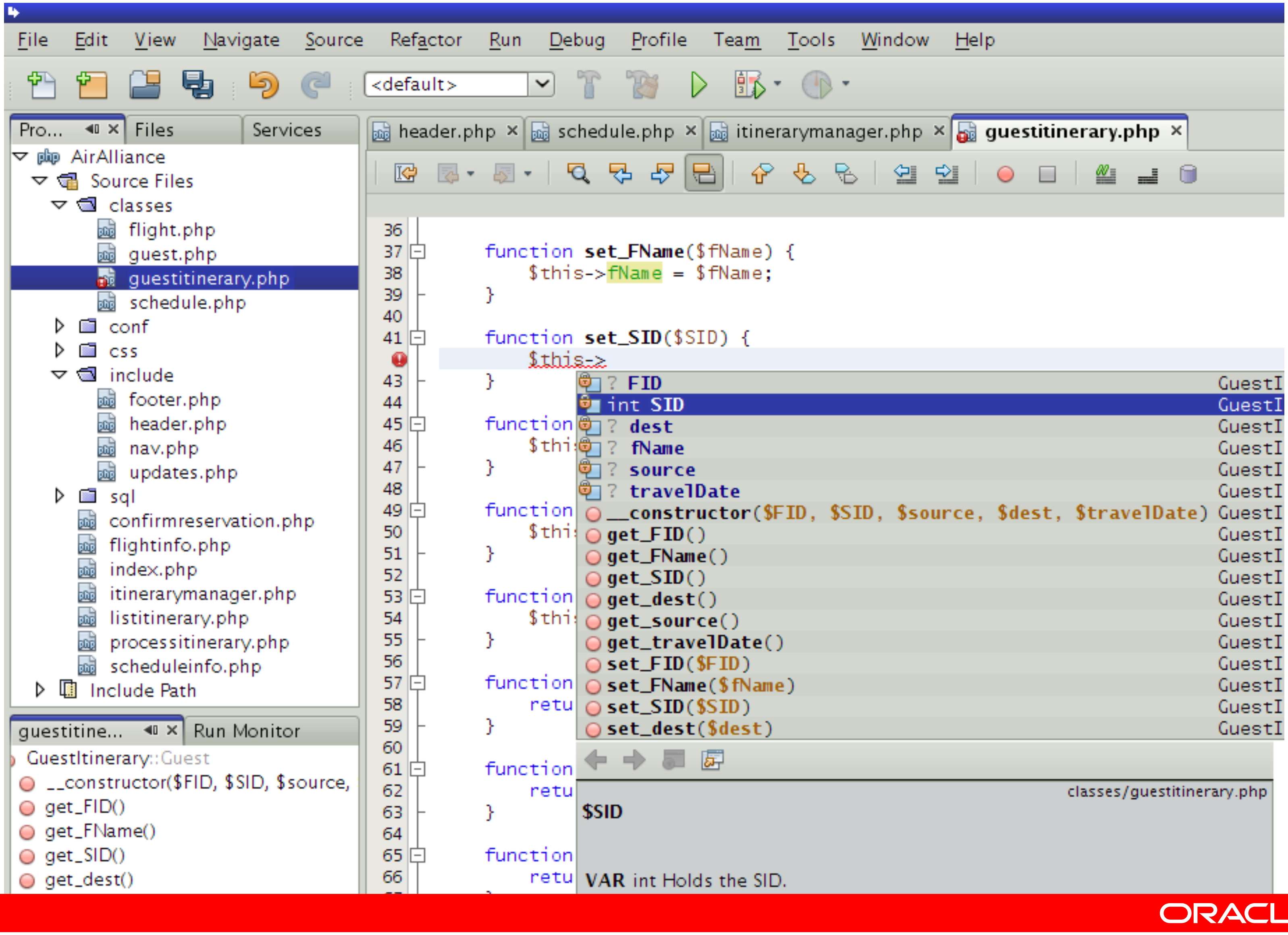
XAMPP Control Panel Application

XAMPP Control Panel
(Apache Friends Edition)

```
XAMPP Control Panel Version 2.5.8 (2009-07-28)
XAMPP for Windows Version 1.7.2
Windows 5.1 Build 2600 Platform 2 Service Pack 3
Current Directory: C:\xampp
Status Check OK
```

www.apachefriends.org/xampp

IDE – NetBeans – www.netbeans.org



```
AirAlliance
  Source Files
    classes
      flight.php
      guest.php
      guestitinerary.php
      schedule.php
    conf
    css
    include
      footer.php
      header.php
      nav.php
      updates.php
    sql
    confirmreservation.php
    flightinfo.php
    index.php
    itinerarymanager.php
    listitinerary.php
    processitinerary.php
    scheduleinfo.php
  Include Path
```

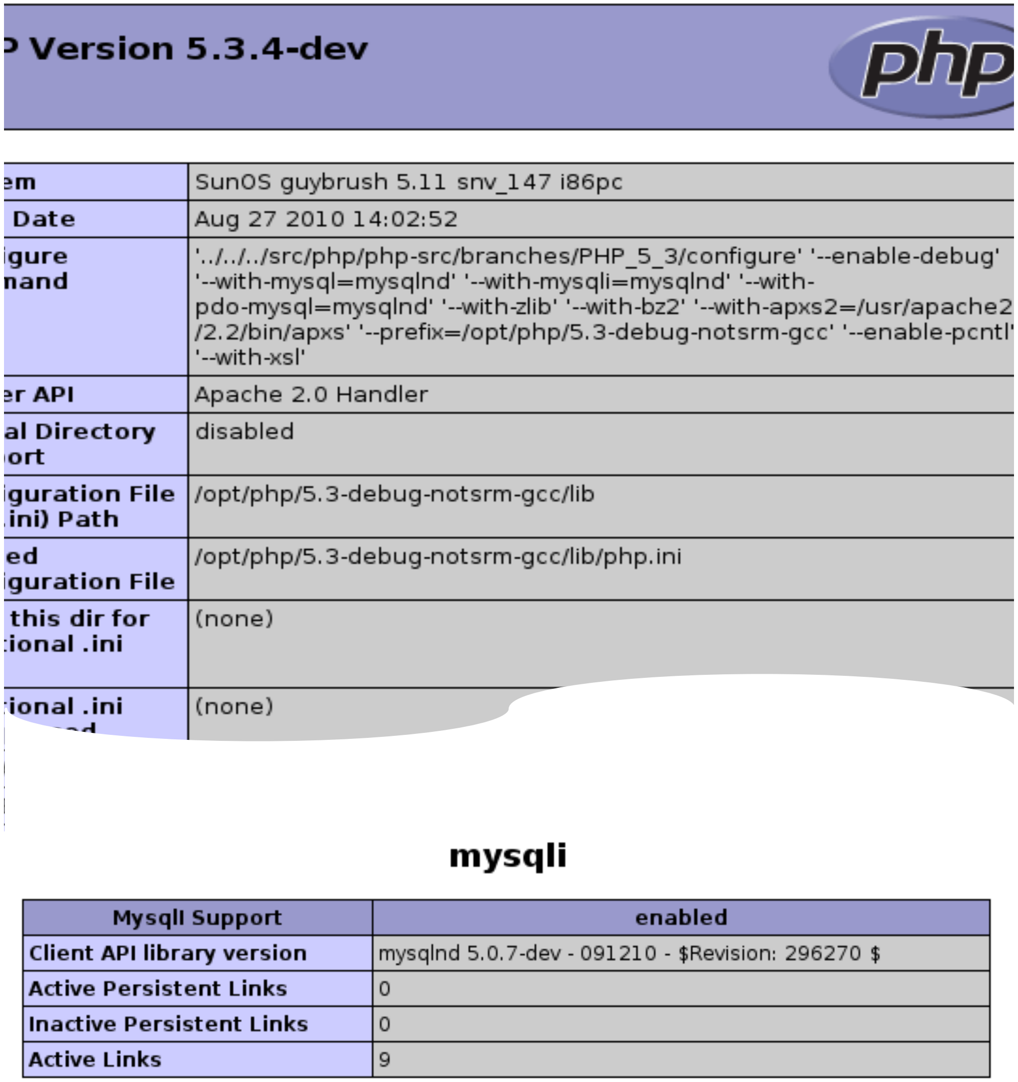
```
GuestItinerary::Guest
  __constructor($FID, $SID, $source,
  get_FID()
  get_FName()
  get_SID()
  get_dest()
```

```
    function set_FName($fName) {
        $this->fName = $fName;
    }

    function set_SID($SID) {
        $this->
    }

    function
        $thi
    }

    function
        $thi
    }

    function
        $thi
    }

    function
        retu
    }

    function
        retu
    }

    function
        retu
```

```
? FID                                                    GuestI
int SID                                                  GuestI
? dest                                                   GuestI
? fName                                                  GuestI
? source                                                 GuestI
? travelDate                                             GuestI
__constructor($FID, $SID, $source, $dest, $travelDate)   GuestI
get_FID()                                                GuestI
get_FName()                                              GuestI
get_SID()                                                GuestI
get_dest()                                               GuestI
get_source()                                             GuestI
get_travelDate()                                         GuestI
set_FID($FID)                                            GuestI
set_FName($fName)                                        GuestI
set_SID($SID)                                            GuestI
set_dest($dest)                                          GuestI
```

```
                                   classes/guestitinerary.php
$SID

VAR int Holds the SID.
```

Verifying the PHP Installation



P Version 5.3.4-dev

em	SunOS guybrush 5.11 snv_147 i86pc
Date	Aug 27 2010 14:02:52
igure nand	'../../../src/php/php-src/branches/PHP_5_3/configure' '--enable-debug' '--with-mysql=mysqlnd' '--with-mysqli=mysqlnd' '--with-pdo-mysql=mysqlnd' '--with-zlib' '--with-bz2' '--with-apxs2=/usr/apache2/2.2/bin/apxs' '--prefix=/opt/php/5.3-debug-notsrm-gcc' '--enable-pcntl' '--with-xsl'
er API	Apache 2.0 Handler
al Directory ort	disabled
iguration File .ini) Path	/opt/php/5.3-debug-notsrm-gcc/lib
ed iguration File	/opt/php/5.3-debug-notsrm-gcc/lib/php.ini
this dir for ional .ini	(none)
ional .ini	(none)

mysqli

Mysqli Support	enabled
Client API library version	mysqlnd 5.0.7-dev - 091210 - $Revision: 296270 $
Active Persistent Links	0
Inactive Persistent Links	0
Active Links	9

c:\xampp\htdocs\test.php:

```
<?php
phpinfo();
?>
```

http://localhost/test.php

A First PHP Example

```
<?php
$connection = mysqli_connect('localhost', 'root', '', 'test');
if (!$connection) {
    die('Error: ' . mysqli_connect_error());
}
$result = mysqli_query($connection,
                    'SELECT first_name, last_name FROM employees LIMIT 5');
if (!$result) {
    die('Error: ' . mysqli_error());
}


echo “<table>\n”;
while ($row = mysqli_fetch_assoc($result)) {
    printf(“<tr><td>%s</td><td>%s</td></tr>\n”,
            htmlentities($row['first_name']),
            htmlentities($row['last_name'])
    );
}
echo “</table>\n”;
mysqli_free_result($result);
mysqli_close($connection);
?>
```

ext/mysql

- *One of the first PHP extensions*
- *Actively maintained with PHP 4*
  - *No new features in PHP 5*
    - *Exception: Added mysqlnd support with PHP 5.3*
  - *Bug fixing only*
- *Best documented database extension*
  - *Tons of books, tutorials, …*
- *Missing support for many MySQL features*
  - *Prepared statements, Queries with multiple result sets (stored procedures), compression, encryption, full charset support, …*

mysqli - The Improved MySQL Extension

- *Full support for all MySQL features*
  - *Stored Procedures*
  - *Prepared Statements*
  - *Encryption (SSL)*
  - *Compression*
  - *Charsets*
  - *…*
- *Actively developed, maintained and supported by Oracle*

PDO_mysql

- *“The PHP Data Objects (PDO) extension defines a lightweight, consistent interface for accessing databases in PHP.” http://php.net/intro.pdo*
- *Lowest common denominator*
- *PHPish API*
- *PDO emulates prepared statements by default*
  - *We recommend turning on “real” prepared statements:*

$pdo->setOption(PDO::MYSQL_ATTR_DIRECT_QUERY, true);

PDO Example

```
<?php
$pdo = new PD
O(“mysql:host=localhost;dbname=test”,
      “user”, “password”);

$query = $pdo->prepare(
                 “SELECT id FROM table LIMIT ?, ?”);
$query->bindValue(1, $_GET[“offset”],
                             PDO::PARAM_INT);
$query->bindValue(2, (int) $_GET[“limit”]);

$query->execute();
```

Reasons for using different APIs

- *mysqli*
  - *Support for all MySQL features*
  - *Best support / stability*
  - *Integration with existing applications / environments*

- *PDO*
  - *Simple applications supporting multiple databases (for instance Oracle DB and MySQL)*
  - *Integration with existing applications / environments*

Validation

- *Validate all input values.*
- *Prevent mistakes by users*
  - *The sooner a wrong input is detected the better it can be handled*
- *Might prevent some attacks*
  - *No full security!*

Validation Examples

- *In some countries last names contain spaces*
  - *Garcia Gonzalez*
- *Some countries have their own letters*
  - *Schlüter*
- *Some countries use characters with special meanings to databases*
  - *O'Harra*
- *Non-Latin alphabets present other challenges, e.g. multi-byte characters*

➔ *Validation can't do everything we need!*
  - *A validation might check the min. and max. length at least*
  - *Validate your input, escape your output. Always.*

Validation can be *relatively* easy ...

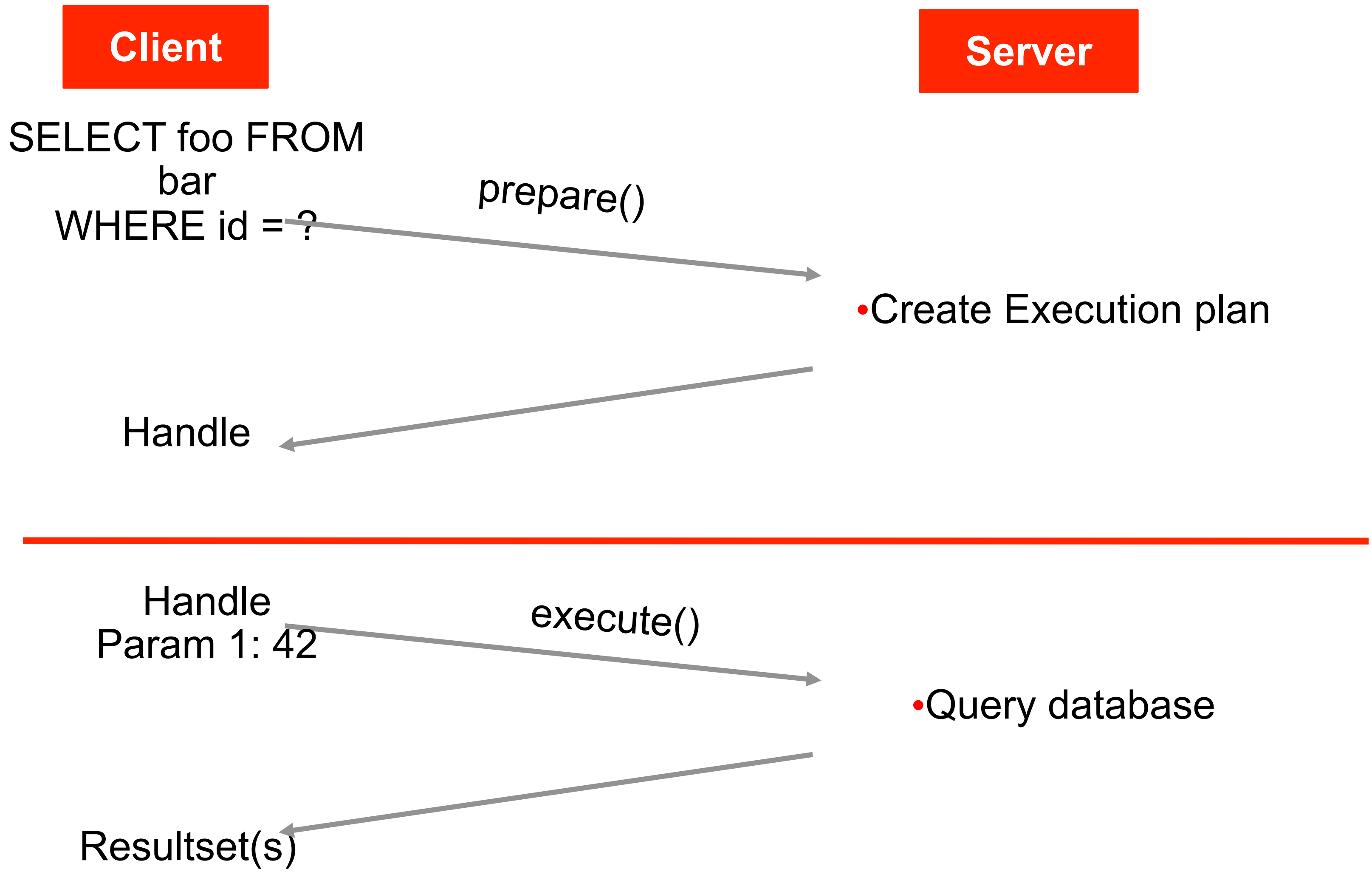
```
<?php
if (!isset($_POST['gender']) || !in_array($_POST['gender'], array('M', 'F')) {
    // The user tried to bypass our system!
    die(“Invalid Gender”);
}

if (!isset($_POST['birth_date']) ||
    !preg_math('/[0-9]{4}-[01][0-9]-[0-3][0-9]/', $_POST['birth_date']))
{
    // Maybe the user typed in something wrong?
    die(“Invalid date!”);
}
?>
```

Escaping for mysqli

- mysqli_real_escape_string()
  - Escapes special characters for usage in SQL statements
  - Takes current encoding into account

```
$sql = sprintf(“INSERT INTO employees
            (birth_date, first_name, last_name, gender)
            VALUES ('%s', '%s', '%s', '%s')”,
            mysqli_real_escape_string($conn, $_POST['birth_date']),
            mysqli_real_escape_string($conn, $_POST['first_name']),
            mysqli_real_escape_string($conn, $_POST['last_name']),
            mysqli_real_escape_string($conn, $_POST['gender'])
          );
 if ( ! mysqli_query($conn, $sql) {
      // ERROR
}
```

Prepared Statements



Client

Server

SELECT foo FROM bar
WHERE id = ?

prepare()

- Create Execution plan

Handle

Handle
Param 1: 42

execute()

- Query database

Resultset(s)

Prepared Statements and mysqli

```
$query = "INSERT INTO employees (first_name, last_name, gender)
                VALUES (?,?,?)";
$stmt = mysqli_prepare($conn, $query);

mysqli_stmt_bind_param($stmt, "sss", $val1, $val2, $val3,$val4);

$val1 = 'Johannes';
$val2 = 'Schlüter';
$val3 = 'M';
mysqli_stmt_execute($stmt);

$val1 = 'Andrey';
$val2 = 'Hristov';
$val3 = 'M';
mysqli_stmt_execute($stmt);
mysqli_stmt_close($stmt);
```

Database Abstraction Layers

```
$connectionParams = array(
        'dbname' => 'mydb',
        'user' => 'user',
        'password' => 'secret',
        'host' => 'localhost',
        'driver' => 'pdo_mysql',
   );
   $conn = DriverManager::getConnection($connectionParams);

   $conn->insert('user', array('username' => 'johannes'));
   // INSERT INTO user (username) VALUES (?) (johannes)

   $conn->update('user', array('username' => 'johannes'), array('id' => 1));
   // UPDATE user (username) VALUES (?) WHERE id = ? (johannes, 1)
```

PHP Frameworks

- *PHP applications often have to do the same things over and over again*
  - *Handling navigation*
  - *Handling form data*
- *There are proven concepts for application architectures*
  - *Model-View-Controller*

➔ *Frameworks usually save time and enforce clean structures*

➔ *Also make choice of PHP extension less of a factor*

Examples of Frameworks

- *There are two major general purpose frameworks*
  - *Zend Framework*
    - *Zend Technologies, Ltd.*
    - *http://framework.zend.com*
  - *Symfony*
    - *Sensio Labs*
    - *http://www.symfony-project.org*
  - *Others include: CakePHP, Agavi, Zeta Components*
- *Many applications provide their own framework*
  - *Typo3, Drupal, Joomla*

Learn More: PHP Resources

- ***MySQL DevZone (technical articles, developer interview …)***

  http://dev.mysql.com/

- ***MySQL Documentation***

  http://dev.mysql.com/doc/

- ***Download Free MySQL White Papers***

  http://dev.mysql.com/why-mysql/white-papers/

- ***View MySQL Training Courses***

  http://education.oracle.com/pls/web_prod-plq-dad/db_pages.getpage?page_id=402&p_nl=JMSQ

Developing .NET Applications with MySQL

What You Need for Connector/NET Development

- ***MySQL Database Installed and Running***
- ***Connector/NET Driver (v6.3.2 or later for VS 2010)***
- ***Visual Studio (2005, 2008, 2010)***
- ***MySQL Workbench 5.2 (optional)***

Connectors & Visual Studio

- ODBC, JDBC, C++, C….
- Connector/NET
  - C#
  - ASP.NET
  - VB.net
- Connector/Net
  - Implements the ADO.NET interfaces
  - Integrates into ADO.NET aware tools
  - Fully managed ADO.NET driver
  - 100% pure C#
- Integrates with Visual Studio

http://www.mysql.com/products/connector

Connector/NET Classes

Classes in Connector/NET connect to the database, execute queries and statements, and manage query results:

- *MySqlCommand: Represents an SQL statement to execute against a MySQL database.*
- *MySqlCommandBuilder: Automatically generates single-table commands used to reconcile changes made to a DataSet with the associated MySQL database.*
- *MySqlConnection: Represents an open connection to a MySQL Server database.*
- *MySqlDataAdapter: Represents a set of data commands and a database connection that are used to fill a data set and update a MySQL database.*
- *MySqlDataReader: Provides a means of reading a forward-only stream of rows from a MySQL database.*
- *MySqlException: The exception that is thrown when MySQL returns an error.*
- *MySqlHelper: Helper class that makes it easier to work with the provider.*
- *MySqlTransaction: Represents an SQL transaction to be made in a MySQL database.*

Creating a Connection String

- ***The MySqlConnection object is configured using a connection string. A connection string contains several key/value pairs, separated by semicolons:***

  Server=127.0.0.1;Uid=root;Pwd=12345;Database=test;

- **In this example, the MySqlConnection object is configured to connect to a MySQLserver at 127.0.0.1, with a user name of root and a password of 12345, and a default database test for all statements.**

Connection Example

*The following **Visual Basic** code creates a MySqlConnection object, assigns the connection string, and opens the connection.*

```
Dim conn As New MySql.Data.MySqlClient.MySqlConnection
Dim myConnectionString as String
myConnectionString = "server=127.0.0.1;" _
& "uid=root;" _
& "pwd=12345;" _
& "database=test;"
Try
conn.ConnectionString = myConnectionString
conn.Open()
Catch ex As MySql.Data.MySqlClient.MySqlException
MessageBox.Show(ex.Message)
End Try
```

*Equivalent **C#** example:*

```
MySql.Data.MySqlClient.MySqlConnection conn;
string myConnectionString;
myConnectionString = "server=127.0.0.1;uid=root;" +
"pwd=12345;database=test;";
try
{
conn = new MySql.Data.MySqlClient.MySqlConnection();
conn.ConnectionString = myConnectionString;
conn.Open();
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
MessageBox.Show(ex.Message);
}
```

Connection Errors

Because connecting to an external server is unpredictable, it is important to add error handling to your .NET application. When there is an error connecting, the MySqlConnection class returns a MySqlException object.

This object has two properties for handling errors:

- Message: A message that describes the current exception.
- Number: The MySQL error number.

When handling errors, your application responds based on the error number. The two most common error numbers when connecting are:

- 0: Cannot connect to server.
- 1045: Invalid user name and/or password.

Using MySqlCommand

- *A MySqlCommand has the CommandText and CommandType properties associated with it. The CommandText is handled differently depending on the setting of CommandType.*

- CommandType can be one of:

  1. Text - *A SQL text command (default)*
  2. StoredProcedure - *The name of a Stored Procedure*
  3. TableDirect - *The name of a table (new in Connector/NET 6.2)*

- *The default CommandType, Text, is used for executing queries and other SQL commands.*

- *If CommandType is set to StoredProcedure, CommandText should be set to the name of the Stored Procedure to access.*

Using MySqlCommand (cont.)

- *If CommandType is set to TableDirect, all rows and columns of the named table will be returned when you call one of the Execute methods. In effect, this command performs a SELECT * on the table specified.*

- *The CommandText property is set to the name of the table you wish to query.*

- *The following illustrates this:*

```
MySQLCommand cmd – new MySqlCommand();
cmd.CommandText = “mytable”;
cmd.Connection = someConnection;
cmd.CommandType = CommandType.TableDirect
SqlDataReader reader = comd.ExecuteReader();
While (reader.Read())
{
        Console.WriteLn(reader[0], reader[1]...);
}
```

Integrating Connector/NET with Visual Studio

- *MySQL Connector/NET supports Visual Studio versions 2005, 2008, and 2010. However, only MySQL Connector/NET version 6.3.x fully integrates with Visual Studio 2010.*

- *Visual Studio 2010 support was introduced with MySQL Connector/NET 6.3.2. From version 6.3.2 the connector ships with both NET 2.x and .NET 4.x versions of the Entity Framework support files, mysql.data.ef.dll and mysql.visualstudio.dll.*

- *When MySQL Connector/NET is installed on Microsoft Windows, Visual Studio integration components are also installed and initialized. This enables the developer to work seamlessly with MySQL Connector/NET in the familiar Visual Studio environment.*

Integrating Connector/NET with Visual Studio (cont.)

The .NET 4.x versions need to be shipped to enable new integration features supported in Visual Studio 2010, including:

- *New DDL T4 template for the Entity Framework (EF)*
- *Enables developers to design an EF model from scratch and use the native Visual Studio 2010 facility to generate MySQL DDL from that model. This is done by creating the model and choosing the SSDLToMySQL template in the properties window.*
- *The correct DDL is then generated and the developer can then save this code as a .mysql file in their project and execute it against the MySQL server.*
- *New SQL Editor - A new SQL editor has been included that enables connections to servers to execute SQL. This is activated by creating a new file with a .mysql extension. A new template is also included to allow creation of this file type using the Visual Studio 2010 main menu item FILE, NEW.*
- *Note: the MySQL SQL Editor is also available in 2005 and 2008.*

Visual Studio Integration: Editing Database Objects

Tables

Columns

Indexes

Foreign Keys

Column & Table Properties

Using ADO.NET Entity Framework

DDL T4 Template Macro

Views

Stored Procs & Functions

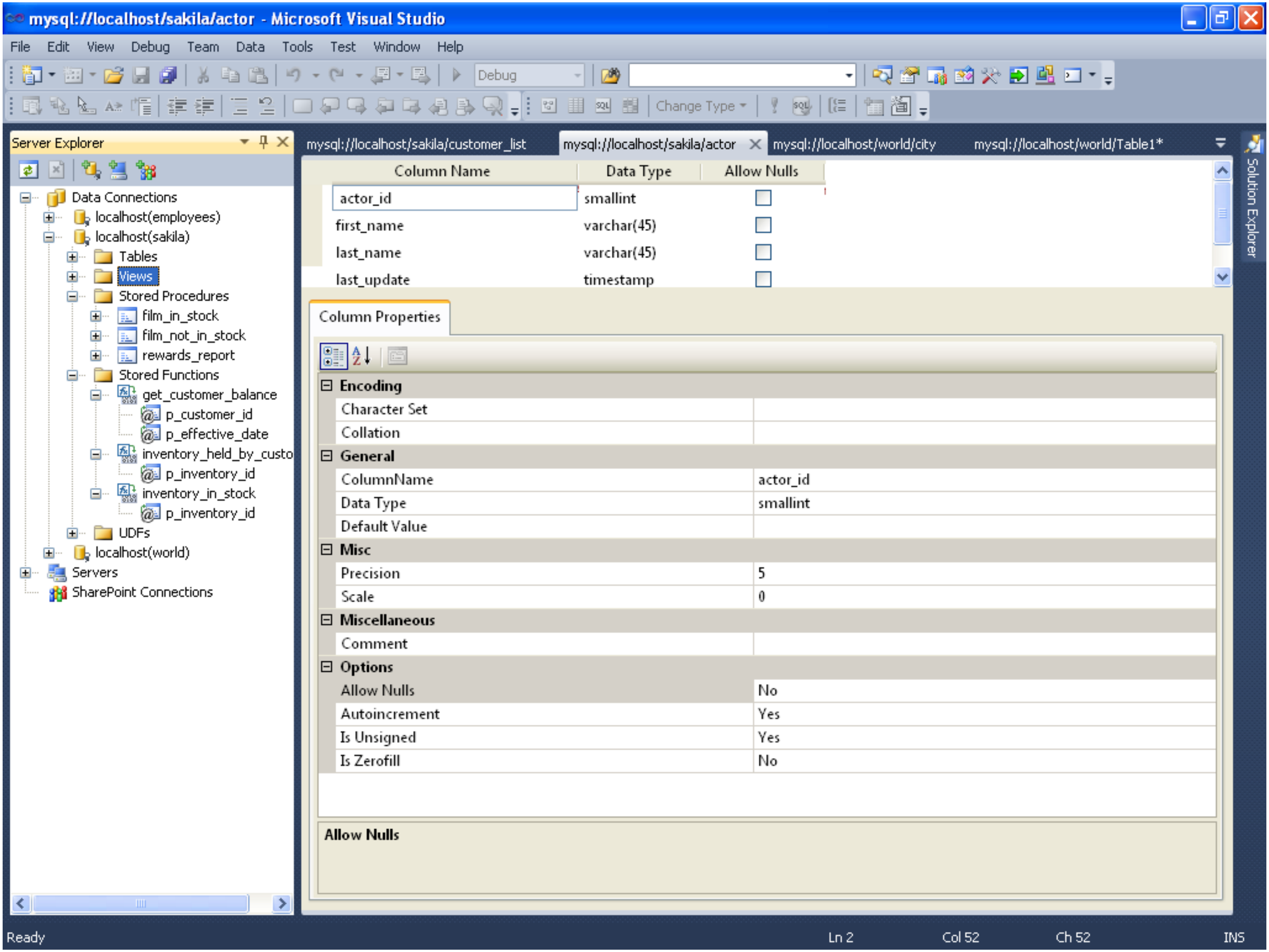
Triggers

User-Defined Functions (UDF)

Cloning Database Objects

MySQL SQL Editor

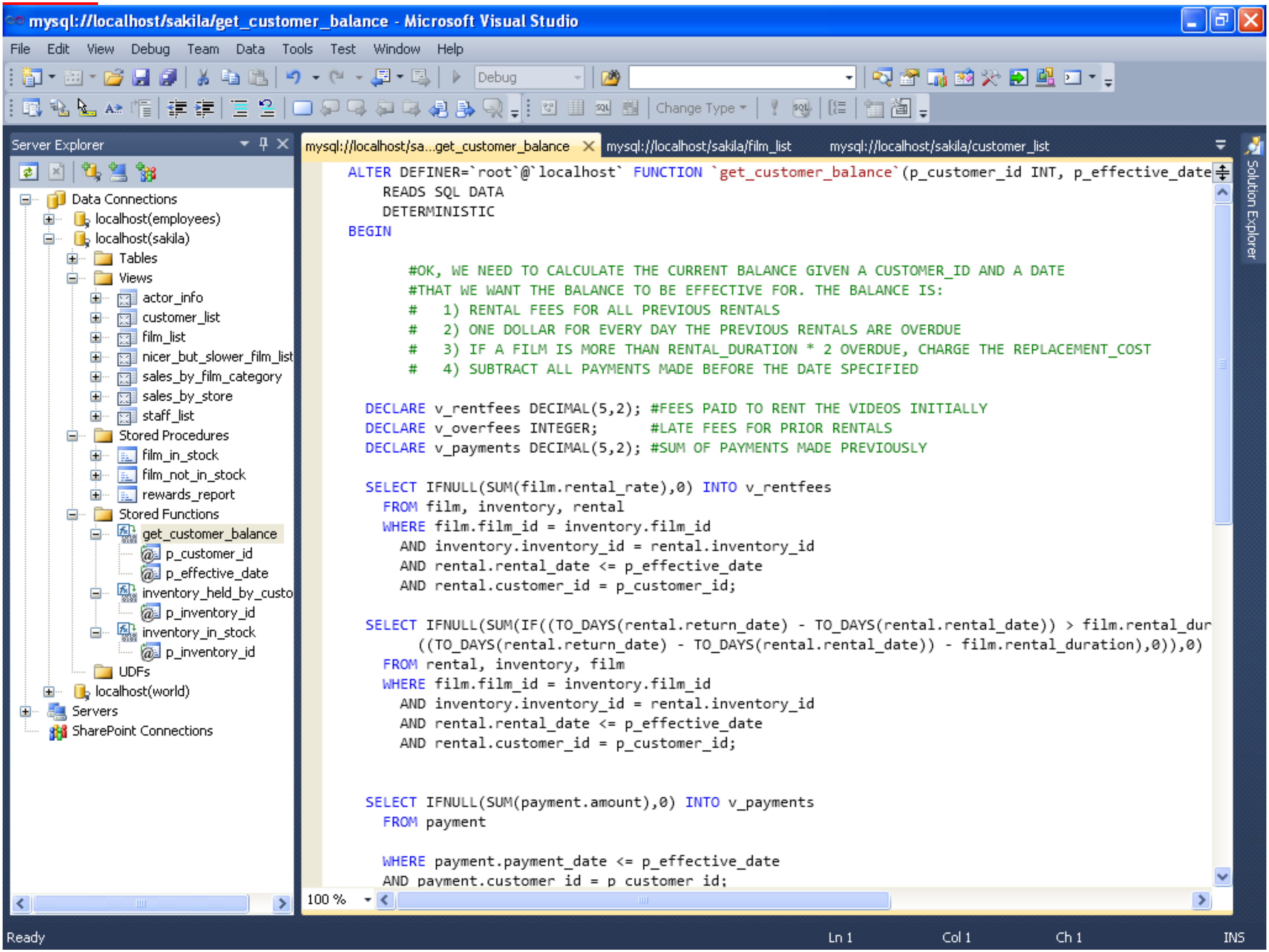
MySQL Website Configuration Tool



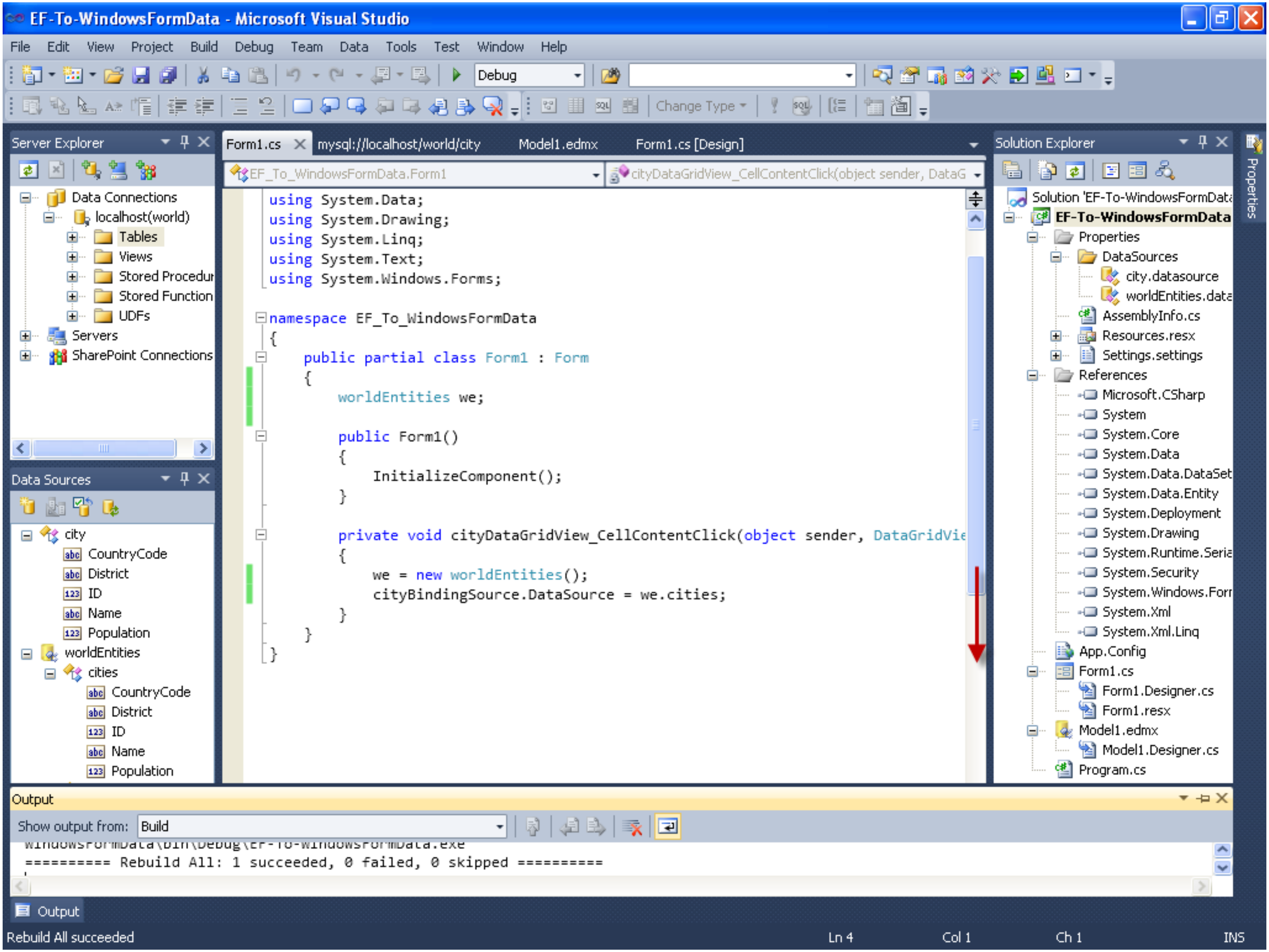
Column Name	Data Type	Allow Nulls
actor_id	smallint	□
first_name	varchar(45)	□
last_name	varchar(45)	□
last_update	timestamp	□

Encoding	
Character Set	
Collation	
General	
ColumnName	actor_id
Data Type	smallint
Default Value	
Misc	
Precision	5
Scale	0
Miscellaneous	
Comment	
Options	
Allow Nulls	No
Autoincrement	Yes
Is Unsigned	Yes
Is Zerofill	No

Allow Nulls



```
ALTER DEFINER=`root`@`localhost` FUNCTION `get_customer_balance`(p_customer_id INT, p_effective_date
    READS SQL DATA
    DETERMINISTIC
BEGIN

       #OK, WE NEED TO CALCULATE THE CURRENT BALANCE GIVEN A CUSTOMER_ID AND A DATE
       #THAT WE WANT THE BALANCE TO BE EFFECTIVE FOR. THE BALANCE IS:
       #   1) RENTAL FEES FOR ALL PREVIOUS RENTALS
       #   2) ONE DOLLAR FOR EVERY DAY THE PREVIOUS RENTALS ARE OVERDUE
       #   3) IF A FILM IS MORE THAN RENTAL_DURATION * 2 OVERDUE, CHARGE THE REPLACEMENT_COST
       #   4) SUBTRACT ALL PAYMENTS MADE BEFORE THE DATE SPECIFIED

  DECLARE v_rentfees DECIMAL(5,2); #FEES PAID TO RENT THE VIDEOS INITIALLY
  DECLARE v_overfees INTEGER;      #LATE FEES FOR PRIOR RENTALS
  DECLARE v_payments DECIMAL(5,2); #SUM OF PAYMENTS MADE PREVIOUSLY

  SELECT IFNULL(SUM(film.rental_rate),0) INTO v_rentfees
    FROM film, inventory, rental
    WHERE film.film_id = inventory.film_id
      AND inventory.inventory_id = rental.inventory_id
      AND rental.rental_date <= p_effective_date
      AND rental.customer_id = p_customer_id;

  SELECT IFNULL(SUM(IF((TO_DAYS(rental.return_date) - TO_DAYS(rental.rental_date)) > film.rental_dur
        ((TO_DAYS(rental.return_date) - TO_DAYS(rental.rental_date)) - film.rental_duration),0)),0)
    FROM rental, inventory, film
    WHERE film.film_id = inventory.film_id
      AND inventory.inventory_id = rental.inventory_id
      AND rental.rental_date <= p_effective_date
      AND rental.customer_id = p_customer_id;


  SELECT IFNULL(SUM(payment.amount),0) INTO v_payments
    FROM payment

    WHERE payment.payment_date <= p_effective_date
    AND payment.customer_id = p_customer_id;
```



```
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;

namespace EF_To_WindowsFormData
{
    public partial class Form1 : Form
    {
        worldEntities we;

        public Form1()
        {
            InitializeComponent();
        }

        private void cityDataGridView_CellContentClick(object sender, DataGridVie
        {
            we = new worldEntities();
            cityBindingSource.DataSource = we.cities;
        }
    }
}
```

```
WindowsFormData\bin\Debug\EF-To-WindowsFormData.exe
========== Rebuild All: 1 succeeded, 0 failed, 0 skipped ==========
```

The preceding is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions.
The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

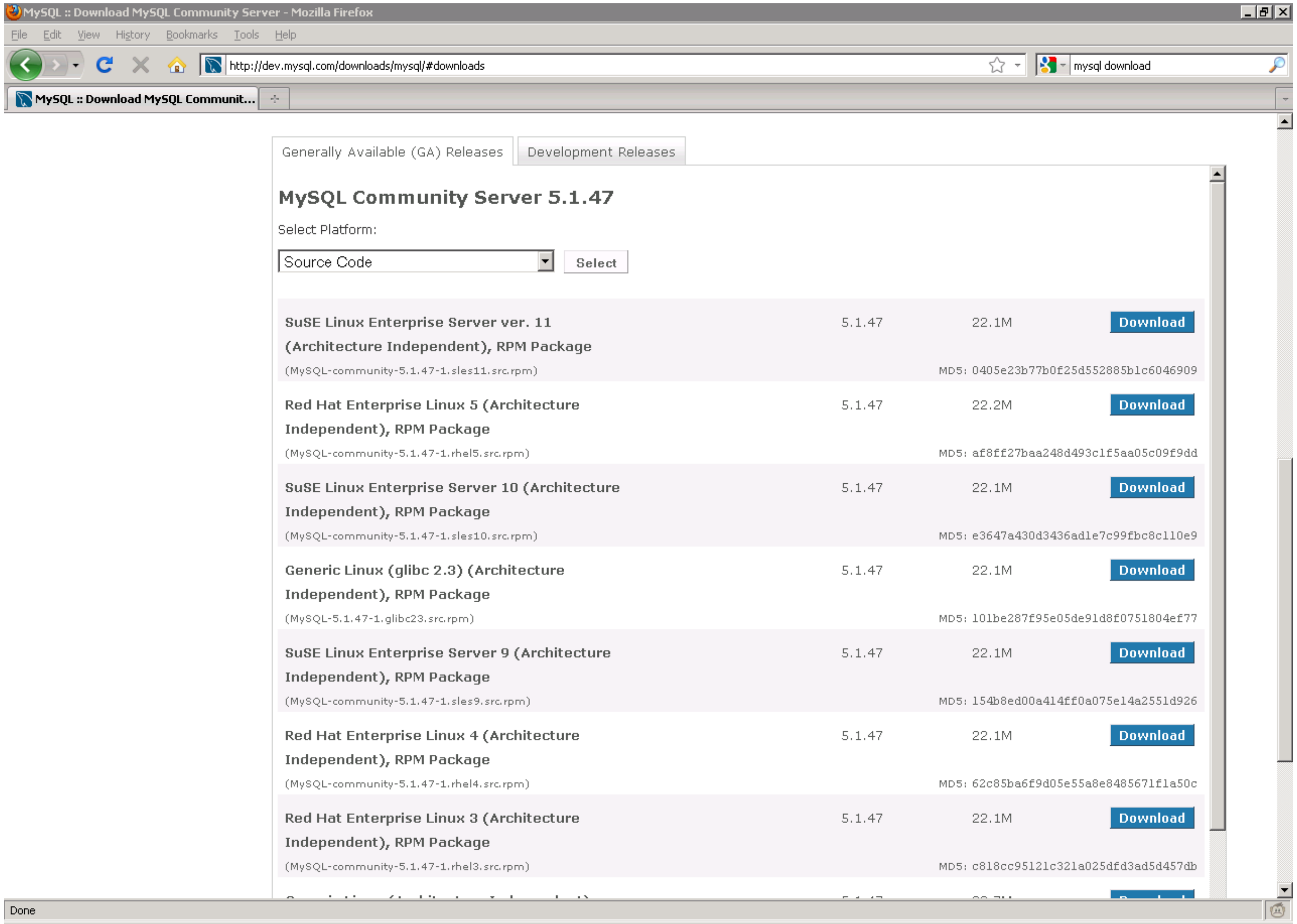
End

Installation Overview

- ***Download source file***
- ***Add MySQL user and group***
- ***Select directory to uncompress***
- ***Navigate to top-level directory***
- ***Configure and compile***
- ***Install the distribution***
- ***Navigate to installation directory***
- ***Set permissions***
- ***Create data directory and initialize GRANT tables***
- ***Start Server***

Download Source

dev.mysql.com/downloads/mysql/#downloads


MySQL :: Download MySQL Community Server - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://dev.mysql.com/downloads/mysql/#downloads
mysql download
MySQL :: Download MySQL Communit...
Generally Available (GA) Releases
Development Releases
Done

MySQL Community Server 5.1.47

Select Platform:

Source Code ▾ Select

SuSE Linux Enterprise Server ver. 11 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.sles11.src.rpm)	5.1.47	22.1M	Download MD5: 0405e23b77b0f25d552885b1c6046909
Red Hat Enterprise Linux 5 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.rhel5.src.rpm)	5.1.47	22.2M	Download MD5: af8ff27baa248d493c1f5aa05c09f9dd
SuSE Linux Enterprise Server 10 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.sles10.src.rpm)	5.1.47	22.1M	Download MD5: e3647a430d3436ad1e7c99fbc8c110e9
Generic Linux (glibc 2.3) (Architecture Independent), RPM Package (MySQL-5.1.47-1.glibc23.src.rpm)	5.1.47	22.1M	Download MD5: 101be287f95e05de91d8f0751804ef77
SuSE Linux Enterprise Server 9 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.sles9.src.rpm)	5.1.47	22.1M	Download MD5: 154b8ed00a414ff0a075e14a2551d926
Red Hat Enterprise Linux 4 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.rhel4.src.rpm)	5.1.47	22.1M	Download MD5: 62c85ba6f9d05e55a8e8485671f1a50c
Red Hat Enterprise Linux 3 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.rhel3.src.rpm)	5.1.47	22.1M	Download MD5: c818cc95121c321a025dfd3ad5d457db

Steps to Build MySQL on Linux / UNIX

- Create MySQL User and Group

```
> groupadd mysql
> useradd –g mysql mysql
```

- Uncompress Source tar

```
> gunzip < mysql-VERSION.tar.gz | tar –xvf –
> cd mysql-VERSION
```

- Configure, Compile and Install

```
> ./configure –prefix=/usr/local/mysql
> make
> make install
```

- Set Up Option File

```
> cp support-files/my-medium.cnf /etc/my.cnf
```

- Set Permissions

```
> cd usr/local/mysql
> chown –R mysql .
> chgrp –R mysql .
```

Steps to Build MySQL on Linux / UNIX (cont.)

Data Directory and GRANT tables

```
> bin/mysql_install_db -user=mysql
```

Set Up Option File

```
> chown -R root .
> chown -R mysql var
```

Start MySQL Server

```
> bin/mysqld_safe -user=mysql &
```

Installing from Development Tree (Linux)

Configure the Build Machine

- Bazaar
- GNU make
- autoconf 2.58 or greater
- automake 1.81
- libtool 1.5
- m4
- bison

Building MySQL From Dev Tree on Linux

- ***Bazaar Repo and Initialize Directory***
  - mkdir mysql-server
  - bzr init-repo –trees mysql-server
- ***Create Local Tree***
  - cd mysql-server
  - bzr branch lp:mysql-server/5.5 mysql-5.5
- ***Copy Active Branch***
  - bzr branch mysql-5.5 mysql-5.5-build
- ***Prepare Source Tree for Configuration***
  - cd mysql-5.5
  - autoreconf –force –install
- ***Configure and Compile***
  - ./configure [OPTIONS]
- ***Make***
  - make install
- ***Make Install***
  - ./configure [OPTIONS]
  - make

Installing from Source

(Windows)

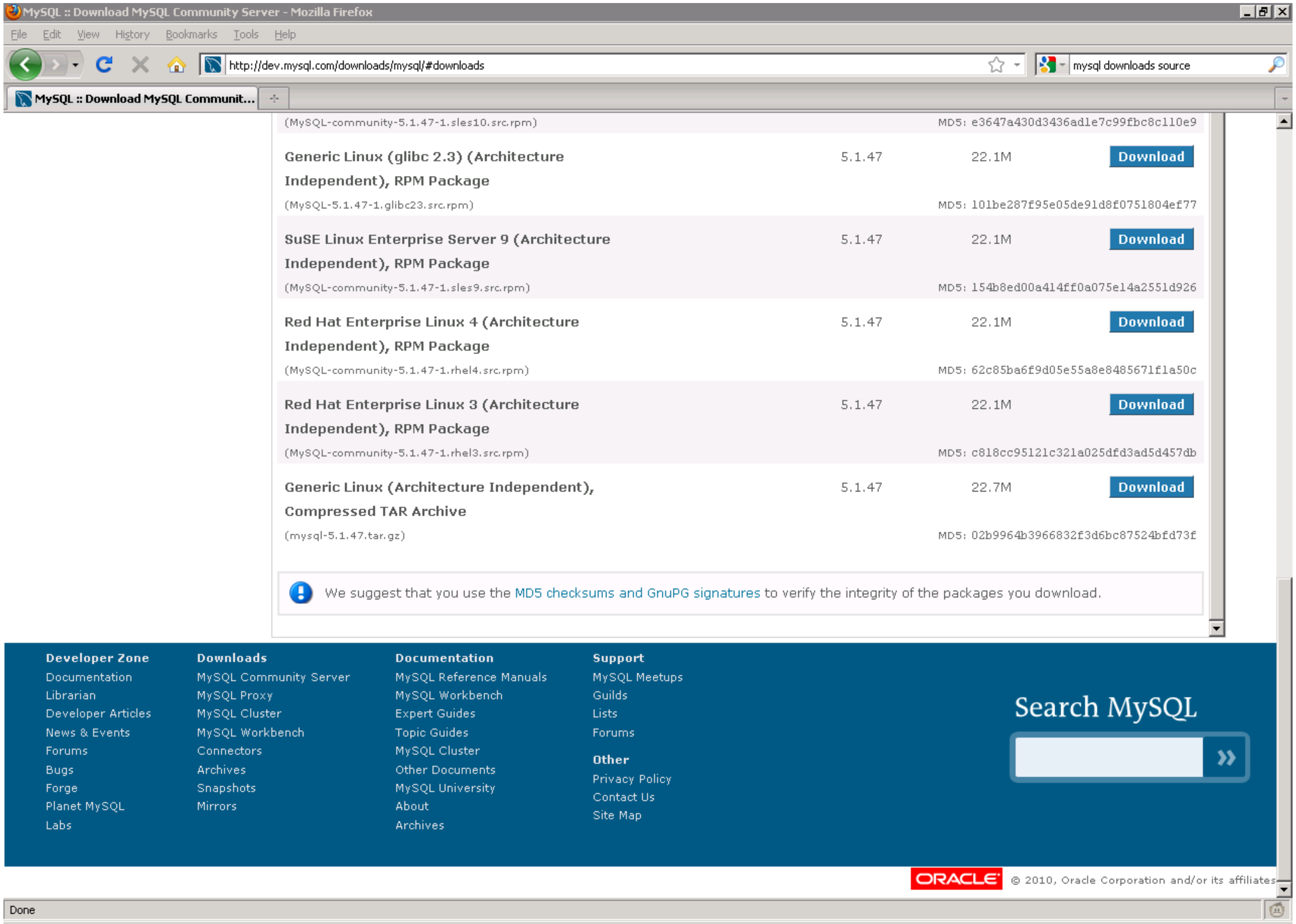
Configure the Build Machine

- Bazaar
- Visual Studio Express
- Windows Platform SDK
- CMake
- Bison for Windows
- Cygwin
- WiX

Building MySQL on Windows

- ***Configure the Build Machine***
- ***Obtain MySQL Source***
- ***Build the Source – Configure CMake***
- ***Build the Source – Create VS Solution***
- ***Build the Source – Build the Solution***
- ***Test the Build – Run the Test Suite***

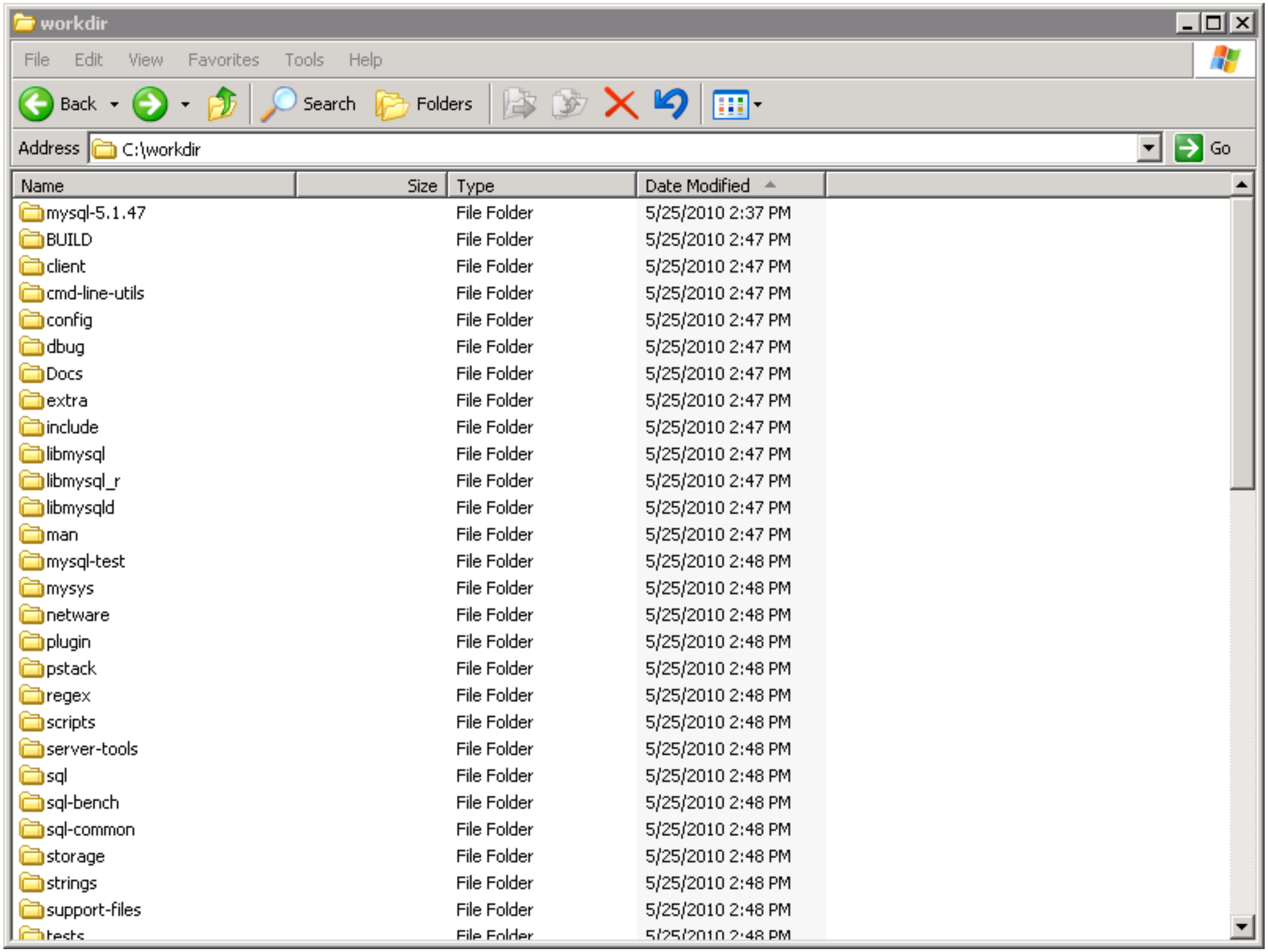
Download MySQL Source Files



(MySQL-community-5.1.47-1.sles10.src.rpm)			MD5: e3647a430d3436ad1e7c99fbc8c110e9
Generic Linux (glibc 2.3) (Architecture Independent), RPM Package (MySQL-5.1.47-1.glibc23.src.rpm)	5.1.47	22.1M	Download MD5: 101be287f95e05de91d8f0751804ef77
SuSE Linux Enterprise Server 9 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.sles9.src.rpm)	5.1.47	22.1M	Download MD5: 154b8ed00a414ff0a075e14a2551d926
Red Hat Enterprise Linux 4 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.rhel4.src.rpm)	5.1.47	22.1M	Download MD5: 62c85ba6f9d05e55a8e8485671f1a50c
Red Hat Enterprise Linux 3 (Architecture Independent), RPM Package (MySQL-community-5.1.47-1.rhel3.src.rpm)	5.1.47	22.1M	Download MD5: c818cc95121c321a025dfd3ad5d457db
Generic Linux (Architecture Independent), Compressed TAR Archive (mysql-5.1.47.tar.gz)	5.1.47	22.7M	Download MD5: 02b9964b3966832f3d6bc87524bfd73f

We suggest that you use the MD5 checksums and GnuPG signatures to verify the integrity of the packages you download.

Uncompress Download



Address: C:\workdir

Name	Size	Type	Date Modified
mysql-5.1.47		File Folder	5/25/2010 2:37 PM
BUILD		File Folder	5/25/2010 2:47 PM
client		File Folder	5/25/2010 2:47 PM
cmd-line-utils		File Folder	5/25/2010 2:47 PM
config		File Folder	5/25/2010 2:47 PM
dbug		File Folder	5/25/2010 2:47 PM
Docs		File Folder	5/25/2010 2:47 PM
extra		File Folder	5/25/2010 2:47 PM
include		File Folder	5/25/2010 2:47 PM
libmysql		File Folder	5/25/2010 2:47 PM
libmysql_r		File Folder	5/25/2010 2:47 PM
libmysqld		File Folder	5/25/2010 2:47 PM
man		File Folder	5/25/2010 2:47 PM
mysql-test		File Folder	5/25/2010 2:48 PM
mysys		File Folder	5/25/2010 2:48 PM
netware		File Folder	5/25/2010 2:48 PM
plugin		File Folder	5/25/2010 2:48 PM
pstack		File Folder	5/25/2010 2:48 PM
regex		File Folder	5/25/2010 2:48 PM
scripts		File Folder	5/25/2010 2:48 PM
server-tools		File Folder	5/25/2010 2:48 PM
sql		File Folder	5/25/2010 2:48 PM
sql-bench		File Folder	5/25/2010 2:48 PM
sql-common		File Folder	5/25/2010 2:48 PM
storage		File Folder	5/25/2010 2:48 PM
strings		File Folder	5/25/2010 2:48 PM
support-files		File Folder	5/25/2010 2:48 PM
tests		File Folder	5/25/2010 2:48 PM

Build the Source – Configure CMake

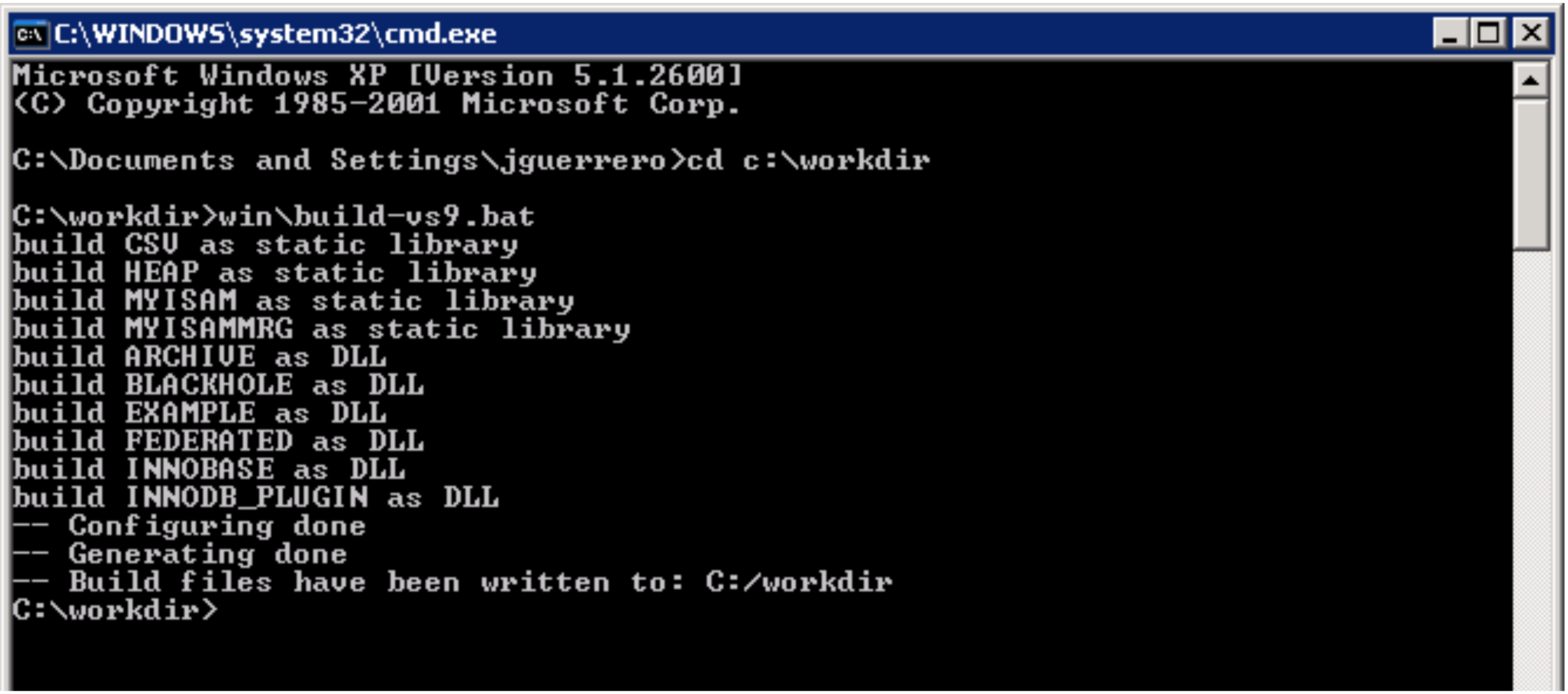
- win/configure.js used to create the configuration file (win/configure.data) used by CMake
- Configuration options are defined in win/README
- Example:

```
'cscript win/configure.js WITH_INNOBASE_STORAGE_ENGINE
   WITH_PARTITION_STORAGE_ENGINE
   WITH_ARCHIVE_STORAGE_ENGINE
   WITH_BLACKHOLE_STORAGE_ENGINE
   WITH_EXAMPLE_STORAGE_ENGINE
   WITH_FEDERATED_STORAGE_ENGINE __NT__'
```

Build the Source – Create VS Solution

- **CMake uses files named CMakeLists.txt in each directory to create the necessary solution/project files**
- **Three batch files are provided to create Visual Studio solutions**
  - win/build_vs71.bat
  - win/build_vs8.bat
  - win/build_vs8_x64.bat

Create Visual Studio Solution



```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\jguerrero>cd c:\workdir

C:\workdir>win\build-vs9.bat
build CSV as static library
build HEAP as static library
build MYISAM as static library
build MYISAMMRG as static library
build ARCHIVE as DLL
build BLACKHOLE as DLL
build EXAMPLE as DLL
build FEDERATED as DLL
build INNOBASE as DLL
build INNODB_PLUGIN as DLL
-- Configuring done
-- Generating done
-- Build files have been written to: C:/workdir
C:\workdir>
```

Build the Solution

- *Open the solution 'MySQL.sln' with Visual Studio*
- *Choose the configuration*
  - *Official MySQL builds use Debug and RelWithDebInfo*
- *Click Build > Build Solution (F7) to start the build*

Test the Build – Run the Test Suite

- Microsoft allows building different configurations of the source in the same tree
- Useful for mix-match, release/debug, client/server testing
- Mysql-test-run(mtr) will try to guess which configuration but better to be specific with –vsconfig dir option

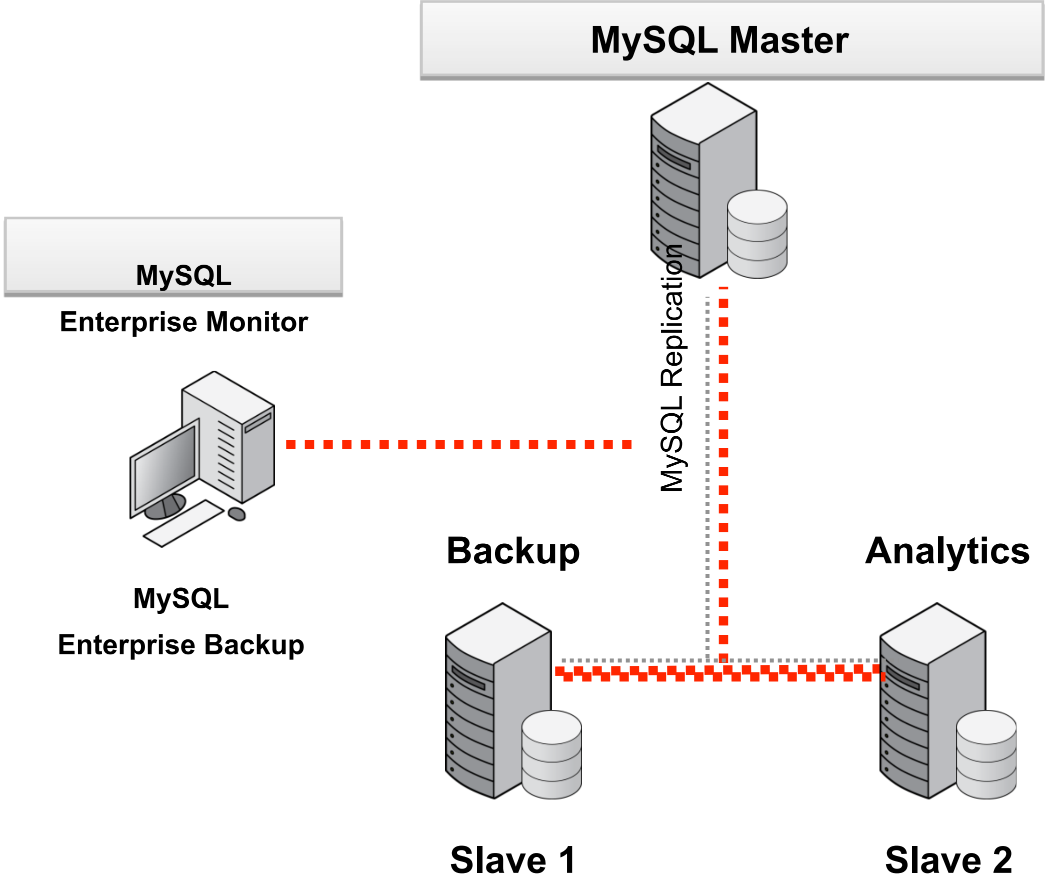
Test the Build – Debugging

- Debugging MySQL in Visual Studio can be awkward but well worth the effort
- If you haven’t already done so, build the solution’s Debug or RelWithDebInfo configuration
- MySQL Test suite has a ‘-manual-debug’ option which displays configuration options needed to run the server in the debugger

Small: Web Reference Architecture

				Social Network
	Small	Medium	Large	Extra Large
Queries/Second	**<500**	<5,000	10,000+	25,000+
Transactions/Second	**<100**	<1,000	10,000+	25,000+
Concurrent Read Users	**<100**	<5,000	10,000+	25,000+
Concurrent Write Users	**<10**	<100	1,000+	2,500+
Database Size				
Sessions	**<2 GB**	<10 GB	20+ GB	40+ GB
eCommerce	**<2 GB**	<10 GB	20+ GB	40+ GB
Analytics	**<10 GB**	<500 GB	1+ TB	2+ TB
Content Management	**<10 GB**	<500 GB	1+ TB	2+ TB

Small: Web Reference Architecture



- ***Single server supporting all workloads***
- ***Data replicated to slaves for back-up & analysis***

Applications

- *Members/Authentication*
- *eCommerce*
- *Content Management*
- *Search*

Only deploy when future traffic growth is very limited

Best Practices

Small Web Reference Architecture

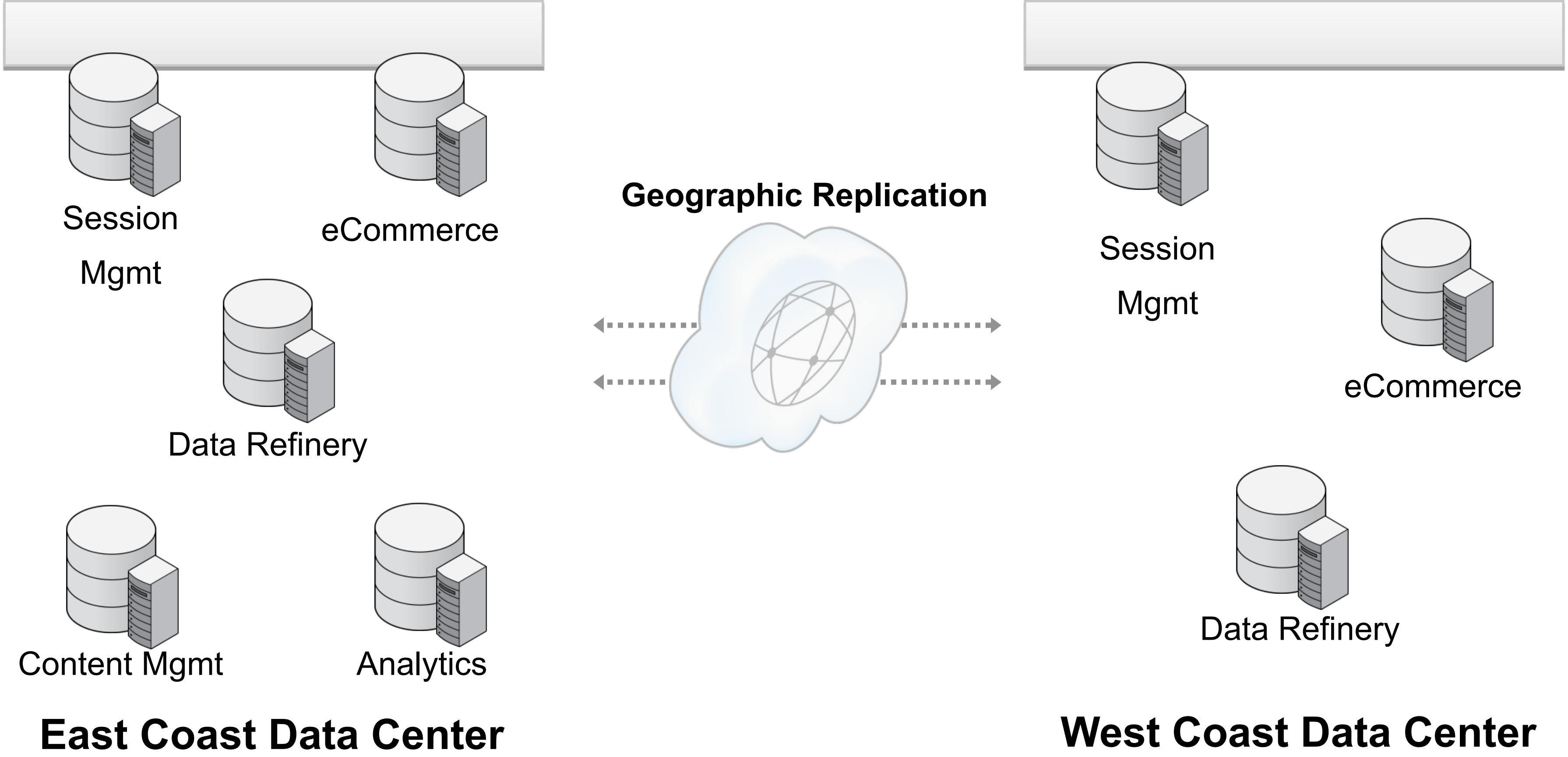
- *If future scalability is required, start with the Medium Reference Architecture*
  - *Complex to tune multiple applications on shared hardware*
- *Use default InnoDB storage engine for all workloads*
  - *Default MySQL storage engine*
  - *ACID Compliant, Transactional*
  - *MVCC & Row-Level Locking*
  - *Foreign Keys & constraints*
- *If traffic volumes increase, scale session management first*
  - *Migrate Session Management to a dedicated MySQL server*

Large: Web Reference Architecture

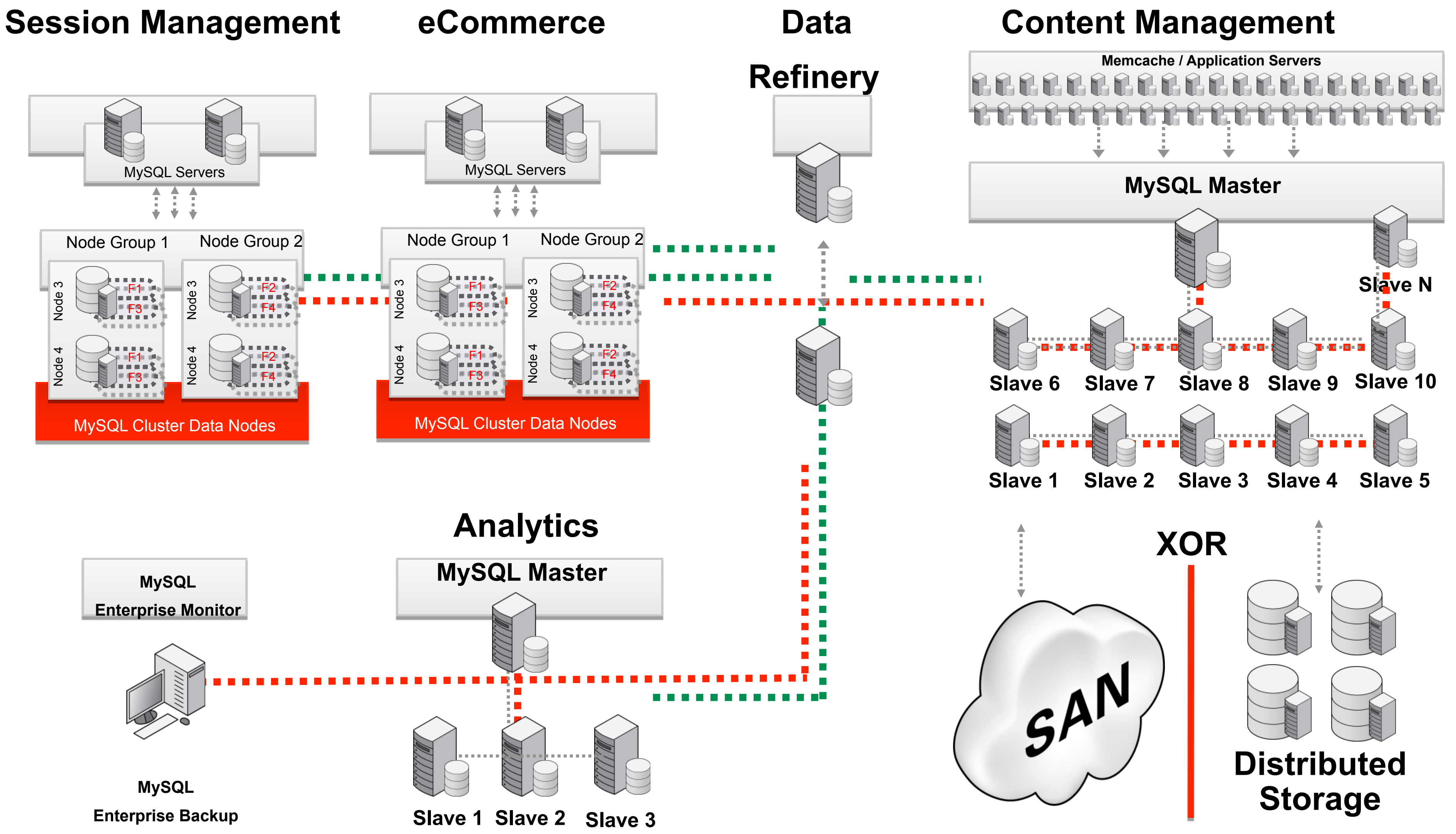
				Social Network
	Small	Medium	**Large**	Extra Large
Queries/Second	<500	<5,000	**10,000+**	25,000+
Transactions/Second	<100	<1,000	**10,000+**	25,000+
Concurrent Read Users	<100	<5,000	**10,000+**	25,000+
Concurrent Write Users	<10	<100	**1,000+**	2,500+
Database Size				
Sessions	<2 GB	<10 GB	**20+ GB**	40+ GB
eCommerce	<2 GB	<10 GB	**20+ GB**	40+ GB
Analytics	<10 GB	<500 GB	**1+ TB**	2+ TB
Content Management	<10 GB	<500 GB	**1+ TB**	2+ TB

Large: Web Reference Architecture

Conceptual View



Large: Web Reference Architecture



Best Practices

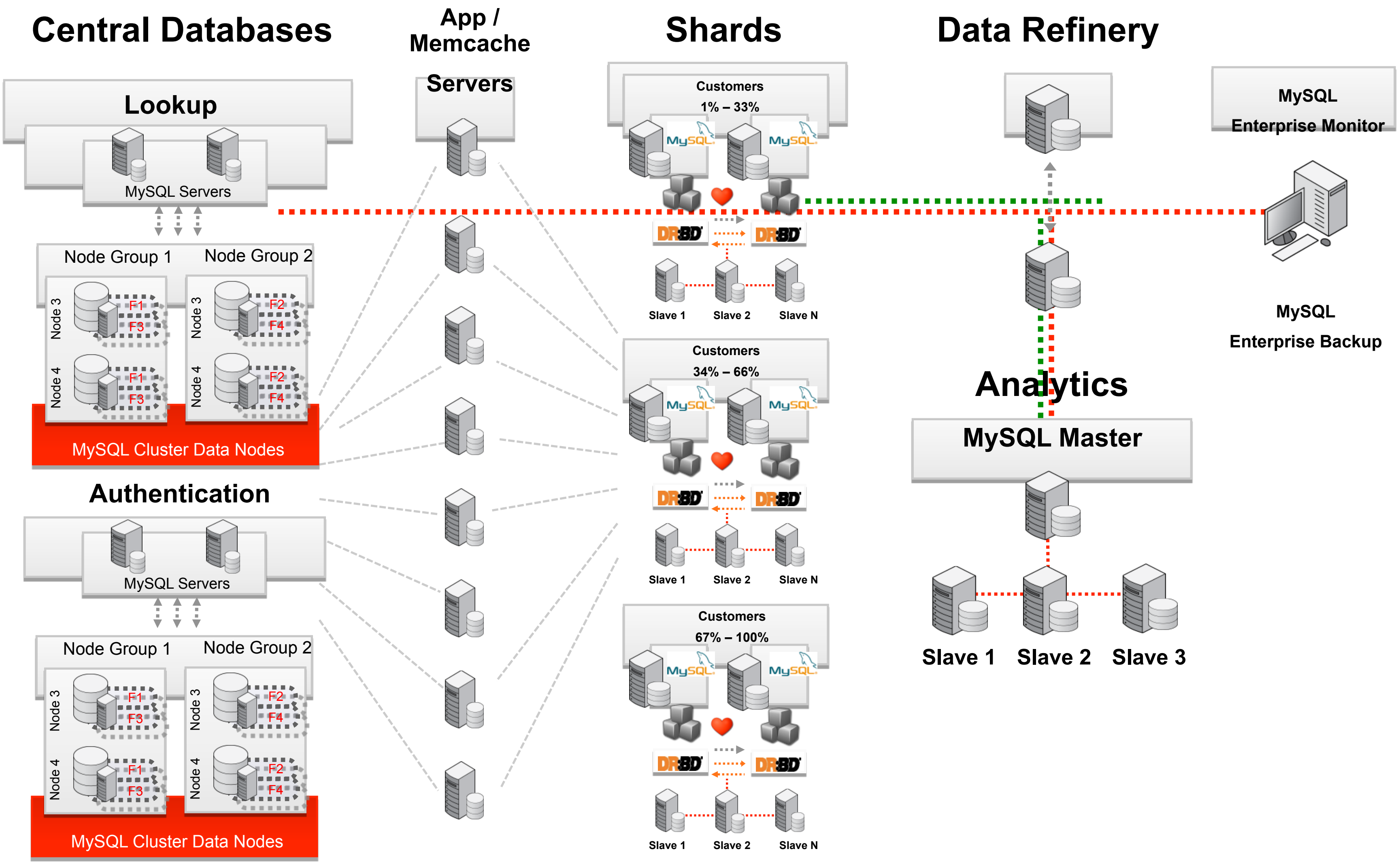
Large Web Reference Architecture

- ***Builds on best practices of Medium Web Ref Arch***
  - ***Dedicated infrastructure for each workload, MySQL Replication, Memcached, etc.***
- ***Introduces Data Refinery***
  - ***Aggregate data across the web components***
  - ***Data cleansing***
  - ***Builds Data Warehouse Dimensions***
  - ***Supports higher volume content management and analytics***
- ***Introduces MySQL Cluster***
  - ***Session Management and eCommerce***

Extra Large: Social Network Reference Architecture

				Social Network
	Small	Medium	Large	**Extra Large**
Queries/Second	<500	<5,000	10,000+	**25,000+**
Transactions/Second	<100	<1,000	10,000+	**25,000+**
Concurrent Read Users	<100	<5,000	10,000+	**25,000+**
Concurrent Write Users	<10	<100	1,000+	**2,500+**
Database Size				
Sessions	<2 GB	<10 GB	20+ GB	**40+ GB**
eCommerce	<2 GB	<10 GB	20+ GB	**40+ GB**
Analytics	<10 GB	<500 GB	1+ TB	**2+ TB**
Content Management	<10 GB	<500 GB	1+ TB	**2+ TB**

Extra Large: Social Network



Best Practices

Social Networking Reference Architecture

- ***Builds on best practices of Web Ref Archs***
- ***MySQL Cluster used for authentication & Look-Up table (Shard Catalog)***
- ***Introduces Sharding***
  - ***Implemented at the application layer for scaling very high volume of writes***
  - ***Data divided into smaller sets, distributed across low-cost hardware***
  - ***Shards based on Hash of a single column – ie. User ID***
- ***Sharding is complex***
  - ***Recommend the Architecture and Design Consulting Engagement***
- ***Sharding only used in a small percentage of workloads***
  - ***Most Web 2.0 workloads are still read-intensive, ie record is read before updates applied***